ONTARIO POWER GENERATION

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April 16, 2013

File No.: NK38-CORR-38000-0459719

Bruce Smith
Project Manager
Power Generation
Black & McDonald
915 Sandy Beach Road
Pickering, ON

Dear Bruce:

Re: Soil Disposal and Management

The D20 Storage Project will need to relocate approximately 22,000m^3 of slightly tritiated soil on the Darlington New Nuclear site. The proposal is to sample and segregate the tritiated soil and stockpile it on the New Nuclear site until it is considered inactive and inert.

A Soil Management Plan (SMP) in two phases is required; first phase to development a SMP, followed by a second phase of SMP execution.

In order to satisfy the requirements of the Darlington New Nuclear Project (DNNP), a Soil Management Plan will need to be developed and approved by Senior Management.

The SMP plan will be developed by the D20 Storage Project and will include the following, but is not limited to:

- A soil sampling protocol
- A soil segregation plan includes volume tracking
- Monitoring and active management of the tritiated soil pile
- A mobilization plan and schedule for removing the soil from the DNNP site
- Support to obtain CNSC site approval

SMP First phase target completion is June 30, 2013

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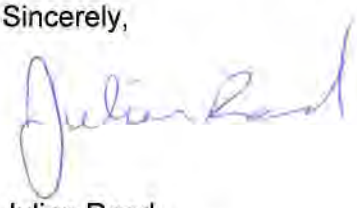
Please provide a quote to execute the planning and development stage as described above. If you require a meeting with key environmental personnel to help further understand and/or clarify this work, please advise.

Sincerely,



Julian Read
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ONTARIO POWER GENERATION

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March 03, 2014

File No.: NK054-00541 P
CD No: NK054-CORR-00531-10011
Project 10: 16-27600

Dr. D. Miller
Regulatory Program Director (Acting)
New Major Facilities Licensing Division

Mr. F. Rinfret
Regulatory Program Director
Darlington Regulatory Program Division

Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, ON K1P 5S9

Dear Dr. Miller and Mr. Rinfret:

Temporary Use of Darlington New Nuclear Project (DNNP) Site by Darlington NGS – Placement and Management of Soil on the Geotextile Pad

Reference: 1. OPG letter, A. Webster to D. Miller and F. Rinfret, "Temporary Use of Darlington New Nuclear Project (DNNP) Site by Darlington NGS – Geotextile Pad Placement", November 1, 2013, CD #NK054-CORR-00531-10001

The purpose of this letter is to formally advise CNSC staff of the planned temporary use of the DNNP site to support infrastructure construction projects underway at the existing Darlington NGS site. This notification is consistent with previous notifications of activities on the DNNP site (see Reference 1).

The following activity is anticipated:

1. Placement and management of soil on the Geotextile Pad located in the vicinity of the old concrete mixing pad.

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On October 2, 2013, the Ministry of the Environment (MOE) District Office visited the proposed soil management site at the Darlington NGS. The MOE indicated that the proposed site and design was consistent with the Ministry's Guide for "Management of Excess Soil - A Guide for Best Management Practices". A Soil Management Plan has been developed based on the guide (NK38-PLAN-38000-10016).

On February 28, 2014, OPG met with CNSC staff to discuss the soil management plan and completed a walk down of the proposed site. A copy of the Soil Management Plan NK38-PLAN-38000-10016 R00 *F1 Soil Management Plan for PROJECT Heavy Water Management Building (HWMB) D20 Storage Facility* is enclosed for your information. OPG has confirmed that CNSC approval is not required under the current licences or the Nuclear Safety and Control Act and its Regulations.

In all of the above cases, the land use is temporary, and will be restored to its original condition at the end of this activity. The work will be performed under the Darlington NGS management system, including the environmental planning and review of the land use.

If you have any questions or require further information, please contact me at (905) 623-6670, extension 3326.

Sincerely,

A. Webster

Allan Webster
Director, Nuclear Regulatory Affairs
Nuclear Projects
Ontario Power Generation

Encl.

cc: A. Ling – CNSC (DNGS – ESSB G11)

Enclosure

Enclosure to OPG letter, A. Webster to D. Miller, “Temporary Use of Darlington New Nuclear Project (DNNP) Site by Darlington NGS – Placement and Management of Soil on the Geotextile Pad”

CD #NK054-CORR-00531-10011

NK38-PLAN-38000-10016 R00 *F1 Soil Management Plan for PROJECT Heavy Water Management Building (HWMB) D2O Storage Facility*

F1 Soil Management Plan
for
PROJECT
Heavy Water Management Building (HWMB)
D2O Storage Facility
Purchase Order No: 00217807

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DOCUMENT NUMBER: 48070014-F1 SMP
OPG Document Number: NK38-PLAN-38000-10016

Rev.#	Date	Prepared by:	Reviewed by:
00	3 Feb 2014	Date 3FEB 2014 S. Jaffer Project Manager, PGL	Date 3 FEB 2014 Kamran Malik Project Engineer, B&M

Approved By:

For S. Smith Date 03/02/2014
Bruce Smith
Project Manager, B&M

Acceptance By OPG:

Terry R. Murphy	VP Projects & Modifications	02.07.14
Terry Murphy	**Title**	**Date**
for	SVP Darlington	25 Feb 14
Brian Duncan	**Title**	**Date**
	VP, Nuclear Services	28 FEB 2014
Laurie Swami	**Title**	**Date**

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Ontario Power Generation Reviewers:
Reviewed by: _____ Date 04 Feb 14 Julian Read, Section Manager Projects
Reviewed by: _____ Date 04 FEB 14 Roger Daly, Manager Chemistry & Environment
Reviewed by: _____ Date 04 FEB 14 Steve Taras, Senior Health Physicist
Reviewed by: _____ Date FEB. 5, 2014 Allan Webster, Director Nuclear Regulatory Affairs

REVISION LIST

REV#	DESCRIPTION OF CHANGE	REVISION PREPARED BY	AMENDMENT DATE
00	Original Issue	Salima Jaffer, PGL	February 03, 2014

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List of Acronyms

B&M	-	Black and McDonald
BBA	-	Barry Bryan Associates (1991) Limited
bgs	-	below ground surface
BH	-	borehole
COG	-	CANDU Owners Group Inc.
CLOCA	-	Central Lake Ontario Conservation Authority
CTP	-	conditional transfer permit
DNGS	-	Darlington Nuclear Generating Station
GG	-	Gross Gamma
GS	-	Gamma Spectroscopy
H3	-	Tritium
HWMB	-	Heavy Water Management Building
IWST	-	Injection Water Storage Tanks
LPSW	-	Low Pressure Service Water Line
MOE	-	Ontario Ministry of Environment
MW##	-	monitoring well
NORM	-	normally occurring radioactive material
OPG	-	Ontario Power Generation
PA	-	protected area
PCBs	-	polychlorinated biphenyls
PGL	-	Pottinger Gaherty Environmental Consultants Ltd.
PHC	-	petroleum hydrocarbons
sVOC	-	semi-volatile organic compounds
TCLP	-	Toxicity Characteristic Leaching Procedure
VOC	-	volatile organic compounds

1.0 GENERAL

The scope of this plan is to provide a means for Black and McDonald (B&M) to inform all interested parties of B&M's intended methods and means for handling the excavated soil for the new Heavy Water Management Building (HWMB) and associated shallow excavations for relocation of utility services, transportation of excavated soil from the Protected Area to Campus Plan **F1** (F1) laydown area, and soil management. This plan does not address the decision for the final soil destination (i.e., F3 location or offsite). The decision for the final soil destination will need to be endorsed by the Director Refurbishment Operations and Maintenance, SVP Darlington, VP Nuclear Services and VP Environment.

As part of the Darlington Refurbishment and Continued Operations Project, large volumes of soil (including bedrock) will be excavated at the Darlington Nuclear Generating Station (DNGS) site to accommodate new infrastructure within the Protected Area (PA), including the HWMB, Low Pressure Service Water line (LPSW) relocation as well as other shallow excavations for relocation of services.

Large volumes of soil from within the PA will be removed as a result of these excavations and there is insufficient laydown area within the PA to stage these materials. Therefore, the excavated soil will be transported and staged on a geotextile pad to be constructed at F1. This pad is required to be in-service application for up to 10 years. The design of the pad is described in Section 6.

1.1 Purpose

The purpose/objective of the Soil Management Plan is to:

a. Ensure compliance with environmental legislation, regulations and conditions of approval;
b. Ensure proper records are maintained to meet regulatory environmental requirements; and
c. Ensure that all personnel involved with the F1 area are aware of the scope of work and the requirements for soil transportation and soil management.

1.2 Scope

This plan deals with the following excavated materials from the HWMB and various shallow excavations within the PA:

a. Daylighting soil using a vacuum truck (top three (3) metres);
b. Spoils from caisson drilling; from surface to 16m below ground surface (bgs), installing caissons along the outer perimeter of the HWMB foot print;
c. Excavation of soils within the HWMB foot print, inside the enclosed caisson area from surface to 3m bgs;
d. Bulk excavation; soil from 3m to a depth of 13m bgs within the HWMB foot print, inside the enclosed caisson area; and
e. Bulk excavation; bedrock from 13m to a depth of 16m bgs within the HWMB foot print, inside the enclosed caisson area.

This plan is to be used in conjunction with "Contractor Environmental Management Plan" (Ref. 16.4).

2.0 BACKGROUND

B&M contracted Kinectrics Inc./Pottinger Gaherty Environmental Consultants Ltd (PGL) to evaluate environmental soil quality within the HWMB footprint in spring 2013.

The Borehole Drilling Investigation (NK38-REF-38000-0483285) consisted of the installation of six new boreholes to determine options for soil generated by HWMB excavation. PGL logged and sampled the soils. Groundwater samples were collected from six existing monitoring wells and one sump. As a part of the work, PGL also reviewed historical reports pertaining to the Injection Water Storage Tanks (IWST) spill in 2009.

The IWST water was primarily demineralized water containing 44,807,000Bq/L of tritium and 58.8mg/kg of hydrazine. Historically, 29 boreholes and 28 wells were used to investigate spill effects. The investigation identified tritium impacts near the HWMB. Two samples both from MW148 had tritium levels over 0.02µCi/kg (0.041µCi/kg and 0.074µCi/kg at 3.6m and 9.7m, respectively). The investigation also identified petroleum hydrocarbons (PHC) and limited volatile organic compounds (VOC) impacts. The soil and groundwater quality were evaluated against Ontario Regulation 153/04 Table 3 industrial/commercial/community standards for coarse-textured soil in a non-potable groundwater condition (Ministry of Environment [MOE] Table 3). Soil and bedrock samples from two locations were submitted for Toxicity Characteristic Leaching Procedure (TCLP) waste characterization to assist with soil management. The TCLP results were compared to Schedule 4 of the General Waste Management Regulation (Ontario Regulation 347). None of the soil and bedrock samples were leachate toxic (i.e., soil and bedrock are non-hazardous).

The results of the work completed by PGL were consistent with IWST findings. The general soil quality within the proposed excavation is good. Tritium in soil was below the 0.02µCi/Kg limit in all samples tested. Testing for conventional parameters indicated that additional testing will not be required for landfilling.

However, there are MOE Table 1 and MOE Table 3 soil exceedences. If the soil is to be reused at DNGS or offsite, then additional testing of the material should be conducted according to Ontario Regulation 153/04.

Two soil samples from the IWST work (conducted in 2009) had elevated tritium levels. Therefore, PGL recommended that their investigation report and results be provided to OPG Health Physics to assess if additional radiological sampling was required for the release of the material. Additional asphalt samples and soil samples were collected as a part of the project to facilitate offsite shipment of soil. This report (NK38-REF-38000-0483285) was previously provided and is available on request.

3.0 REGULATORY REQUIREMENTS

The following regulatory requirements need to be met to use the area at F1:

a. Soil sampling and management procedure will follow Ontario Regulation 153/04 soil sampling requirements;
b. OPG's standard for F1 is the MOE Table 3 Industrial Commercial Community standards for a coarse-textured soil in a non-potable groundwater condition;
c. The F1 area is within a wetland area regulated by Central Lake Ontario Conservation Authority (CLOCA); therefore, a Large Fill permit was prepared and submitted to CLOCA for approval. The Permit expires on September 23, 2015, and will be reapplied for, as required by the Project;
d. Soil transportation and soil movement at the F1 laydown area has been designed such that it will not interrupt bird migratory season and will not interfere with endangered species habitat;
e. All federal, provincial and municipal regulations will be followed, including conditions stipulated by the CLOCA Large Fill permit; and
f Completion of OWRA – Minor Modification Notice (N-FORM-10559) within 30 days of discharging F1 sump water to OPG yard drainage/forebay

4.0 ROLES AND RESPONSIBILITIES

B&M (with their subcontractors, PGL and EllisDon) will work in coordination with OPG to ensure compliance of this Plan. The list below identifies personnel involved in the Plan and their roles and responsibilities.

a. Project Manager (PM) – responsible for the overall F1 Soil Management Plan, ensuring that it is prepared, approved and followed. (Bruce Smith 416-791-1898).
b. Construction Manager (CM) – responsible for the implementation of the F1 Soil Management Plan on the project. (Kurt McDonald 416-677-7273).
c. Environmental sampling, analysis, and monitoring (ES) – Responsible for all environmental sampling, analysis, and monitoring activities at F1. (Salima Jaffer/Brandon Partridge 905-668-4908)
d. All onsite personnel – all personnel are responsible for identifying and reporting any adverse conditions or issues that could affect soil management.

5.0 MANAGING EXCAVATED MATERIALS

This section describes how excavated materials are removed from the PA and additional requirements, if any, prior to being transported to F1. Details pertaining to Campus Plan C13 are not duplicated herein. Information on the specifics of C13 are detailed in the Soil Management Plan for C13 Area (Ref. 16.9).

5.1 Daylighted Soils

Soil will be removed by vacuum truck from various small excavations within the PA and taken to area C13 pad. The soil will be dewatered and tested for radiological parameters. PGL will provide the analytical results to Radiation Protection for evaluation. When Radiation Protection provides a decision regarding the pathway, the tested soil may be shipped offsite to a landfill site or to soil staging areas F1/F3 (as available) at Darlington Nuclear outside the PA.

5.2 Excavated Soils

Excavation work will be conducted using various types of heavy equipment.

Trucks will be used to transport excavated soil material from the PA to Area F1 outside the PA. The trucks will be loaded with soil from the HWMB excavation while the truck is stationed on the asphalt of the roadway. Once truck has been loaded, a laborer will walk around the truck and inspect the immediate area for debris. The laborer will sweep the dry debris away from the truck and the truck tires will be swept using a stiff bristle broom/brush.

The truck tires will be inspected by PGL prior to the truck leaving the PA and confirmation will be communicated to the driver that the truck is clean and can proceed to F1. A specific route will be followed and inspected on a daily basis. Refer to the Traffic and Logistics Plan (TLP Ref. 16.8).

Two types of trucks may be used to transport soil from the PA to Area F1: Tri-axel (dump trucks) and/or Rock trucks with a low "belly" to contain soil/water.

a. For the installation of the caissons, a drill rig will auger down to bedrock while inserting a steel liner. The soil pulled up by the auger is the caisson spoils.
    i. The caisson spoils will be removed from augers within the HWMB foot print.
    ii. The spoils will be allowed to dewater for a period of time but will not remain within the HWMB footprint. Any water generated from saturated spoils will be contained on the HWMB foot print and will be directed/stopped using soil berms or straw bales from migrating from the HWMB footprint.
    iii. If soil is saturated and needs to be removed from the footprint, then rock trucks will be used exclusively.
    iv. The caisson spoils will be loaded using an excavator or loader onto trucks and transferred to F1.
    v. The caisson spoils will be off loaded onto the F1 geotextile pad in a cell designated for caisson spoils.
b. The bulk excavation will be completed as described in the following steps. The top one (1) metre of material that the spoils were allowed to drain on will be excavated and placed in the same cell as the caisson spoils. The next two (2) metres will be loaded and transferred to F1 and unloaded on the geotextile pad in a cell designated for this material.
c. Below the three (3) metre markdown to bedrock the soil will be excavated into trucks at grade. This material will likely be damp and will be placed in the same cell as the caisson spoils.

d. Using a jack hammer attachment to the excavator the bedrock will be broken up, loaded into trucks and transferred to F1 and unloaded on the geotextile pad in a cell designated for this material.

The F1 pad will be constructed with two separate cells to hold at least 25,000m^3 of soil/bedrock. The estimated volume of material type being generated during excavation work is listed below in Table A with the storage cell number identified.

Table A: Estimated Volumes of Material Generated During Excavation Works

Cell	Origin of soil	Estimated Volume
Cell 1	Grade to 3m below grade (shallow excavations within PA) 1 to 3m below grade (HWMB) estimated amount	7,000m^3
Cell 1	Bedrock (HWMB excavation)	2,300m^3
Cell 2	Caisson Spoils (full depth of HWMB excavation)	2,254m^3
Cell 2	3m below grade to Bedrock (HWMB excavation)	12,650m^3
	Total	**24,204m^3**

[1]Due to construction delays at F1, soil generated during the caisson work of the HWMB construction project will be staged in Cell 1. The caisson spoils will be positioned towards the north end of Cell 1 to segregate it from shallow soil from C13. When Cell 2 is complete, soil from the caisson work will be moved to Cell 2.

6.0 LAYDOWN AREA F1

6.1 Description of F1

Area F1 is shown on the Campus Plan Appendix A. The site is covered with vegetation and mixed gravel fill. An existing concrete pad, approximately 72m x 23m, is on the northwest side of F1. On the east side is an existing building that is not being used. East of the F1 pad is an area designated F1a which is approximately 90m x 30m. Once the excavated material has been dewatered, sampled, tested and declared suitable for transfer under a UTP; it will be shipped offsite for landfilling or spread out on area F1a or area F3 (another soil staging area at OPG DN) as available.

6.2 Background of F1

In preparation for the design of the F1 soil staging pad, B&M requested PGL to prepare a design scope document as well as assess existing soil quality (environmental and geotechnical) conditions at the proposed F1 area.

A design document "F1 Soil Staging Pad Scope Document" was prepared and accepted by OPG on August 9, 2013. The functional design requirements included allowing end-users to use the geotextile pad facility for soil storage over a 10-year period. PGL contracted Barry Bryan Associates (1991) Limited (BBA) to design the F1 Pad. The following general design elements were required:

a. The designed pad shall abutt the existing concrete pad to the north;
b. Four chambers to hold soil/bedrock;
c. Berms to separate the chambers to delineate the area;
d. Sump and holding tank need to be included for each of the chambers; and
e. The pad shall follow the natural grade of the Site to the south be graded.

PGL reviewed historical environmental documents provided by OPG and then conducted a limited test-pit investigation program at the proposed F1 area to characterize background soil quality (environmental and geotechnical). PGL completed the environmental evaluation and contracted Soil Engineers Ltd. to complete a geotechnical evaluation of the proposed F1 pad area.

Nine test pits were conducted within the footprint of the F1 pad south of the existing concrete pad. Soil samples were tested for conventional (environmental and geotechnical) and radiological parameters. PGL prepared and submitted a report for the environmental findings; all tritium limits of samples collected were below the method detection limit of 15bq/kg (Ref. 16.10). This document was previously provided and is not included herein.

Soil Engineers Ltd. provided a report of their findings; their report indicated that 0.6m of material would need to be removed and engineered material supplied to support the volume of soil/bedrock on the pad (Ref. 16.11).

6.3 Preparation of F1 (F1 Early Works Plan)

To support the initial construction activities for F1, B&M requested PGL to prepare an F1 Early Works Plan. This plan included the evaluation of the items listed below.

- **Sediment Control:** a silt fence will be erected around the full Disturbance Limit (as shown Appendix A – Erosion, Sediment, & Drainage Control Plan). The silt fence will be inspected on a weekly basis and within 12 hours of a rainfall event. Additionally, there will be berms erected around the soil staging area to prevent sediment from leaving the staging area. There are no water courses in close proximity to the F1 Area so further measures are not warranted.
- **Drainage Control:** the site will be graded per the Engineer's requirements (BBA) and the facility will be constructed on the west half of F1. The Pad will be approximately 100m x 80m. Additional drainage swales with straw-bale check dams will be installed to route water around the pad (see Appendix A – Figures).
- **Soil Removal:** soil with low engineering value will be removed (about 10,000m^3) and placed east of the onsite building (F1a). This soil was tested *in situ* during the F1 Preparation works. PGL confirmed that the soil meets MOE Table 3 coarse-grain standards for the tested parameters of concern. This soil will be placed on a geotextile fabric, staked in place to mark the existing ground elevation (to assist during site restoration works). A copy of this report has been provided and is not included in this document.
- **Dust Control:** all trucks will have a bed cover that will be closed once the truck is filled. It is anticipated that once the soil is placed at F1a it will remain there until such time the area is required to be developed for additional plant operations. The soil will be placed using heavy equipment (i.e., rock trucks, dozers) in flattened mounds and hydro-seeded. Side slopes will be maintained at 3H:1V.

- **Public Access:** all driveway entrances to F1 will be fitted with a chain and signage to prevent public access to the area. As part of the site fence perimeter, a locked gate already exists at the Maple Grove Road extension, north east of the F1 area. The construction silt fence will also demark the construction area.

6.4 F1 Design

The four-cell pad design described in Section 6.2 was revised by the Project Team (BBA, PGL, EllisDon and B&M) based on discussions, evaluations, and existing site conditions. All design changes have been presented and approved by OPG prior to implementation.

To maintain separation between the excavated soil/bedrock and the native soil an impermeable geo-membrane pad will be built on Area F1 with two distinct cells with berms (or similar) separating the cells to avoid cross contamination of materials. See Appendix A – Figures (Site Plan).

F1 pad will include two cells, as described in Section 1, to hold caisson spoils, soil from the top 3m (10ft) of the excavation and shallow daylighting activities, soil from 3m below grade to the top of bedrock and bedrock material.

A general overview of the F1 Early work activities are provided below:

1) Clean up surficial material (Black Beauty) at F1 identified;
2) Install a silt fence around F1 area;
3) Install bollards with chains to limit site access at all three driveway entrances to F1 area;
4) Excavate the top 0.6m of soil within the F1 pad footprint. This material will be stockpiled east of the existing building;
5) Stockpile excavated soil from Item 4 on a geotextile fabric. The soil will be mounded with side slopes of 3:1 (H:V) and hydro-seeded; and
6) Remove vegetation from existing drainage swale on the south side of F1 area if required.

BBA and B&M are evaluating/approving materials (geotextile liner, sump, concrete additive, piping, valves, etc.) to be used to construct the pad to support the 10-year application.

Once the early works are completed the F1 area will be graded (see Appendix A – Liner Cross-Section). This will be covered with a 16oz, non-woven geotextile; a double layer of Enviro Liner 4040 will be installed, followed by another layer of 16oz, non-woven geotextile topped with six inches of sand and a final layer of woven geotextile.

To protect the liner, a 4-inch Geoweb (Geo Cell) will be in placed on top of the liner, filled with Granular B and compacted. This Geoweb is rated for 40,000lbs and will protect the liner from possible damage from equipment. In order to secure the Enviro Liner, the liner has to be anchored to the block walls/berms.

Sediment runoff will be prevented by using a geotextile filter to prevent any sediment from flowing out of F1. Three underground sumps will be installed, one for Cell 1 and two for Cell 2. Any remaining moisture in the soil will infiltrate to the liner and be directed to the sumps. Sumps will be inspected and emptied as identified in Section 11.

The cells will be covered by a manual tarping system. The tarps are multi-layered material and will be provided in roughly 100ft by 30ft sections. The sections will be positioned using an excavator (similar) and manually joined together in the field using woven straps. Tarps will be placed on the soil pile as the cell is filled, typically starting from the concrete-block wall out. The tarps will limit the amount of rainwater that F1 cells accumulate and minimize the volume of rain water that enters the F1 sump system.

7.0 MOBILIZATION PLAN

a. Caisson spoils and bulk excavation soil will be loaded into trucks as identified in Section 5.2. The trucks will leave the PA following a pre-planned route as shown in the TLP (Ref. 16.8). The specific route will be followed and inspected by B&M (or their subcontractor) on a daily basis.

b. As required, street sweeper vehicles (or similar) will be deployed to clean the pre-planned route between the PA and F1. The sweeper deployed should sweep and vacuum up the debris. Debris collected will be discharged at the F1 pad.

c. Trucks leaving the PA will have the tires cleaned to remove debris off the truck and tires. A laborer will walk around the truck and inspect the immediate area for debris. The laborer will sweep the dry debris away from the truck and the truck tires will be cleaned using a stiff bristle broom/brush. The truck tires will be inspected by PGL prior to the truck leaving the PA and confirmation will be communicated to the driver that the truck is clean and can proceed to F1.

d. B&M (or their subcontractor) will provide the personnel to inspect and clean the trucks at the HWMB excavation site. The trucks will be inspected for (hydraulic/seal) leaks prior to leaving the PA by the truck operator. If a leak is discovered the truck will unload excavated soil back on to the HWMB excavation area. The truck will be cleaned/washed and sent for repair.

e. The trucks will be monitored by the Exploranium when exiting the PA.

f. The trucks will deposit the soil from the HWMB footprint onto the F1 laydown area in the entrance of the appropriate cell. To minimize tracking of soil via the truck tires; trucks should remain on the concrete apron at F1.

g. Trucks leaving F1 will cross a rip-rap section of road which will shake debris off the truck and tires. Drivers will stop the truck near the F1 gate and will inspect the truck/tires and remove any additional debris using a stiff-bristle broom prior to exiting the site. The trucks will travel back to the PA on the assigned route (Ref. 16.8).

h. Trucks will stop before leaving F1 area to allow PGL personnel time to inspect truck tires before leaving F1. PGL personnel will provide go/no-go to the driver after visual inspection. If it is a no-go, the driver will have to clean the tires again.

i. To leave the Site at the end of the day (i.e., travel on public roads); Tires and truck box will be inspected by PGL personnel and driver will brush truck tires before allowing the trucks to leave OPG property.

j. For traffic management and vehicle-noise management, see TLP (Ref 16.8).

8.0 CONTROL OF ACCESS TO F1

Access to F1 area will be controlled. Only soil generated from construction projects within the Darlington PA with potential radiological impacts (e.g., the D20 Storage Project) will be accepted.

a. All three access points at F1 will be secured with gates/chains and locks. A silt fence will enclose rest of the area.

b. A placard will be installed on the gate identifying F1 site contact names.

c. EllisDon will issue placard/magnetic stickers to authorized truck operators for offloading soil during the D20 project works.

d. PGL will record truck number and license plate (Truck tracking form – see Appendix D) and provide direction for offloading soil to the correct cell based on excavated materials.

9.0 SOIL SEGREGATION PLAN AND VOLUME TRACKING

Excavated soil from in the OPG's D20 Project will be placed in Cell 1 or Cell 2 at Area F1 based on *in situ* soil analytical data (i.e., where and from what depth below grade the soil originated from LPSW and HWMB excavations). Excavated material is described in Section 1, Table A.

Soil will be transported to F1 in a dump truck or similar. The soil will be unloaded at the entrance to the cell and moved into the cell with a second piece of earth moving equipment. This method will minimize trucks tracking mud across the site.

Soil will be placed in either Cell 1 or 2. To facilitate manual tarping of the cells, soil will be placed adjacent to the cell walls to provide support to the tarp to be deployed. Moving the soil from the entrance area to where it is to remain while the cell is being filled will provide aeration.

While the cells are being filled, tarps will only be deployed to cover specific areas. During this time, weighted-sand bags or similar may need to be used to secure the tarps.

a) Once the soil has been received at F1, active soil management will be evaluated on an ongoing basis. All segregated soil piles located at the F1 area will be sampled and submitted an external lab for analysis. The analytical results will determine active soil management (i.e., aeration of the soil using mechanical equipment). Initial soil turnover will be performed two times a week to a maximum depth of 1m. Sampling and analysis will be conducted weekly per gridded area within the cell until a baseline can be established. Once the baseline is established (after one month) the sampling and aeration frequency will increase or decrease based on the soil-turnover aeration and tritium-removal efficiency. PGL will document sampling work conducted and track sample results versus depth and area within the cell. Other factors that will affect soil-turnover aeration are weather and temperature. Once a soil pile is deemed inert (i.e., meets the requirements of a UTP) the material will be removed at the earliest convenience to the final destination that is either offsite landfilling or at F3 as available.

b) The volume of soil for each area will be tracked by monitoring the number of trucks for each area being excavated and/or calculation of area excavated. A truck-tracking form will be used to document this information. (Appendix D – Inspection Forms).

c) Two construction entrances will be provided at F1 equipped with 20m-long mud mats/clear stone for removing mud/debris from truck tires. (Appendix A – Erosion, Sediment, & Drainage Control Plan). This option has been selected as there is no electrical power or water available at F1. Once construction of the pad is complete, truck access to offload material at F1 will only be through the west entrance.

10.0 SOIL SAMPLING PROTOCOL

a) The sampling methodology for moving soil from the Protected Area to F1 meets the sampling requirements in Ontario Regulation 153/04. Mainly, the sampling protocol consists of *in situ* soil characterization, augmented with 2% audit sampling of the trucks as they leave the protected area.

i. Ontario Regulation 153/04 characterizes imported fill at a site for purposes of filing a Record of Site Condition. It is also used as an industry standard for providing an acceptable level of characterizing soil.

ii. The regulation specifies sampling requirements if soil is to be re-used as clean fill onsite or offsite. If offsite, one sample is required for every 160m^3 for the first 5,000m^3 and one sample per 300m^3 after that. The regulation also identifies the number of samples required to reuse soil onsite. This consists of field screening 50 soil samples and analyzing 10 samples for every 1,000m^3. Based on the nature of the work and the potential contaminants, we recommend that 10 soil samples be analyzed for every 1,000m^3.

iii. The estimated quantity of soil that will be moved to temporary laydown pad F1 area is 24,204m^3. Field screening of soil will not be conducted at this time as the material will only be moved from within the PA to outside the PA. Based on the estimated 2,800 truckloads, PGL will collect soil samples from 2% of the trucks (i.e., at a frequency of 1 sample per 50 trucks). Soil samples collected will be sent to an external lab for testing of conventional parameters, tritium and gross gamma for documentation purposes only. Representative soil sampling to facilitate removal of the material from the PA was conducted and reported by PGL in spring 2013 (NK38-REF-38000-0483285)

iv. Based on the *in situ* soil characterization completed as well as the 2% audit sampling to be conducted (on soil from trucks leaving the PA). Radiation Protection has provided a blanket Conditional Transfer Permit (CTP).

b) The sampling methodology for moving soil from F1 to F3 or F1 to offsite will meet the requirements in Ontario Regulation 153/04 and be consistent with the CANDU Owners Group Inc. (COG) sampling methodology recommendations described in the report, "COG-08-3105I, "Protocols for sampling of representative scenarios of recurrent non-homogenous solid waste".

i. The sampling protocol to evaluate material prior to removing from the F1 pad will be conducted at a frequency of one sample for 100m^3, for a minimum total of 207 samples that will be sent to an external lab for analysis. These samples will be shipped under the blanket CTP provided by Radiation Protection. Additional sampling may be required based on evaluation of radiological and conventional results for material to be re used at Darlington.

ii. Radiological and TCLP parameters will be tested and results evaluated prior to determining offsite shipment from F1 to F3 if available or to a MOE-approved landfill facility if necessary. The soil must meet: (i) the applicable release limits for radiological testing and be in compliance with the Nuclear Substances and Radiation Device

regulation, and (ii) MOE Table 3 coarse-grain standards for the tested parameters of concern.

iii. Sample parameters associated with each type of analyses are listed in the Table B below.

c) Soil placed in the F1 laydown area cells will be tracked weekly as soil is moved from inside the PA to the F1 pad. Cells will be mapped in a grid system and soil will be traced to segregate any abnormal tritium, gamma or conventional parameter results.

Table B: Soil Sample Parameter Summary

Parameter Type	Analytical Testing
Radiological Parameters	H3 = Tritium GG = Gross Gamma GS = Gamma Spectroscopy
Conventional Parameters	PHC = Petroleum Hydrocarbons F1 to F4 M&I= Metals and inorganics VOC =volatile organic compounds (including benzene, toluene, ethylbenzene and xylenes
TCLP	TCLP = metals and inorganics, VOC, sVOC, bulk and leachate PCBs, soil pH and ignitibility.

11.0 SUMP SAMPLING

a) Each of the F1 soil-storage cells will have three underground sumps to collect water from the soil and rainwater. There will be an insulated valve controlling the flow of water between the two sumps. The sumps will be inspected daily and an inspection checklist will be completed (see Appendix D). The checklist will include the following items: date/time, personnel name, observed leaks/accumulated debris, approximate volume in sump.

b) One sump will be sampled when it is 50% full and the valve will be closed so that additional water cannot come into it. The sampling parameters are provided in Table C below. The samples will be submitted to OPG Chem Lab or an external lab for analysis.

c) If the samples are submitted to an external lab for analysis, the sample shipment will require a CTP issued by the Radiation Protection Department with the approval the Responsible Health Physicist.

d) If the limits in Table C are met, the water can be either discharged to surface or transferred to the nearest yard drainage point to F1 (see Section 12 and Appendix B).

e) If there is an oil sheen on the water and the rest of the parameters are acceptable, Detox will be called in to skim off the sheen for disposal as per item (f) or (g) below as applicable.

f) If there are total organic carbon or pH issues and the dewatering system is not available, the water will be disposed via Detox for disposal as per item (g) or (h) below as applicable.

g) If all parameters except Tritium from Table C are met, the following process can be followed to dispose of the water inside the protected area at the forebay:

i. Ensure dedicated vac truck is used for all transfers. If a new vac truck is required, or truck was utilized for a different task, then a sample must be submitted for Table C parameters;

ii. If the sump has additional water added to it during this time, it will have to be re-tested for Table B parameters;

iii. The vac truck cannot be used for other work until the sump transfer is complete; and

iv. Discharge water from vac truck to the forebay at the same location as the Box Drain Pump out in a controlled manner (approximately 1hr discharge). Ensure vac-truck tracking form is complete (Appendix D).

h) If tritium limits *and* other parameters in Table C are exceeded, the following options should be considered for practical effectiveness in achieving the parameter criteria:

i. Dilute with station non-chlorinated waste water, (if the intent is to meet (f), or

ii. Transfer to the dewatering system (if still in operation)

iii. Dispose water via Detox to Clean Harbours.

Table C: F1 Sump Sample Parameter Summary

Parameter	OPG Limits
Tritium	<100Bq/L can be discharged to surface Between 100Bq/L to 4000Bq/L will be transferred to yard drainage for release at catch basin 654 or 468 (Appendix C) >4000Bq/L can be diluted (with non-chlorinated waste water or domestic water) and re tested. If only tritium concentration persists, then either (i) dispose offsite via Detox or (ii) return water to the protected area for discharge at the forebay, provided that all other parameters have been satisfied. >8000Bq/L cannot be diluted, either (i) dispose offsite via Detox or (ii) return water to the protected area for discharge at the forebay, provided that all other parameters have been satisfied.
Gross gamma	GG < MDA/NORM (verify with Radiation Protection)
Total Suspended Solids*	≤70mg/L
Visible Oil*	No visible sheen/allowed
Total Organic Carbon*	≤15mg/L
pH	6.0-9.5

Notes:
1.(*) The effluent shall be essentially free of floating and settleable solids and cannot contain oil or any other substance in amounts sufficient to create a visible film, sheen foam or discolouration on the receiving waters.
2. Offsite disposal of sump water by Detox will be covered by the blanket CTP with an upper limit of 2μCi/L (74,000Bq/L).

In the event of extreme rainfall or predicted rainfall, PGL staff will close the gate valves to isolate the sumps from F1 pad cells 1 and 2. If standing water accumulates in the cells, the water will be vacuumed (vac truck) out of the cells before the valves are opened. Testing of the water will follow that detailed in the F1 SMP.

Table D: Additional Considerations for F1

Concern	Mitigation
Weather – rain/snow/wind events	Review weather forecast to plan for staffing, sampling of sump water, installation of tarp to cover soil pile, inspection of silt fence.
Timing for receipt of analytical results	Ensure that samples are collected timely so that sump water can be discharged/disposed of appropriately

12.0 YARD DRAINAGE POINTS

The nearest yard drainage points to F1 are provided in Appendix B. Yard Drainage Catch Basins 654 and 468 (that have a maximum discharge limit of 4,000Bq/L) are potential options for re-routing water if the 100Bq/L groundwater limit is exceeded in the sump water tested at F1. .

As a prerequisite to the use of the yard drainage system, these locations would need to be confirmed in the field (i.e., walkdown); accessibility and condition of the catch basin to receive the discharge water evaluated. This action will be completed by Ellis Don prior to soil being shipped to F1 and reported as being completed in an email communication to OPG Environment and B&M.

13.0 GROUNDWATER MONITORING AT F1

Parameters and groundwater sampling frequency requirements for the F1 soil staging area are outlined in the F1 Groundwater Monitoring technical memo (NK38-REF-38000-0483349) provided in Appendix E. There are eight wells that will be sampled on a quarterly basis to evaluate groundwater tritium concentrations in specific wells at F1 and wells in close proximity to F1 (upgradient and downgradient).

In addition to these eight wells, two new sentinel wells will be installed at F1; one east and one west the F1 lay down area. The wells will be positioned along the southern edge of the soil staging pad down gradient of the pad and sump tanks. The sentinel wells will be sampled according to the F1 Groundwater monitoring technical memo and are designed to monitor the possible introduction of tritium to groundwater from the subsurface piping system of the F1 pad and the sump tanks.

Background groundwater sampling will be conducted as a prerequisite at those well locations where historical tritium results were not available. Once soil is placed at F1, groundwater sampling will be conducted at these wells quarterly until the F1 pad is removed. The quarterly results will be tabulated and provided to OPG in an email and an annual technical memo will be generated documenting the

findings. Groundwater wells will continue to be sampled quarterly for one year after F1 has been decommissioned. A final report documenting all the work will be completed three months after the removal and restoration of F1 and a short technical memo will be completed documenting the groundwater monitoring work completed in the year after decommissioning works.

If groundwater well sampling results are higher than the prescribed limit, then: (i) increased sampling frequency will be followed per NK38-REF-38000-0483349 and (ii) remediation actions to restore F1 and surrounding affected area will discussed and scheduled for implemented by the Project.

14.0 RESTORATION OF F1

When F1 is no longer required for staging soil for the OPG Projects and/or, no longer needed by other Nuclear Refurbishment projects and/or as directed by OPG, the material installed for the soil staging (silt fence, geotextile, berms, etc.) will be removed, recycled as appropriate and or appropriately disposed of.

The area will be restored in consultation with OPG (i.e., if the area is to be developed for additional plant operations or remain unoccupied). If the area if to remain vacant, the original soil removed from the proposed pad location will be relocated, graded to allow precipitation to drain naturally to the existing swale and hydro-seeded. Imported sand fill may remain at F1 if deemed clean.

Environmental testing of (soil/granular fill) materials to remain at F1 will be required as well as testing of the native material under the pad location to confirm that the soil quality has not been altered from its original condition as documented in the test pit work conducted by PGL at F1. Material will be tested for conventional and radiological parameters as identified in Section 10.0.

Soil/granular fill will be screened and sampled according frequencies set out in Ontario Regulation 153/04: for every 100m^3; five samples will be field screened and one submitted for analytical testing.

A report documenting the post F1 removal findings will be generated based on the soil quality results. If soil impacts are identified, recommendations for remedial works will be provided after consultation with OPG's Project team and Environment Group.

15.0 BACKOUT PROVISIONS

In the event that backout condition occurs, excavation equipment should be left in a safe state.

a) Backout in the case of fire or personal injury. Notify station emergency response team (ERT) first. In addition to backout procedures, workers will immediately notify the CMO who will immediately notify the shift manager.

b) Backout in the case of an electrical storm or unsafe weather conditions such as high winds, rain or snow.

c) Backout In the event of a station alarm: stop work, listen and follow instructions given on the public address system. Ensure that the work area does not pose a safety hazard, cover any open areas. All workers shall proceed to the designated assembly area identified in the daily pre-job briefing.

d) Backout in the case of a spill event. Follow Spill plan actions outlined in Ref 16.5.

e) Backout if tangible evidence of hydrocarbon impacted soil is encountered. Notify OPG, B&M and PGL project managers. Contact PGL personnel to investigate so that soil is segregated/sampled as determined to be required for landfilling, per options outlined in this Plan.

16.0 REFERENCES

16.1. N-GUID-09701-10013: Environmental Requirements Guidoline
16.2. D-INS-79000-10002: Waste Disposal Guidelines for Solid Waste and Recycling at Darlington
16.3. D-INS-07290-10000: Darlington Spill Prevention and Contingency Plan
16.4. NK38-PLAN-38000-10003: Contractor Environmental Management Plan (B&M 48070014-CEMP)
16.5. NK38-PLAN-38000-10005: Spill Prevention and Contingency Plan (B&M 48070014-SPCP)
16.6. NK38-PLAN-38000-10020: Groundwater and Dewatering Plan (B&M 48070014-GDP)
16.7. NK38-PLAN-38000-10006: Waste Management Plan (B&M 48070014-WMP)
16.8. NK38-PLAN-38000-10018: Transportation Logistics Plan (B&M 48070014-TLP)
16.9. NK38-PLAN-38000-10004: Soil Management Plan for C13 area (B&M 48070014-SMP)
16.10. NK38-REF-38000-0483816: F1 Test Pit report
16.11. NK38-PLAN-38000-0475693: F1 Early Works Plan
16.12. NK38-REF-38000-0483285: Borehole Drilling Investigation
16.13. NK38-FEX-15200-0506: Catch Basin 468 Location
16.14. NK38-FEX-15200-0507: Catch Basin 654 Location

APPENDIX A

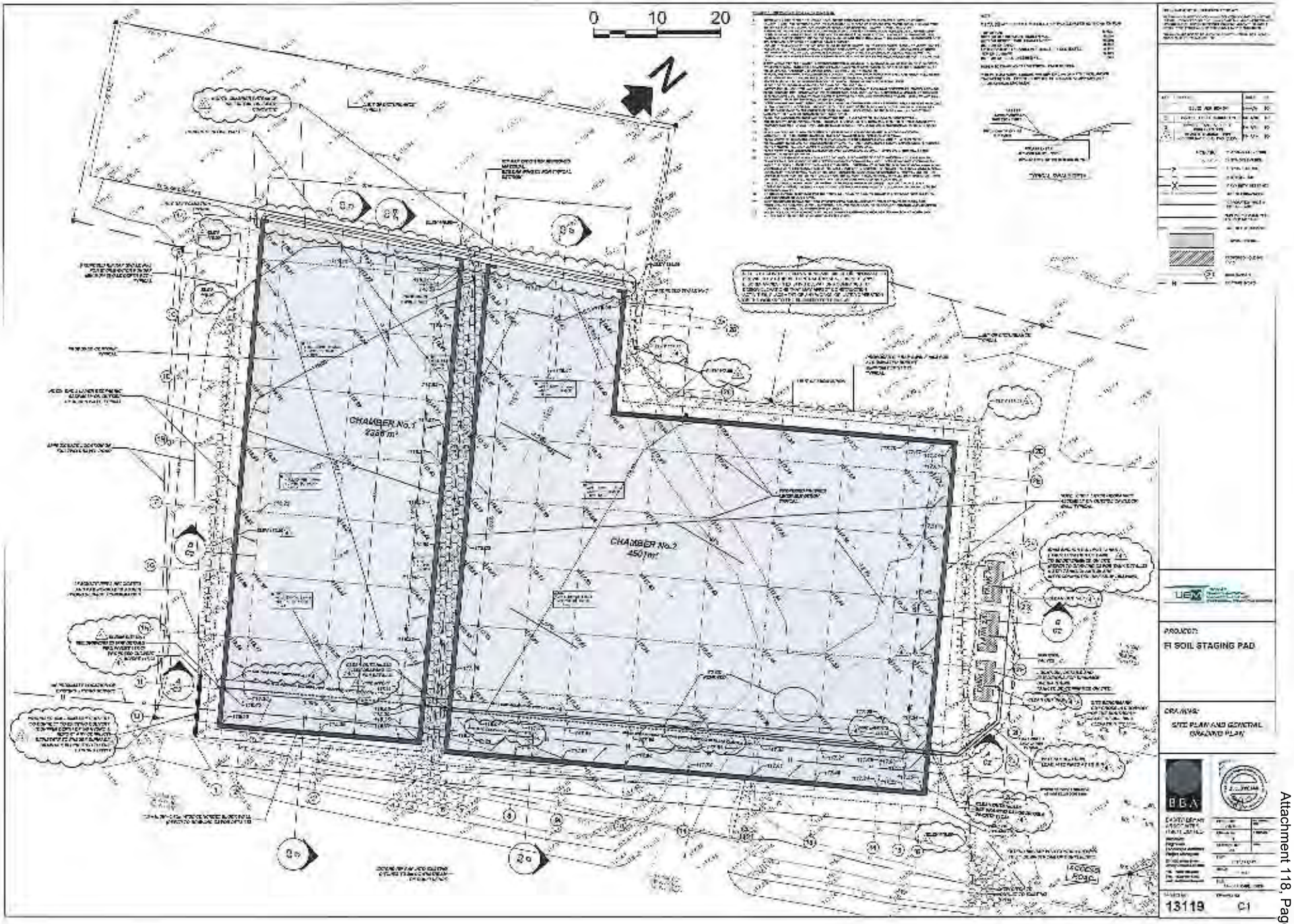

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Exhibit L-D2-02-AMPCO-137
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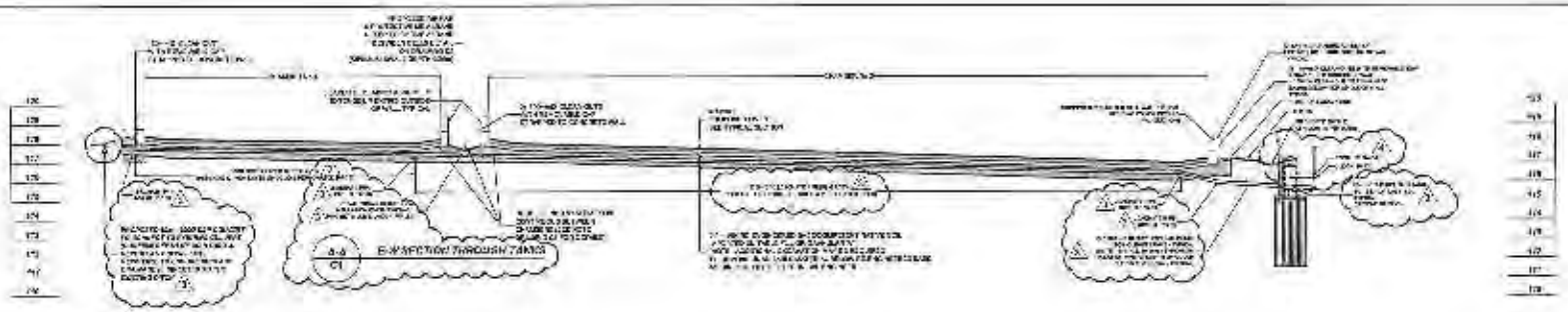
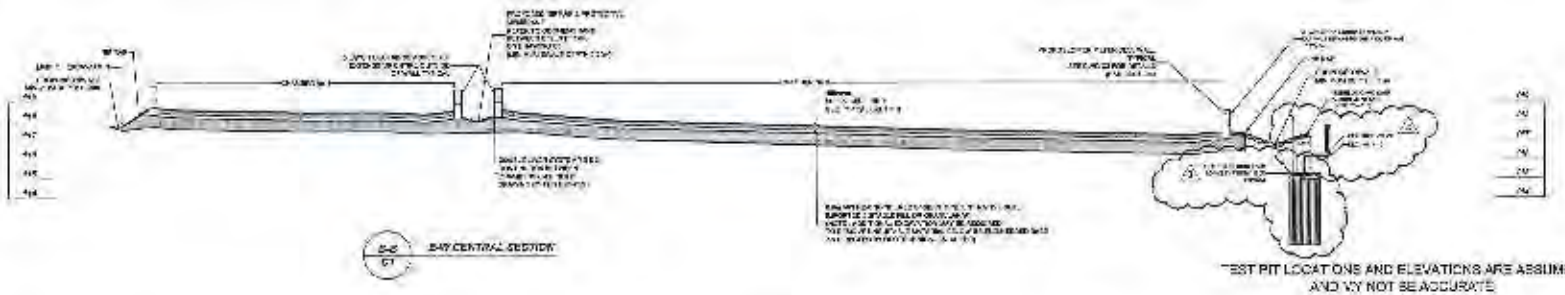
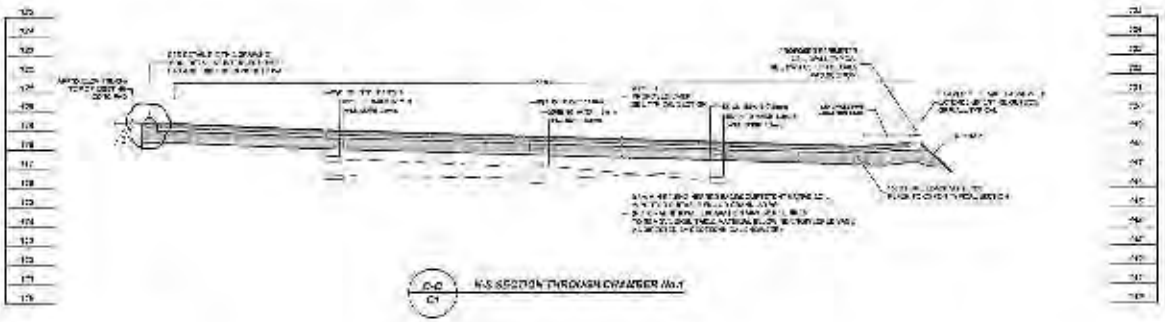
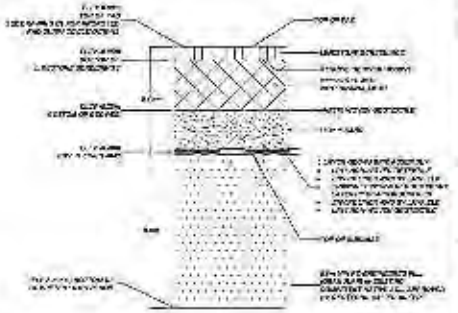


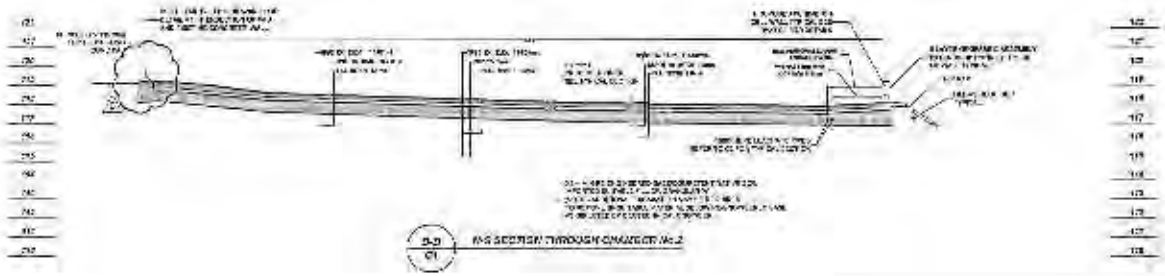


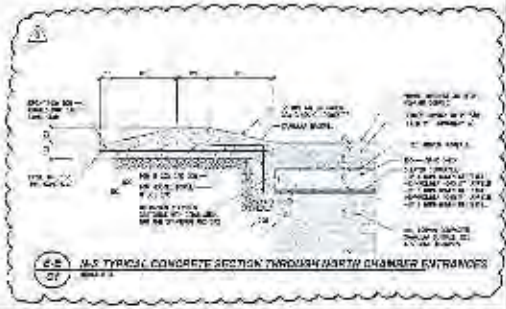
TEST PIT LOCATIONS AND ELEVATIONS ARE ASSUMED AND MAY NOT BE ACCURATE





TYPICAL PROPOSED LINER DETAIL





N-S TYPICAL CONCRETE SECTION THROUGH NORTH CHAMBER ENTRANCES

PROJECT:
F. SOIL STAGING PAD

DRAWING:
GRADING PLAN SECTIONS

13119 C2

Filed: 2021-04-19, EB-2020-0290
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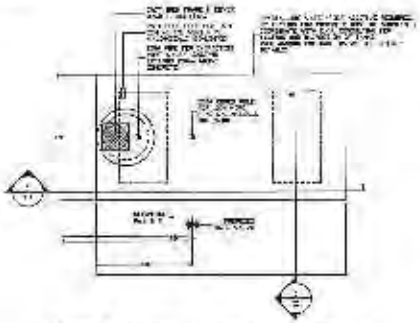
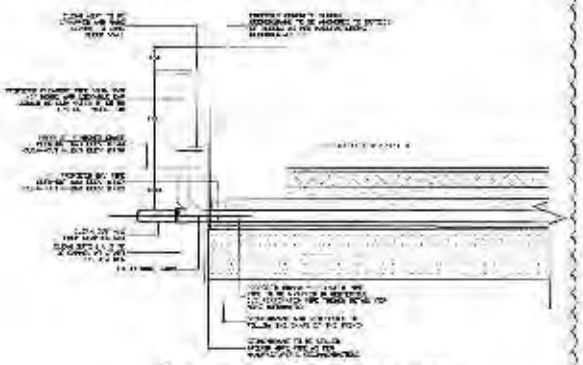
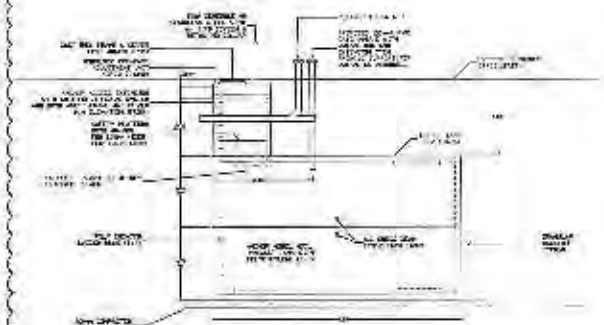


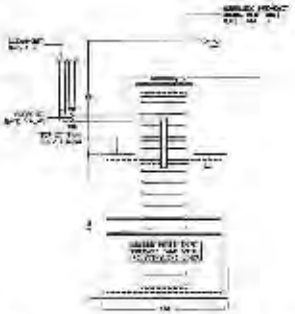
1 57m³ TYPICAL HOLDING TANK DETAILS



3 CLEAN CUT DETAIL FOR No's 1-3



A 1/C3 57m³ TYPICAL HOLDING TANK DETAILS



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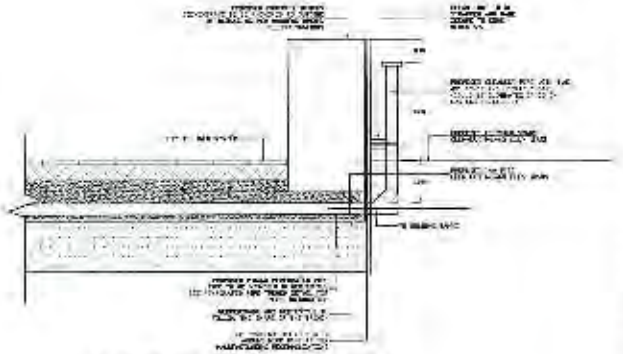
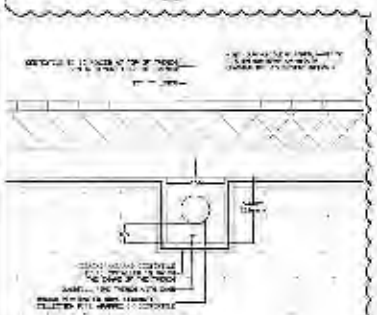
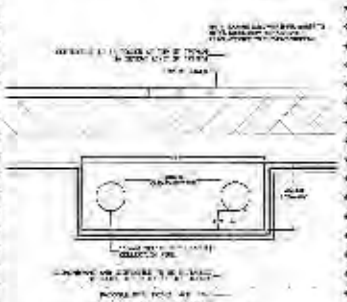


4 CLEAN CUT DETAIL FOR No's 4 & 5



CHAMBER No.1 PIPE TRENCH DETAIL



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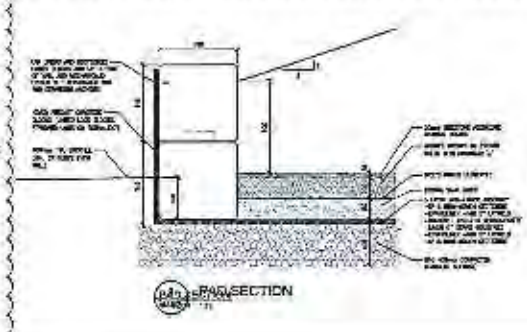
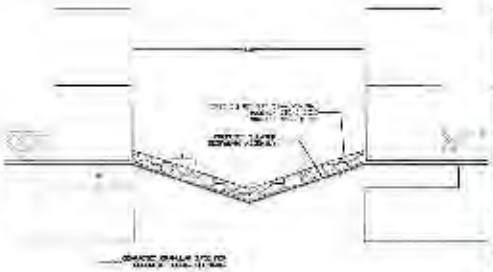


1 PAD SECTION



GEOMEMBRANE DETAIL BETWEEN CELLS

PROJECT:
F SOIL STAGING PAD

DRAWING:
DETAILS

13119 C3

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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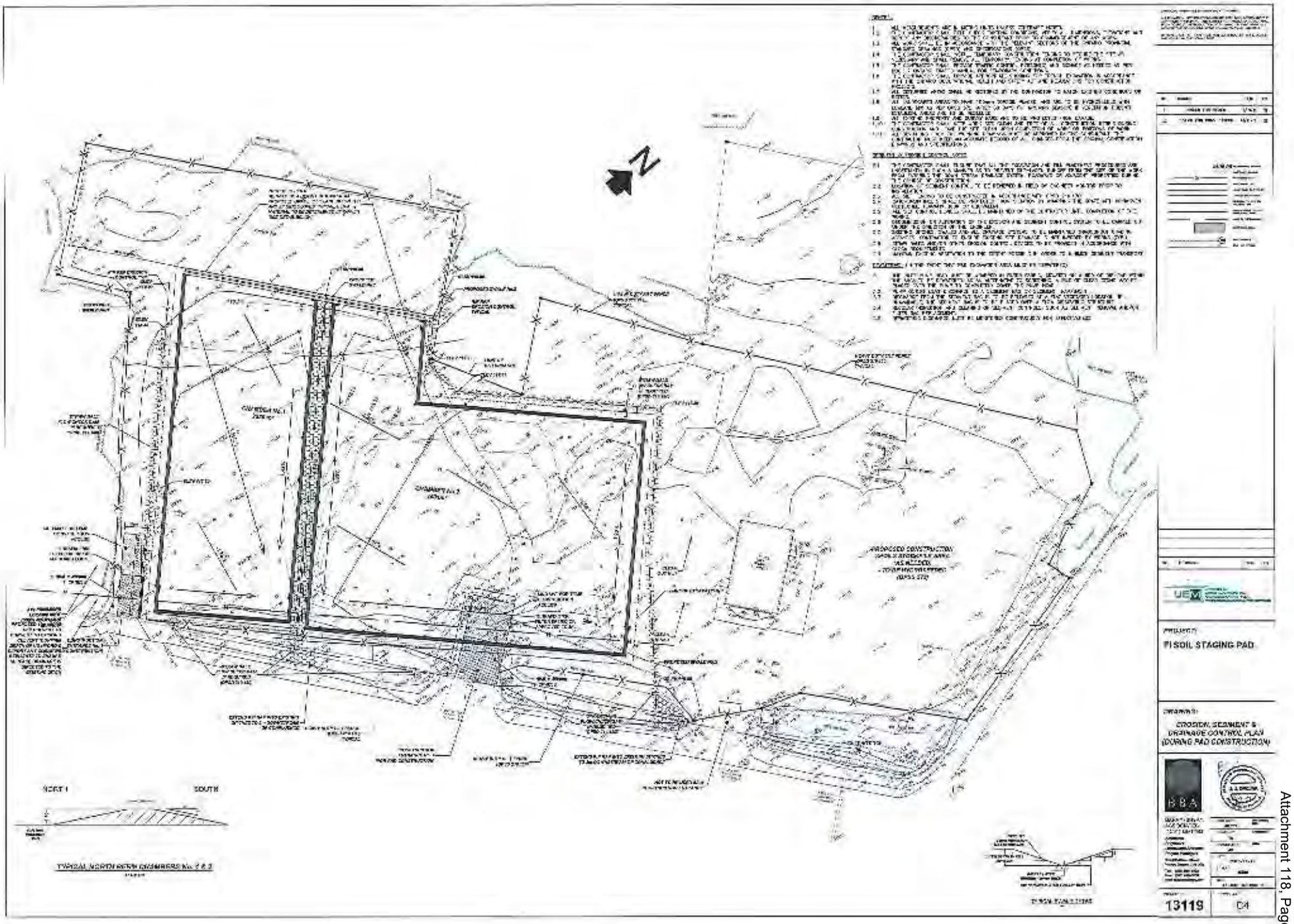

PROJECT:
FI SOIL STAGING PAD

DRAWING:
EROSION, SEDIMENT & DRAINAGE CONTROL PLAN (DURING PAD CONSTRUCTION)

13119 | D4

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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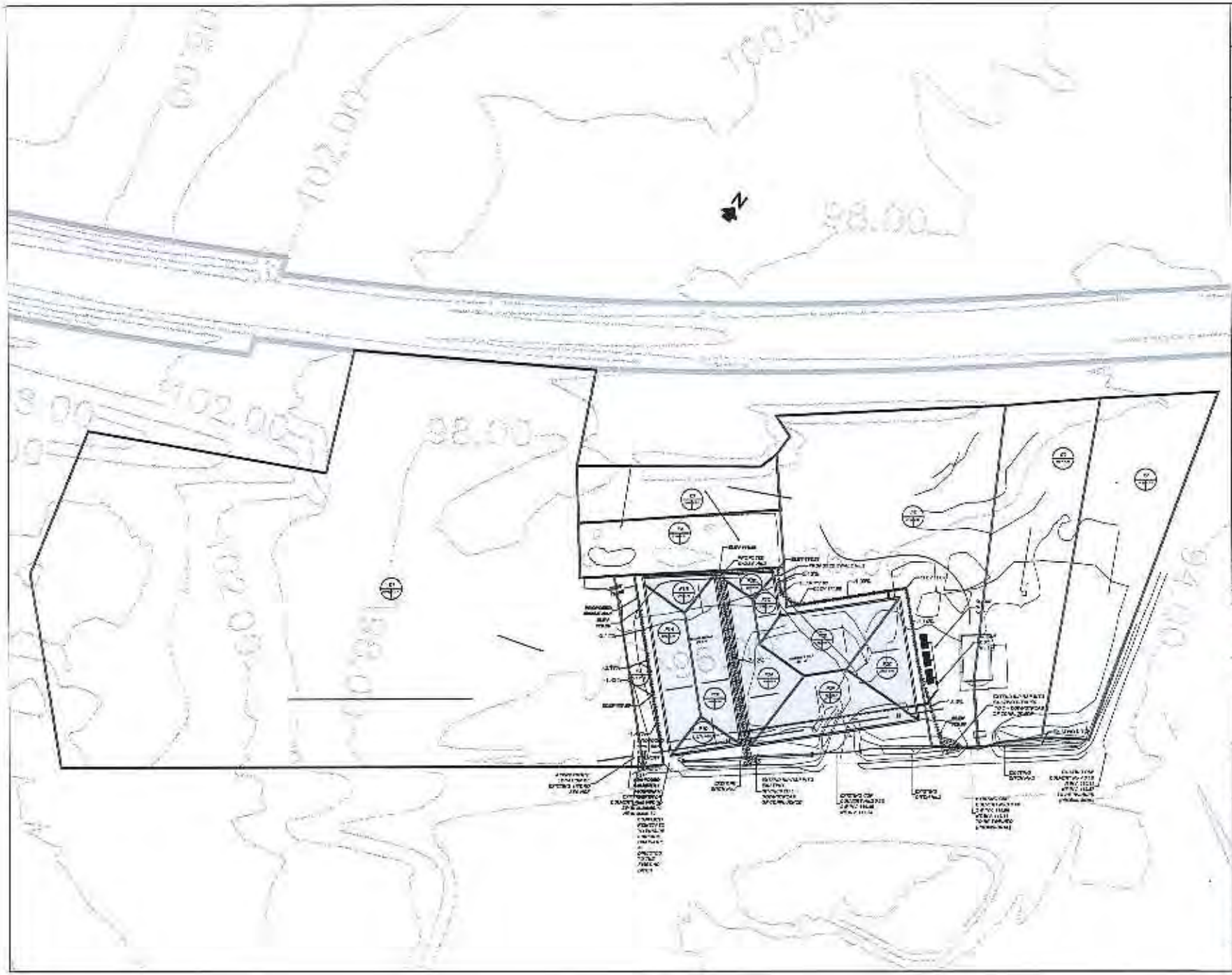

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APPENDIX B

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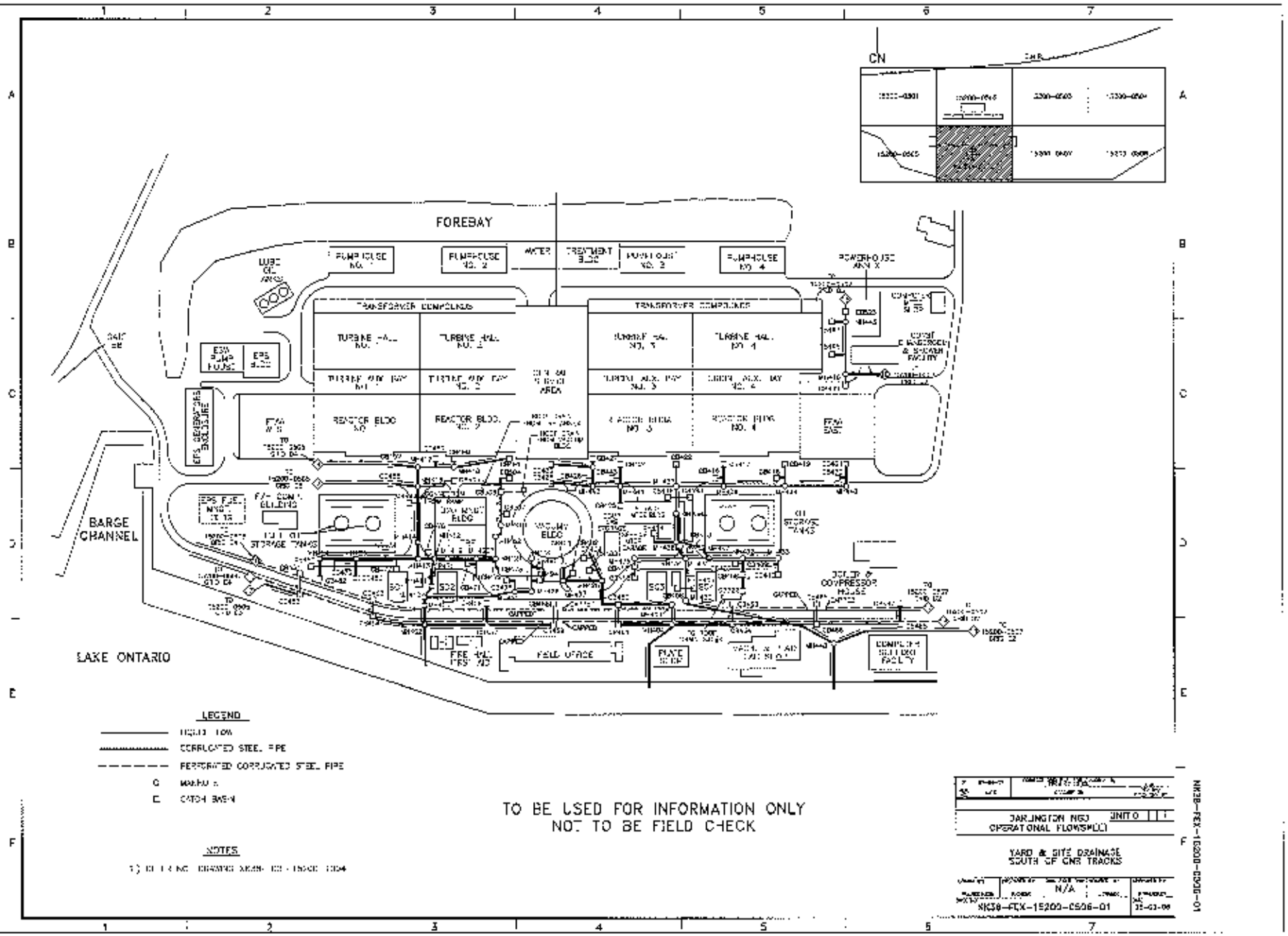
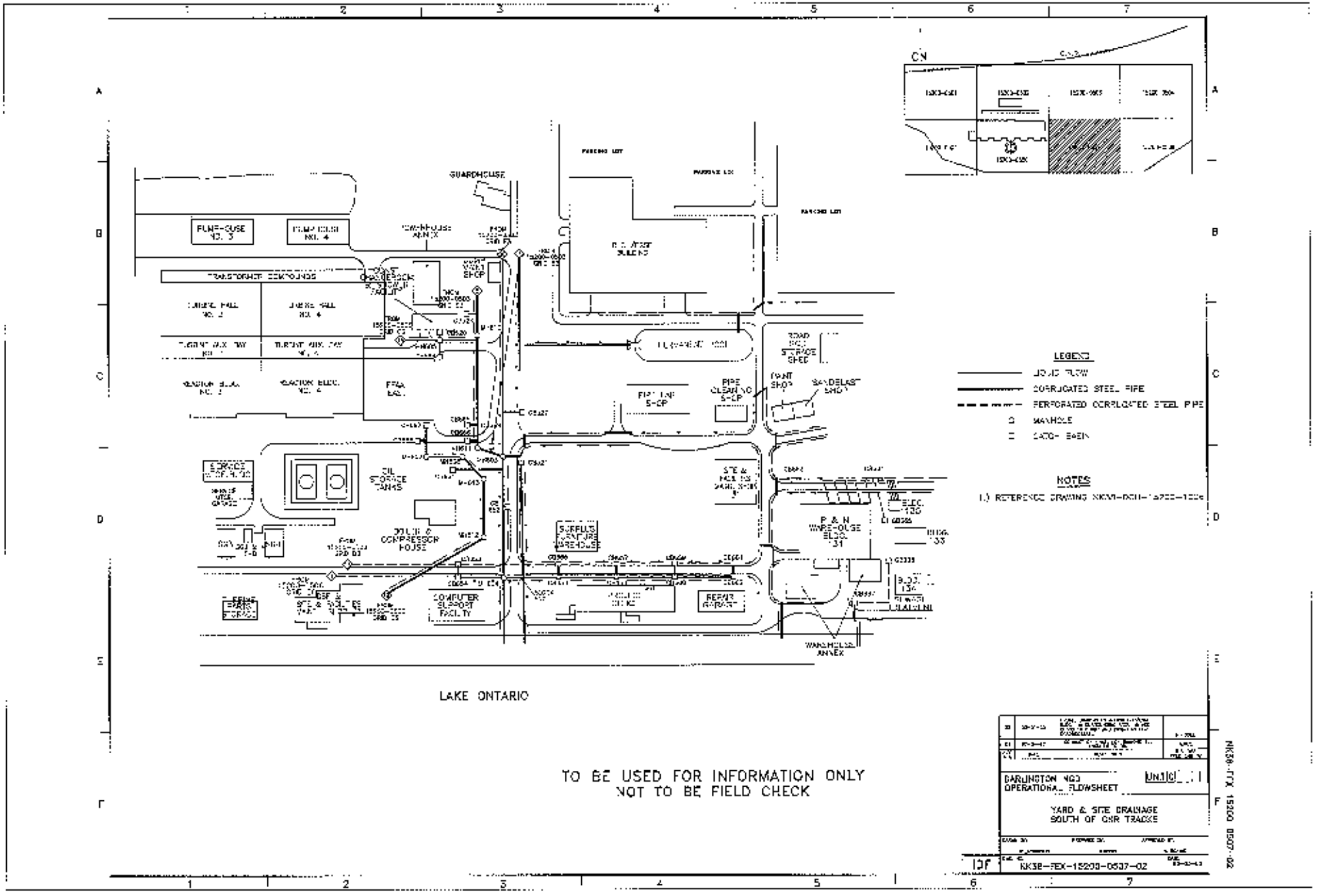


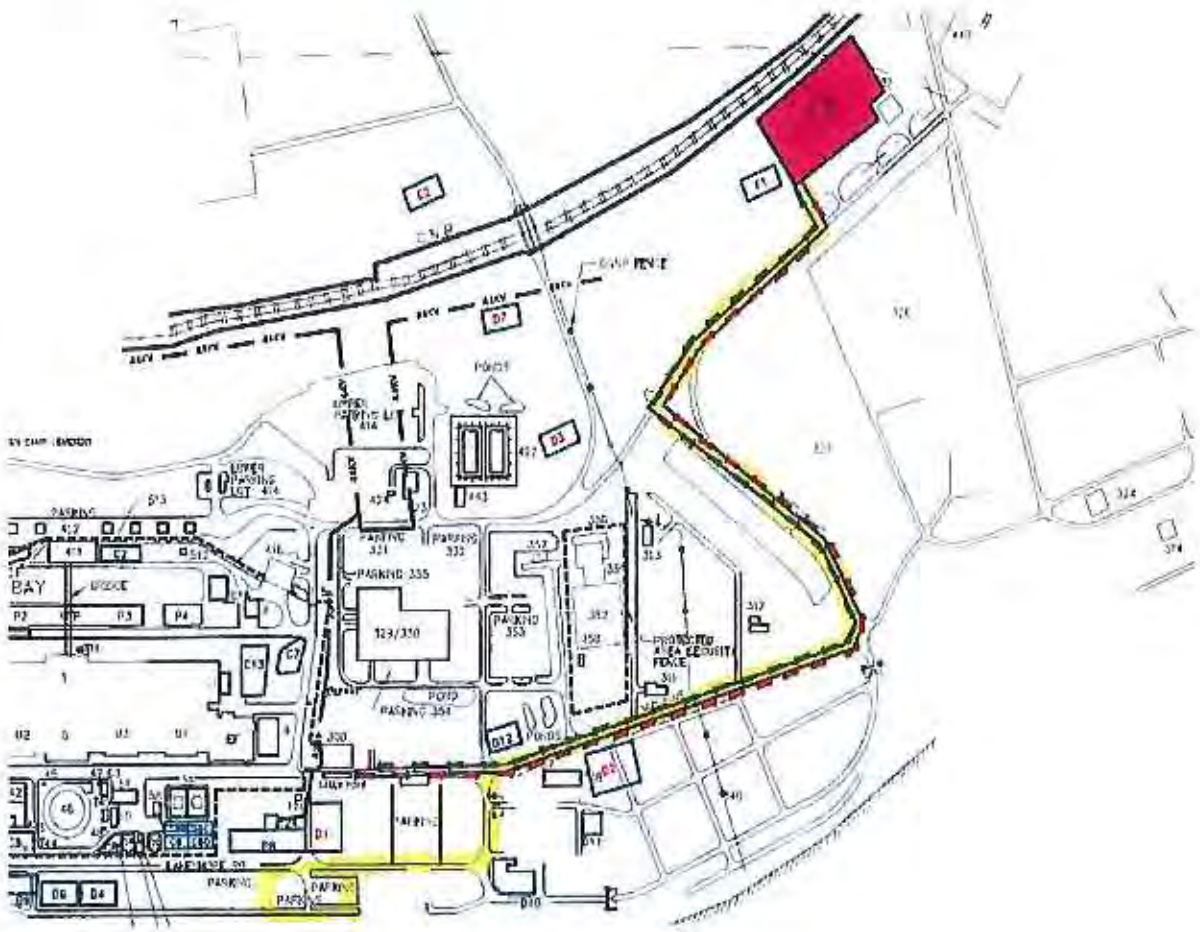

GUARDHOUSE
FUME-CUSE NO. 3
FUME-CUSE NO. 4
TRANSFORMER COMPOUNDS
OIL SERVICE TANKS
COMPUTER SUPPORT FACILITY
SURPLUS FURNITURE WAREHOUSE
PIPE CLEARANCE SHOP
PAINT SHOP
SCAFFOLDING SHED
P & M WAREHOUSE BLDG. 31
WAREHOUSE ANNEX
LAKE ONTARIO
LEGEND
ROAD
CORRUGATED STEEL PIPE
PERFORATED CORRUGATED STEEL PIPE
MANHOLE
CATCH BASIN
NOTES
1.) REFERENCE DRAWING NK38-DGN-15200-0506
TO BE USED FOR INFORMATION ONLY
NOT TO BE FIELD CHECK
DARLINGTON NGS
OPERATIONAL FLOWSHEET
YARD & SITE DRAINAGE
SOUTH OF CNR TRACKS
NK38-FEX-15200-0507-02

APPENDIX C

Transportation Route

Sally Port to F1 and Back

F1 to Catch Basins and Back



Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
Attachment 118, Page 35 of 57

APPENDIX D

PGL

BM FORM LIST

BM-FORM-000-F1SMP Rev0

Project Information

Project Number: 4325-02.01 F1 Soil Management Plan
Site Address: OPG-DN Bowmanville, ON

Document #	Document	Revision	Date Issued
BM-FORM-000-F1SMP Rev 0	PGL BM Form List	0	22-Jan-14
BM-FORM-001-F1SMP Rev 0	PGL Truck Tracking Form - F1 Laydown Area	0	22-Jan-14
BM-FORM-002-F1SMP Rev 0	PGL Truck Tracking Form - D20 Excavation	0	22-Jan-14
BM-FORM-003-F1SMP Rev 0	PGL Daily Sump Inspection Form	0	22-Jan-14
BM-FORM-004-F1SMP Rev 0	PGL Silt Fence Inspection Form	0	22-Jan-14
BM-FORM-005-F1SMP Rev 0	PGL Vacuum Truck Tracking Form	0	22-Jan-14
BM-FORM-006-F1SMP Rev 0	PGL F1 Laydown Area Pad Grid Form	0	22-Jan-14
BM-FORM-007-F1SMP Rev 0	PGL Soil Pile Sampling Form	0	22-Jan-14
BM-FORM-008-F1SMP Rev 0	PGL Soil Pile Sampling Sketch	0	22-Jan-14

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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Truck Tracking Form at F1 Laydown Area

BM-FORM-001-F1SMP Rev0

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Truck Information										
Date	Load Number	Time On-Site	Time Off-Site	Company	Truck #	License Plate #	Material	Soil Location (Grid)	Truck Inspected by PGL (Y/N)	Volume (m^3)
								Total Volume		

Personnel (Print): _____

Personnel (Signature): _____

Material
(CS): Caisson Spoils
(0 - 3): 0 - 3 mbgs
(3 - B): 3 mbgs - bedrock
(B): Bedrock

Soil Location (see F1 Pad Grid Form)

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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Truck Tracking Form at D20 Excavation

BM-FORM-002-F1SMP Rev0

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

				Truck Information						
Date	Load Number	Time On-Site	Time Off-Site	Company	Truck #	License Plate #	Material	Soil Destination (Cell)	Truck Inspected by PGL (Y/N)	Volume (m^3)
									Total Volume	

Personnel (Print): _____

Personnel (Signature): _____

Material
(CS): Caisson Spoils
(0 - 3): 0 - 3 mbgs
(3 - B): 3 mbgs - bedrock
(B): Bedrock

EXAMPLE

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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PGL

Sump Inspection Form at F1 Laydown Area

BM-FORM-003-F1SMP Rev0

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	
Weather		**Sump ID**	
Notes:	**1. Increase inspection frequency after rain event.**		

				Sample Results			
Date	Time of Inspection	Estimated Volume (fraction full)	Sample Collected (Y/N)	Table C (pass/fail)	Tritium Result	Dilution (Y/N)	Discharge Path

Personnel (Print): _____

Personnel (Signature): _____

NA - Not Applicable

EXAMPLE

PGL

Silt Fence Inspection Form

BM-FORM-004-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area
Site Address:	OPG-DN Bowmanville, ON

Notes:
1. **Inspect silt fence weekly, damages must be corrected within 3 days**
2. **Inspect silt fence within 12 hour of rainfall**
3. **Check condition of fence, identify holes, damage, deficiency**

Date:	Name:			Company:	
				Description of Repair Required	Date Deficiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

Date:	Name:			Company:	
				Description of Repair Required	Date Deficiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

Date:	Name:			Company:	
				Description of Repair Required	Date Deficiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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PGL

Vacuum Truck Tracking Form

BM-FORM-005-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area Sump Discharge	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Notes: **1. Discharge flow rate must be monitored to be <20 L/s.**

Weather:

SUMP ID:		Sample ID:	
SUMP Volume:		Tritium (Bq/L):	TOC (mg/L):	pH:
Date Sampled:		TSS (mg/L):	GG (uCi/L):	O&G (mg/L):
Date Empty:				

Vac Truck #	Date of Discharge	Sample Collection (Y/N)	Volume Discharged (L)	Discharge Time (hh:mm) Start	Discharge Time (hh:mm) Stop	Flowrate (L/s)	Discharge Location	Comments
		Total Volume						

General Comments:

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
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F1 Laydown Area Pad Grid Form

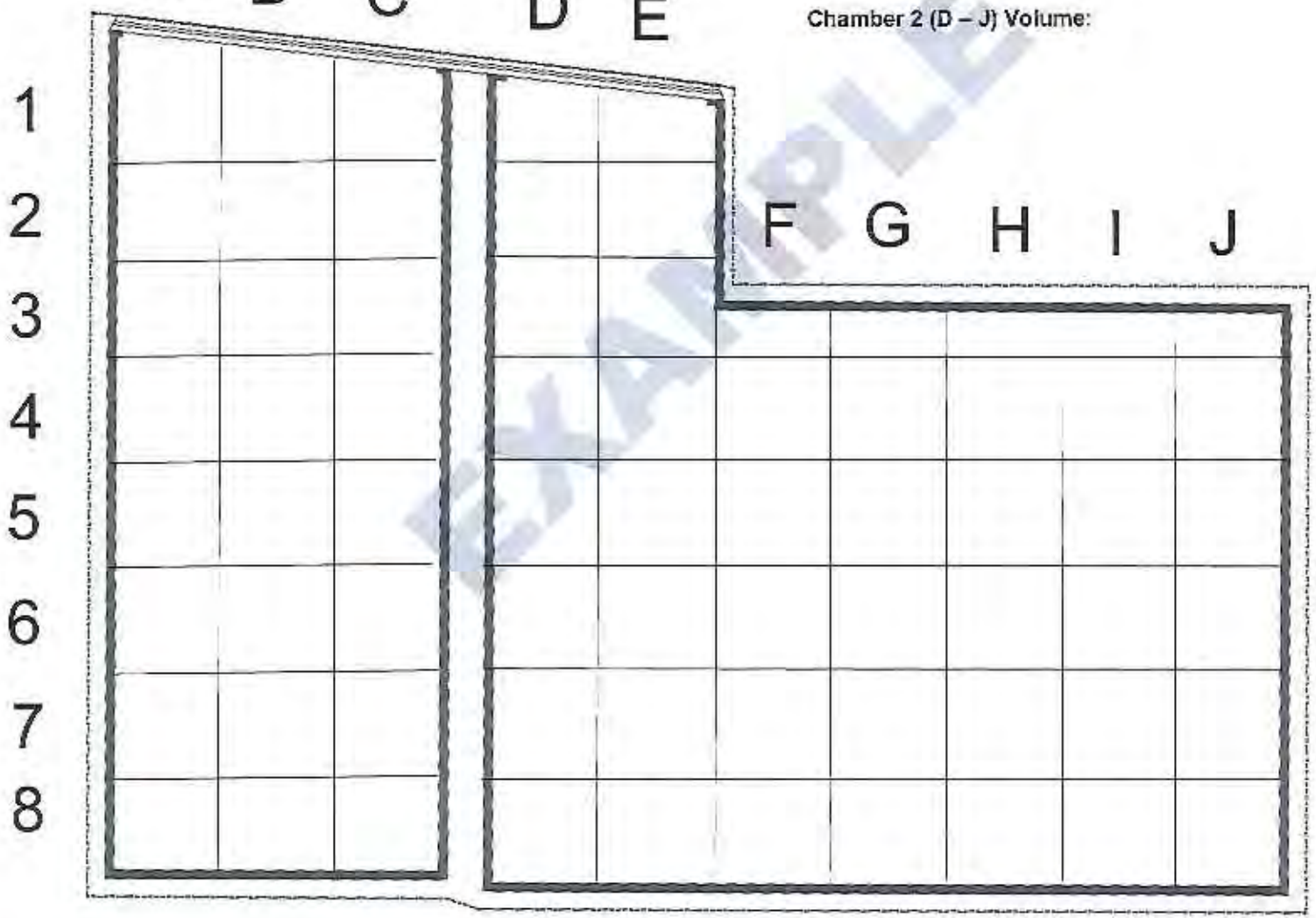
BM-FORM-006-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area	Client: B&M/OPG-DN	Date
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Chamber 1 (A – C) Volume:

Chamber 2 (D – J) Volume:



EXAMPLE

PGL

Soil Pile Sampling Form

BM-FORM-007-F1SMP Rev0

Project Information				
	Project Number:	4325-02.01 F1 Laydown Area	Client:	B&M/OPG-DN
	Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

SOIL PILE ID: _____ DATE: _____

SOIL PILE ORIGIN: _____ PGL REP: _____

SOIL PILE LOCATION: _____ INSTRUMENT: _____

ESTIMATED SIZE: _____ CALIBRATION DATE: _____

SAMPLING FREQUENCY: _____ EXCAVATOR: _____ REP: _____

Sample Number	Volume (m^3)	Soil Type	OVM (ppmv)	Submitted Sample						Comments
				H_3	GG & GS	PHC	BTEX	VOC	M & I	

Soil Description
(minor/major soil type, texture, density, structure, colour, moisture)

A: _____

B: _____

C: _____

D: _____

E: _____

F: _____

Laboratory Parameter Submission

H_3: Tritium

GG & GS: Gross Gamma and Gamma Scan

PHC: Petroleum Hydrocarbons F1 - F4

VOC: Volatile Organic Compounds

BTEX: Benzene, Toluene, Ethylbenzene, Xylene

M & I: Metals and Inorganics

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
Attachment 118, Page 45 of 57

PGL

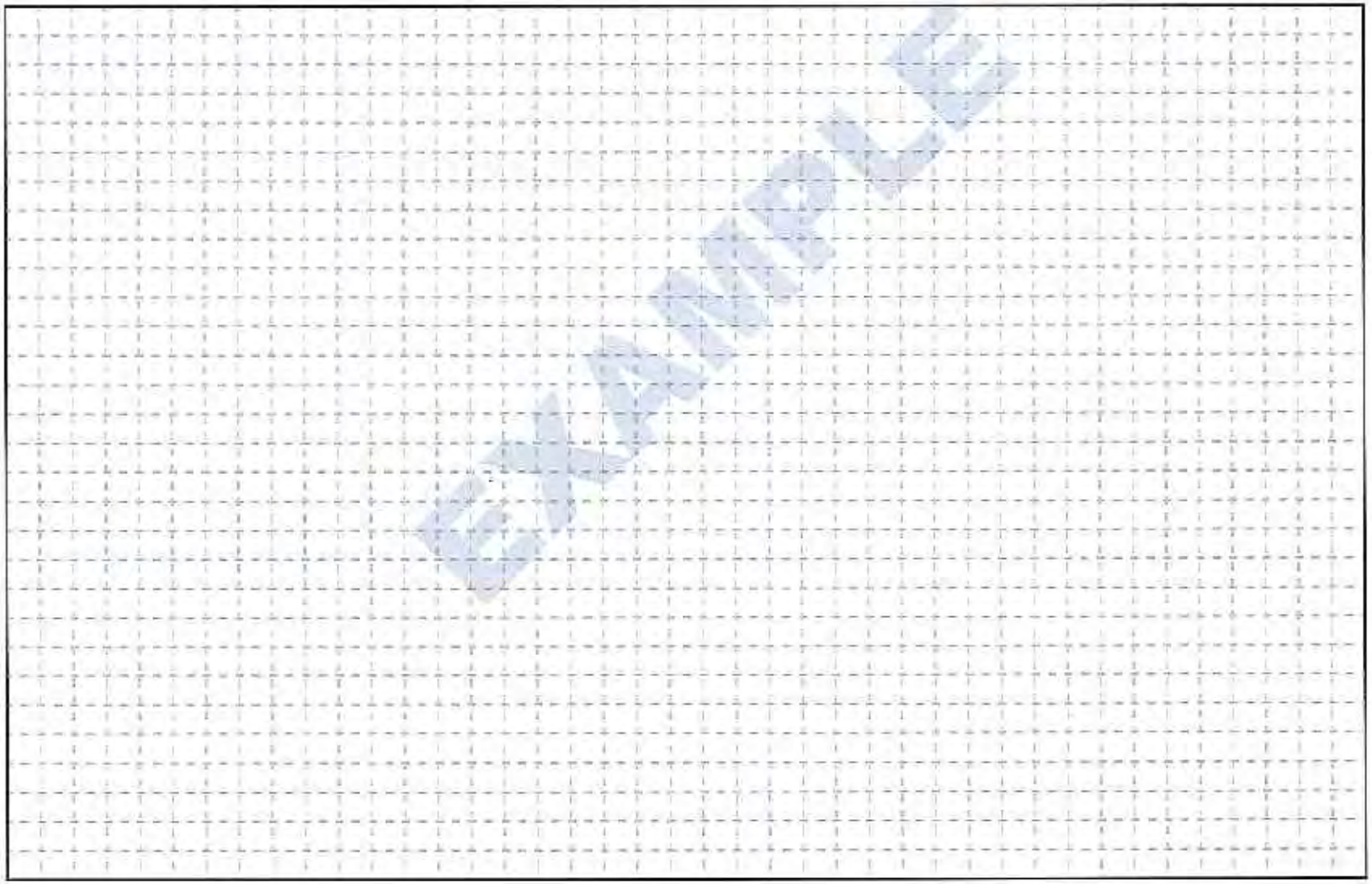
Project Information

Soil Pile Sampling Sketch

BM-FORM-008-F1SMP Rev0

Project Number:	4325-02.01 - F1 Laydown Area	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Dimensions: _____ **Volume:** _____ **Number of Samples:** _____



EXAMPLE

APPENDIX E

Heavy Water Management Building Project: Campus Plan F1
Background Groundwater Review
Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-004-TM-0004-R00
September 13, 2013

Kinectrics Inc
Analytical and Waste Services

Kinectrics Inc., 800 Kipling Avenue, Unit 2
Toronto, Ontario, Canada M8Z 5G5

Heavy Water Management Building Project: Campus Plan F1
Background Groundwater Review
Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-004-TM-0004-R00
September 13, 2013

Prepared by: Pottinger Gaherty Environmental Consultants Ltd
Unit 102-250 Water Street
Whitby, ON, L1N 0G5

Reviewed by: _____
Ruth Burany, PhD, PEng.
Engineer
Analytical and Waste Services
Kinectrics Inc

Approved by: _____
Otto Herrmann, PhD
Department Manager
Analytical and Waste Services
Kinectrics Inc.

Dated: September 13, 2013

DISCLAIMER

This report was prepared for Black and M°Donald under the Kinectrics Inc ISO 9001 Quality Program Registered with QMI. Kinectrics Inc. takes reasonable steps to ensure that all work performed shall meet the industry standards, and that all reports shall be reasonably free of errors, inaccuracies or omissions. This report was prepared in accordance with Purchase Order Number 48005626 R001.

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REVISIONS

Revision Number	Date	Comments	Approved
R00	September 13, 2013	Initial Release	OH

PGL
Pottinger Gaherty
Environmental Consultants Ltd.
250 Water Street, Unit 102
Whitby, ON Canada L1N 0G5
T 905.668.4908
F 905.668.4909
www.pggroup.com

Memo

PGL File #: 3821-01.03

DATE: September 16, 2013

TO: Ruth Burany, Kinectrics Inc.

FROM: Archana Uprety, PGL
Salima Jaffer, PGL
Will Gaherty, PGL

Re: Heavy Water Management Building Project: Campus Plan F1 Background Groundwater Review – Ontario Power Generation – Darlington Nuclear (OPG-DN)

PGL was retained by Black and McDonald to evaluate the existing groundwater condition in the wells near Campus Plan F1 area (F1) and develop a groundwater monitoring program to support the F1 soil management plan.

1.0 INTRODUCTION

F1 will receive soil excavated from the Protected Area during the excavation and construction work associated with the new D2O Heavy Water Management Building. A 2009 spill event in the Protective Area at the Heavy Water Management Building foot-print means excavated soil may be impacted with tritium. Therefore, OPG has requested the development of a groundwater monitoring program for F1.

2.0 PURPOSE

The purpose/objective of this memo is to:

- Review existing reports provided by OPG to determine up and downgradient tritium concentration in groundwater at F1;
- Review the reports to identify overburden and shallow bedrock groundwater-flow directions;
- Identify gaps in available data provided by OPG; and
- Develop a groundwater monitoring program to support the F1 soil management plan.

Our technical memo presents a review of existing wells, results of the groundwater programs from existing reports provided by OPG and the proposed groundwater monitoring program.

3.0 DATA

PGL reviewed specific sections (groundwater flow direction and analytical data) of the below listed reports provided by OPG:

- EcoMetrix Incorporated – *Darlington Nuclear Generating Station Groundwater Monitoring Program Design*, March 2012;
- Genivar – *OPG Darlington Nuclear Site Delineation of Areas of Elevated pH in vicinity of Former Truck Wash Area, August 2009*. OPG File Number: NK38-REP-07010-0266518; and

- CH2M HILL (Excerpt 3 pages) – *Ontario Power Generation Inc. New Nuclear – Darlington Project Geological and Hydrogeological Environment Existing Environmental Conditions* Technical Support Document, 2008. OPG File Number: NK054-REP-07730-00005.

PGL reviewed data from 3 groundwater wells at F1 and 25 wells nearby to determine existing groundwater conditions. The groundwater wells that were selected for review based on groundwater-flow direction, and proximity to F1 (Figure 3 and 4.4). Results were compared to Ontario Regulation 153/04 Table 3 Standards.

In aggregate, data was available from 17 of the 28 wells:

1) EcoMetrix contained maximum values measured from 2008 to 2012 from 12 wells for benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons (PHC) fractions F1 to F4, metals/inorganics, volatile organic compounds (VOCs), tritium and gamma.
2) Two wells were analyzed for tritium only in February and June 2008.
3) Groundwater samples collected from the three wells at F1 were analyzed for dissolved metals and inorganic parameters in December 2008.

There were exceedences of:

- Chloride in two wells;
- Selenium in one well;
- PHC fraction F3 in one well which a had concentration of 522 µg/L; and
- One well which had a concentration of 130Bq/L tritium, exceeding the F1 New Build limit of 100Bq/L.

All analytical results in the remaining wells were below the Table 3 Standards (See Table A).

Table A: Data Review

Groundwater Wells (EcoMetrix, March 2012)		
Well ID	**Analyzed Parameters**	**Exceedence**
MW010-18	-	NA
MW011-31	-	NA
MW012-5	-	NA
MW044-34	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW045-10	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW046-6	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW047-92	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (37.2 M µg/L) exceeds the Table 3 Standards (2.3 M µg/L)
MW048-31	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	
MW049-20	-	NA
MW050-7	-	NA

Table A: Data Review (continued)

Groundwater Wells (EcoMetrix, March 2012)		
Well ID	**Analyzed Parameters**	**Exceedence**
MW052-15	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Tritium (130 Bq/L) exceeds the F1 New Build limit of 100 Bq/L
MW053-31	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	PHC F3 (522µg/L) exceeds the Table 3 Standards (500µg/L).
MW054-20	-	NA
MW055-14	-	NA
MW056-85	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (15.3M µg/L) exceeds the Table 3 Standards (2.3M µg/L)
MW057-27	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (5.29M µg/L) and Selenium (234.7µg/L) exceed the Table 3 Standards (2.3M µg/L, 63µg/L, respectively)
MW058-6	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW059-12	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW063-98	No analytical	NA
MW064-40	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW065-25	-	NA
MW066-8	-	NA
MW106-29	-	NA
Groundwater Wells (C2M HILL, 2008)		
MW051-7	Tritium	None
MW105-6	Tritium	None
Groundwater Wells at F1 (Genivar, August 2009)		
MW08-12	Metals and inorganics	None
MW08-13	Metals and inorganics	None
MW08-14	Metals and inorganics	None

Notes: N/A = Not applicable
- = Not analyzed
M = Millions
Results evaluated against Ontario Regulation 135/04 Table 3
Last set of numbers in MW notation refer to depth of well in meters. For example, MW10-18 is 18 meters deep. This does not apply to the three wells at F1

GROUNDWATER FLOW DIRECTION

Based on the EcoMetrix report, overburden groundwater-flow direction is towards the southeast and the shallow groundwater-bedrock flow is towards the south.

3.1 DATA GAPS

PGL reviewed groundwator data from 28 wells; 11 wells did not have any analytical results available and 3 of the wells (at F1) were only analyzed for metals and inorganics. Therefore, a total of 14 wells did not have background tritium results available for review. The groundwater wells with no tritium results include the following wells: F1 wells (MW08-12 to MW0 8-14), and 1 1 downgradient wells (M W010-18, MW011-31, MW012-5, MW49-20, MW050-14, MW054-20, MW055-14, MW063-98, MW065-25, MW066-8, and MW106-29).

4.0 PROPOSED GROUNDWATER MONITORING PROGRAM

As part of the long -term strategy for groundwater protection at F1, PGL re commends a groundwater-monitoring and sampling program. No n ow wells are requi red. Eight existing gro undwater wells were selected for the monitoring program which includes existing well s near and downgradient of F1 and wells with limite d or no available analytical results. This includes the following wells:

- One upgradient well (MW105-6);
- Three F1 wells (MW08-12 to MW08-14); and
- Four downgradient wells (MW050-14, MW051-7, MW058-6, and MW059-12).

PGL recommends that the wells selected for the m onitoring program that do not have ba seline tritium results (MW08-12 to MW08-14, and MW050-14) be sampled for tritium before any soil is staged at F1.

PGL recommends quarterly monitoring and sampling as presented in Table B. The monitoring and sampling will begin approximately four months after F1 is in use and will be continued for as long as soil is staged at F1.

Table B: F1 Groundwater Monitoring program

Objective	Monitor tritium concentrations in wells in close proximity to F1.		
Monitoring Well	**Frequency**	**Analysis Parameter**	**Considerations**
MW08-12	Quarterly	Tritium	At F1
MW08-13	Quarterly	Tritium	At F1
MW08-14	Quarterly	Tritium	At F1
MW050-14	Quarterly	Tritium	South Site Boundary
MW051-7	Quarterly	Tritium	South Site Boundary
MW058-6	Quarterly	Tritium	Southeast Site Boundary
MW059-12	Quarterly	Tritium	Southeast Site Boundary
MW105-6	Quarterly	Tritium	North Site Boundary
Method detection limit for tritium:		100 Bq/L	

5.0 STANDARD LIMITATIONS

PGL prepared this memo for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report. The memo's purpose is to transmit and interpret monitoring data and so will need to be used in conjunction with previous reports by PGL or others. As is true for all environmental investigations, potential remains for the presence of unknown, unidentified, or unforeseen surface or subsurface contamination. More or different investigation may be required if other risks are identified. The data presented in this report is valid for the date of sampling, but site conditions may change with time.

The findings and conclusions are Site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this memo is for use now. The memo should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions and limitations on our liability are set forth in our work program/contract. No warranty, express or implied, is made.

Attachments: Figure 3 – Genivar – Groundwater Monitoring Wells Locations
Figure 4.4 – EcoMetrix – Groundwater Monitoring Wells Locations

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
Attachment 118, Page 56 of 57

DATE : June 2009	**Groundwater Flow Direction**	GENIVAR	
SCALE : See Map			
FILE No. : MA-08-256-00-MA	**OPG Darlington Nuclear Site**	FIG No.: 3	REV
APP'VD : M.H.			

Filed: 2021-04-19, EB-2020-0290
Exhibit L-D2-02-AMPCO-137
Attachment 118, Page 57 of 57

NK38-CORR-38000-0497255 LOF

ONTARIO POWER GENERATION

P.O. Box 4000, Holt Rd South, Bowmanville, Ontario L1C 3Z8

March 26, 2014

Radiological risks associated with soil from Darlington Nuclear Protected Area

The soil being transferred from the Protected Area at Darlington Nuclear to the F1 Soil Management Facility has been extensively sampled and found to contain trace amounts of tritium that are well below the unconditional clearance levels specified by the Canadian Nuclear Safety Commission in the Nuclear Substances and Radiation Devices Regulations.

The risks to individuals that may come in contact with the soil or water (i.e. on clothing or skin or inhalation) during the course of performing work is very small and well below any Regulatory Public dose limits. The levels involved are below what we would consider to be designated as radioactive work and so low that no doses could be assigned to any workers from coming into contact with this material.

Sampling of the soil being transferred to the F1 Soil Management Facility continues to be performed to verify and confirm the levels of tritium are well below the Regulatory levels.

Should you have any further concerns or questions, please feel free to contact me.

S. Taras,

Steve Taras
Health Physicist, Radiation Protection Programs
Radiation Protection Department
Darlington Nuclear
(905) 623-6670, ext. 7090

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ENGINEERING MEMO

RCM Doc No.: 13720-COR-00261 R000

OPG Doc No.: NK38-CORR-23800-0512781

To: Mark Elliott – Chief Nuclear Engineer, OPG

Date: 16SEP2014

Re: HWMB West Annex – Technical Viability of Raising the Foundation Elevation

Purpose

The purpose of this memo is to address the technical viability of elevating the foundation of the Heavy Water Management Building West Annex (HWMBWA) from the current design elevation of 87.0m to a higher elevation of 94.8m.

The current analysis was not to determine the strength of the structure (ie. concrete design). This would be completed during the redesign effort once a stable arrangement was determined, and a decision to proceed with the alternate design is made.

This memo addresses only design considerations with respect to building stability and does not evaluate other design impacts of this elevation change (i.e. building systems, etc).

This analysis only reviewed the feasibility of elevating the currently designed building with limited modifications within the current building footprint, without soil improvement and deep foundations. Designing the building founding on soil could have been a viable option if it had been considered in the conceptual design phase.

Background

The HWMBWA has been designed, in accordance with the Conceptual Design Report, with the basement level at EL87.0, which is the same as the existing facility. The depth of excavation is approximately 15m, and a caisson wall has been designed, and is currently being installed in order achieve the depth of excavation to construct the building in the 'current design' configuration.

To date the construction has experienced water ingress during tie-back installation (N-2014-23031) on the east wall and pull test issues. It is unknown what other issues may result as the dig continues. In addition, there are schedule concerns surrounding the installation of rock anchors and construction of the buried pipe chase linking the West Annex and the existing TRF/HWMB.

As a result of increasing construction risk and schedule concerns, RCMT was asked by OPG to look at changes to the current design with potential to mitigate cost/schedule risk including relocating the base of the foundation at or near the current depth of excavation.

This memorandum focuses on the viability of raising the building elevation as close as possible to the current depth of excavation.

Raising the elevation of the building would preclude the need to install the lower level of caisson wall tiebacks and would eliminate the need for rock anchors in the final design, thereby improving the overall construction schedule to support the Refurbishment Project.

Calculations to support this proposal will verify:

- The stability of the structure against overturning and sliding during a seismic event.
- That adequate soil bearing capacity is achieved without the use of deep foundations to bedrock.

Overall Methodology

The approach was based on evaluating the building with simple conservative assumptions and simple calculations. Initially, a simple overturning analysis using static seismic accelerations which were considered to be conservative was used.

When this simplistic approach did not provide positive results, a dynamic analysis was undertaken. Due to limited time this analysis used certain methodology and assumptions in order to complete the analysis within a reasonable timeframe to support the Engineering Decision Making process.

The following loading conditions were considered in the analysis:

- Building Dead Weight
- 20% of live load and fixed equipment (mass for seismic analysis)
- Upward water pressure
    - The upward water pressure assumed the top of the ground water to be at Elevation 97.3.
    - The base of the mat was assumed to be at Elevation 93 with the thickened perimeter down at Elevation 92.1
    - The total upward water load from the water pressure was calculated as 9,600 kips.
- Soil lateral loads on the embedded foundation due to seismic events

  As the resultant moment will be added to the calculated seismic overturning moment using square root of the sum of the squares (SRSS) method, and is much less than the overturning moments from the analyses, the load would have no impact on the evaluation and is not considered.

  The force is included in the evaluation for sliding.)

- Seismic loads per NK38-DG-03650.2B Rev 06, "Common Mode Incidents Seismic Design" (0.12g).
- Passive soil pressure is provided by lateral soil springs in analysis models. The calculated passive force on the long wall was calculated as 12,200 Kips

For the evaluation of overturning, two conditions were evaluated. The minimum acceptable factor of safety for overturning is 1.25 per clause 5.9.3 of CSA N289.3-10. The conditions evaluated are:

- Seismic overturning moment resisted by the building loads
- Seismic overturning moment resisted by the net building load after reduction for the vertical seismic forces and the upward water pressure.

For bearing pressure, an additional case was considered which added the vertical seismic to the building loads.

For each case the eccentricity caused by the overturning moment was calculated to check the stability of the structure and the bearing pressure.

Initial Evaluation – Static Analysis

Methodology

An initial evaluation was performed to evaluate the need for more advanced analysis. For the lateral seismic loads, the building floor weights were factored by a constant seismic "g" factor.

Horizontal acceleration was determined by calculating the peak response spectra acceleration (g) at 5% damping x static analysis factor x soil factor

= 0.35 x 1.5 x 1.25 = 0.656g

Where:

- Peak acceleration = 0.35g
- Static factor = 1.5
- Soil factor = 1.25 (based on difference in Building Code Soil factors for Class B (rock) and Class C (stiff soils) soil classes

In accordance with Clause 4.3.3.3, CSA N289.3-10, the vertical acceleration is estimated to be 2/3 of the horizontal = 2.3 x 0.656 = 0.437g.

Results

The analysis based on the above criteria resulted in overloading of the bearing capacity of the soil and an unstable structure. The calculated eccentricity was outside the width of building. This is a result of large reduction of the resisting dead weight load due to the upward vertical seismic acceleration.

Dynamic Response Spectra Analysis

In order to perform a more realistic analysis, a dynamic response spectra analysis was performed.

The purpose of the analysis was to determine the design acceleration, lateral force and overturning moment values, particularly for the east-west, or short, direction of the building which would have the greatest effect on the stability of the structure. Additionally, the overturning moments would increase the bearing forces on the soil as the building weight would be redistributed.

Methodology

1. Modelling

The analysis utilized existing STAAD models from the original design effort. In order to provide a representation of the dynamic response from the soil the following simplifications were made within the model:

- The analysis assumed the vertical and rocking soil springs could be represented by vertical springs at the corners. This simplified the calculation of the overturning moments.
- The lateral springs were applied at the side walls to a height of ½ of the embedment as recommended by ASCE 4.
- All floors were modeled as rigid diaphragms.

A second simplified stick figure model was used as a simplified approach to evaluate alternatives. Although the model had few masses and elements, the results for base shear and overturning were consistent with the results from the more detailed model.

During the development of the methodology discussed above, OPG was involved and raised a number of concerns with respect to the use of STAAD as the analysis tool. RCM agreed that STAAD would not perform the dynamic analysis that would be required to finalize this engineering product, however given the timeframe to complete this preliminary analysis, and the tools at hand RCM is confident that this methodology can provide a reasonable representative basis of the amplification through the soil.

2. Building Stability and Soil Bearing

The probable amplification of the ground motion due to the soil layer between the foundation and the rock is not defined. As such, the building stability was evaluated at various amplification factors and damping values to determine the design margins within these variables. The evaluations were performed on the stick model, and the STAAD model at 5% and 7% damping. The acceleration was incrementally increased from 1.0, (representing the acceleration at bedrock) to 2.0 in order to determine at which point the building would become unstable, or when soil bearing would exceed the allowable capacity.

The evaluation was limited to the east-west overturning, or the narrow width of the building. The overturning moment for the detailed model was calculated from the vertical spring reactions at the corners of the building. The weight is the seismic weight used in the response spectra analysis. Shear vertical seismic forces are directly calculated by the analyses.

Values for water uplift, lateral force due to the soil seismic load and soil resistance are fixed and independently calculated.

3. Soil Structure Interaction

The available properties of the soil and rock where used to determine the probable range and most likely value of the amplification of the ground motion from the rock base to the underside of mat foundation.

a. Impedance Factor

An upper bound of the amplification can be calculated from the rock and soil properties, particularly the shear velocity and the density of the underlying rock and the soil cover. Some properties of the rock are available in the original site calculation files. Material properties of the overburden were provided in the geotechnical reports. Using these values, the necessary properties of the materials were estimated. This value calculated does not consider the damping of the soil which would slightly lower the value.

The value calculated based on the estimated material properties is 3.

b. Building Code

The National Building Code of Canada and Ontario Building Code provide ratios of based on soil types and ground acceleration to simulate the effect of soil structure interaction. For building design, the underlying soil is classified and the applicable factors are provided in the codes for each soil type.

The soil types are based on the shear wave velocity and the blow counts. The geotechnical reports classified our soil type as Class C, a stiff soil. Two factors are provided in the codes, one at a period of 0.2 seconds and a second at a period of 1 second. The 1 second period

would fall within the constant velocity range of the site response spectra and the 0.2 second factor would represent the constant acceleration range of the response spectra.

From the modal analysis, the dike natural periods were approximately 0.2 seconds and lower. Thus the factors for 0.2 would be the more representative of the amplification factor.

A review of the calculated shear velocity identified that the soil would fall in the upper end of the Type C classification. For the estimate of amplification, the average of the Class C and Class D factors was used. This value was compared to the factors for Class A for solid rock.

The calculated amplification for 0.2 second period is 1.61.

The soil factors were derived assuming 30 meters of soil above the rock. The codes would recommend that the soil properties could be averaged over the depth. This would lead to a lower factor when averaging the rock and the soil. The 1.61 is likely an upper bound on the soil factor.

c. Dynamic Load Factor

The natural period of the soil over the rock is a function of the travel time of the wave through the depth of the soil. Based on the soil depth and the shear wave velocity calculated from the soil properties provided within the geotechnical reports, the first natural frequency of the soil layer was calculated as 15.78 cycles per second.

The dynamic load factor for a structure subject to harmonic loading is a function of the forcing function frequency, the natural frequency of the structure and the damping value. The forcing function frequency can be based on the site MDE curve which provides acceleration values vs. frequency. The soil damping ratio was estimated to be approximately 5% using the formulas presented in NIST GCR 12-917, "Soil Structure Interaction for Buildings and Structures". Using the estimated first mode of the soil, amplification factors at various frequencies can be calculated which could be used to calculate a pseudo MDE response spectra.

This approach would limit the amplification for frequencies which are not close to the soil value and provide greater amplification to the resonant frequencies of the structure. The estimated frequency of the soil is based on the shear wave velocity value. To try to envelope any soil material property variability, the soil natural frequency was modified by 10%, 25%, and 50%, and the dynamic load factors for the various frequencies were calculated.

The pseudo response spectra based on the soil natural frequency were utilized to determine the expected overturning moments and forces. It is assumed this approach would give the best estimate of the amplification of the rock accelerations by the soil.

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Inputs

1. Soil Properties

Additional testing of the soils was requested of EXP in order to determine the required soil properties. Values of the bearing capacity, shear modulus (G), Young's modulus and Poisson's ratio were determined by EXP based on additional testing at the site.

The estimated soil shear wave velocity used to calculate the soil damping value was based on the shear modulus provided by EXP.

- E (Young's modulus) – 650 MPa (94.27 ksi)
- G (Shear modulus) – 250 MPa (36.259 ksi)
- Poisson's ratio – 0.3
- Ultimate bearing capacity – 700 kPa (14.6 ksf)

Assumptions

Assumptions were made as to the soil properties and seismic loadings in order to proceed. These assumptions will be validated during detailed design.

1. Soil Springs

The stiffness of the soil would be based on spring constants calculated using the provided soil properties in accordance with the NEHRP "Soil-Structure Interaction for Building Structures" (GCR12-917-21) , including adjustments for embedment and dynamic loading.

2. Response Spectra

The evaluation was based on increases to the ground motion due to the earthquake on rock for which the existing site spectrum was generated. A soil-structure interaction analysis (ie. FEA modelling) will be performed during detailed design to validate the response spectra amplification value.

The responses spectra utilized the maximum ground acceleration of 0.12g (Design Guide) modified for 5% and 7% structural damping.

The design response spectra for the soil level will need to be calculated and verified based on definitive soil perimeters by a geotechnical engineer.

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Limitations of the Analysis Performed

1. Response Spectra

As discussed in the methodology section above, an equivalent method to determine the amplification due to dynamic analysis was completed. This entailed some empirical design, engineering judgment, and engineering research. A detailed analysis will be completed as a part of the final design to validate the amplification factors that were calculated in this preliminary analysis.

2. Damping

Clause 6.6 of CSA N289.3 permits the use of 7% damping in concrete structures when designing for the DBE earthquake, or if stress levels are greater than 50% yield. The concrete foundation (slab and walls) has relatively low levels of stress, with most of the structure well below the 50% level. Although permitted by code, RCM is concerned that the use of 7% damping may not be an adequate representation of this structure. Additional research is required to validate the use of 7% damping.

Results

1. Modelling

The response spectra analysis results showed:

- The building natural frequencies were in the area of the highest accelerations on the site response spectra;
- For each direction of earthquake, only one or two modes contributed to the loading.
- Each direction of earthquake had minimal effect on the forces in the tangential directions.

As the soil springs values can have considerable variability, the STAAD calculations are required to consider a +/- 50% range, as per clause 5.2.3 of N289.3 Adding mass or stiffening of the soil to modifying the natural frequencies would not likely change the building accelerations.

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2. Acceleration Threshold

The results of the analyses determined that soil bearing is not a concern until the seismic factors are near the upper bound for the 5% damping scenario. The governing limitation for the building is stability (overturning), and the upper thresholds for which the accelerations can increase are;

- 1.25 times for the 5% damping response spectra, and
- 1.4 times for the 7% damping response spectra.

The range for allowable amplification is 1.25 to 1.4.

3. Acceleration Demand (Dynamic Load Factor)

The dynamic load factor was capped at an amplification of 3.0 based on the impedance factor. The results from the dynamic loading for the expected range of the soil frequency is an 8% to 15% increase (ie. 1.08 to 1.15) of the building overturning moment.

Further, if the soil frequency variability is adjusted by -50%, as per 5.2.3 of N289.3, it would equal the building frequency, and the increase in loading is 33%, therefore the likely upper bound of the amplification is 1.33.

The range for expected amplification is 1.08 to 1.33.

Conclusion

It was anticipated upon the completion of the preliminary analysis that significant margin would exist between the resistance threshold values for the amplification of response spectra acceleration and the conservative estimate of the demand amplification through sound engineering principles.

At the current stage of the analysis, the lower range of threshold amplification values overlap the upper range of the expected demand.

Recommendation

The results of the preliminary analysis do not provide RCMT with adequate certainty that a detailed analysis would produce a stable structure, and as such, RCMT cannot endorse a decision to elevate the foundation of the HWMB West Annex at this time.

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References:

NK38-DG-03650.2B Rev 06
Geotechnical Reports (EXP)
NK38-REP-38000-10001
NK38-REP-38000-10123
Soil Parameters for Base Slab Re-Design – 08SEP2014
CSA N289.3-10

16 Sept 2014
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ONTARIO POWER GENERATION Darlington Nuclear
ACCEPTED ☑
ACCEPTED AS NOTED ☐
REVISE AND RESUBMIT ☐
Signature Date
Name: Mark Elliott
Department: C.N.E
THIS ACCEPTANCE DOES NOT RELIEVE THE CONTRACTOR FROM RESPONSIBILITY FOR ERRORS OR OMISSIONS OR FROM ANY OBLIGATIONS OR LIABILITY UNDER THIS CONTRACT

Meeting Minutes

Date: October 29, 2012

Subject: Critical Material Handling/Lift Plans

Location: Project Office Conference Room A

Attendees: Steve Taras – Health Physics
Scott Stafford – Health Physics
Amy Gottschling - Kinectrics
Peter Moore – OPG Projects
Chris Wood – Environment
Ian Hartford - Environment
Larry Berti – Ellis Don
Bruce Smith – Black & McDonald
Salima Jaffer – PGL
John DeWilde – PGL
Elio Fracalanza – Refurbishment Operations

Agenda:

The D2O Project is currently preparing for day lighting and bulk excavation to support construction of a new D2O Storage facility. The soil removal is scheduled to begin early in the new year. **Excavated soil is expected to be approx 16,500 m^3, plus excavated bedrock approx 4,500 m^3**. Both of those figures take into account de-compaction when removed from the ground. The purpose of this meeting is to start discussions with the EPC vendor on how to support and execute this work. Specifically, the project would like to discuss:

1. Soil and ground water sampling requirements for incorporation into the environmental plan
2. Possibility of doing in situ borehole sampling prior to excavation
3. RP requirements during excavation and prior to releasing the soil

Minutes:

- B&M indicated their plan was to daylight 2,000 m3 (approx 7-m depth) to remove buried services, and that soil would be stored temporarily within the PA, then returned to the hole in order to install caissons.
- B&M/EllisDon is to outline a plan for temporary storage of this soil (how much, when, etc) and OPG Projects will attempt to secure the area west of Unit 4 through Campus Plan.
- B&M/EllisDon asked if soil samples “stale date”. This issue has not been addressed by Health Physics before, however it was agreed that if there is no additional contaminant introduced to the site, a rule of thumb would be 18 months as per MOE Record of Site Condition regulations.

- Sample requirements – Reg 347 requires one sample only (conventional contaminants). Reg 153-4 would require 75 samples. Steve Taras did not see an issue with that number, but needs to check with Whitby office.
- It was agreed if in situ testing is done, no CTP requirement for each soil shipment. Although, trucks themselves need to be scanned as per normal security / rad protection process.
- Use of the CSA N292.5-11 standard (2.7 uCi/L limit) was discussed. If MOE agrees, there is a willing recipient, and OPG senior management agrees, this would be an option. This issue is currently with Raphael Macalla (Corporate Environment).
- Larry B. offered to approach a "willing recipient" with proper framing of the issue provided by OPG. First this needs to be cleared with Raphael McCalla – Chris Wood to follow up.

Actions:

1. **Steve Taras** to check with Whitby office re: acceptability of in situ 75 sample proposal.
2. **Chris Wood** to check with Raphael McCalla if OPG can authorize B&M/Ellis Don to approach a willing recipient.
3. **Peter Moore** to provide Larry Berti an email outlining the proper information to approach willing recipient, if cleared by Raphael.
4. **Peter Moore** to forward Bruce Q2 & Q3 data from the IWST ESA Phase II Project for PGL.
5. **Bruce Smith** to provide Peter a proposal for temporary storage of daylighted soil inside the PA.

Soil Management Plan
for
PROJECT
Heavy Water Management Building (HWMB)
D2O Storage Facility
Purchase Order No 00217807

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Power Generation Region
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DOCUMENT NUMBER 48070014-SMP

Rev.#	Date	Prepared by:	Reviewed by:
1	25-Apr-2013	Roger Luck Engineering & Procurement Date 25/Apr/13	Magdi Chidiac Project Engineer Date 25 April 13
		Approved by:	
		Bruce Smith for Project Manager April 25, 2013	
		Acceptance by OPG	
		ROGER DALY (Name)	MNGR. CHEM & ENV. (Title) 26APR13 (Date)

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REVISION LIST

REV #	DESCRIPTION OF CHANGE	REVISION PREPARED BY	AMENDMENT DATE
0	Original Issue	Roger Luck	3 Apr 2013
1	a. Revised Sec. 2.0 b. Revised Sec. 3.1 c. Revised Ref. 5.4 d. Appendix "B" final issue added e. Added Appendix "C"	Roger Luck	25 Apr 2013

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1.0 General

The scope of this plan is to provide a means for Black and McDonald to inform all interested parties of B&M's intended methods and means for handling the excavated soil for the new Heavy Water Management Building.

1.1 Purpose

The purpose/objective of the Soil Management Plan is to:

a. Ensure compliance with environmental legislation, regulations and conditions of approval.
b. Ensure proper records are maintained to meet regulatory environmental requirements.

1.2 Scope

The scope of this issue of the plan deals with the following excavated materials:

a. Daylighting using vacuum truck.(Top 3 metres)

This plan is a living document which will be revised to address the following additional excavated materials:

b. Caisson drilling
c. Bulk excavation
d. Miscellaneous soil excavation.

This plan is to be used in conjunction with 48070014-CEMP "Contractor Environmental Management Plan" (Ref 5.5)

2.0 Roles and Responsibilities:

a. Project Manager (PM) – responsible for the overall SMP, ensuring that it is prepared, approved and followed. (Bruce Smith 416-791-1898)
b. Work Coordinator (WC) – responsible for the implementation of the SMP on the project. (Kurt McDonald 416-677-7273)
c. Construction Superintendent (CS) – Responsible for all site construction activities. (Robert Nixon 289-685-0553)
d. All onsite personnel - All personnel are responsible for identifying and reporting any adverse conditions or issues that could affect soil management.

3.0 Daylighting

3.1 Daylighting

In order to confirm that there are no underground services that enter the footprint of the new HWMB building a vacuum truck will be used to daylight the first three (3) metres depth of the foot print. This will be done in a trench like fashion. B&M and field engineering shall verify that there are no services and if declared clear the trench will be back filled with lean concrete (0.7Mpa). This is to ensure that the area is stable and avoid cave-ins during the main excavation with excavators.

The daylighting will continue around the perimeter of the building foot print, when an underground service is encountered the area around the underground service will be further daylighted in order to allow a construction crew access to relocate the service. The area will be fenced off for safety.

B&M has contracted Kinectrics to sample the first 3 metre depth at 5 borehole locations. The test results have indicated that the top 3 metres of soil is below the allowable limit of tritium, confirmed with a report. Appendix "B" provides the conclusion of the report only. The full report (172 pages) is available upon request.(Ref 5.9)
Based on the results of the tests the daylighted material will be transported by truck to a temporary laydown area (C13 on the campus plan). The plan is to eventually send this material to a landfill site outside the PA.

4.0 Laydown Area C13 (Future site of Rad Waste Processing Building) RWPB

The temporary laydown area inside the PA is identified as C13 on the campus plan. (Appendix "A")
The plan for this laydown area is to keep the excavated soils separately: that means no mixing at this time.
Daylighted material (top 3 metres)

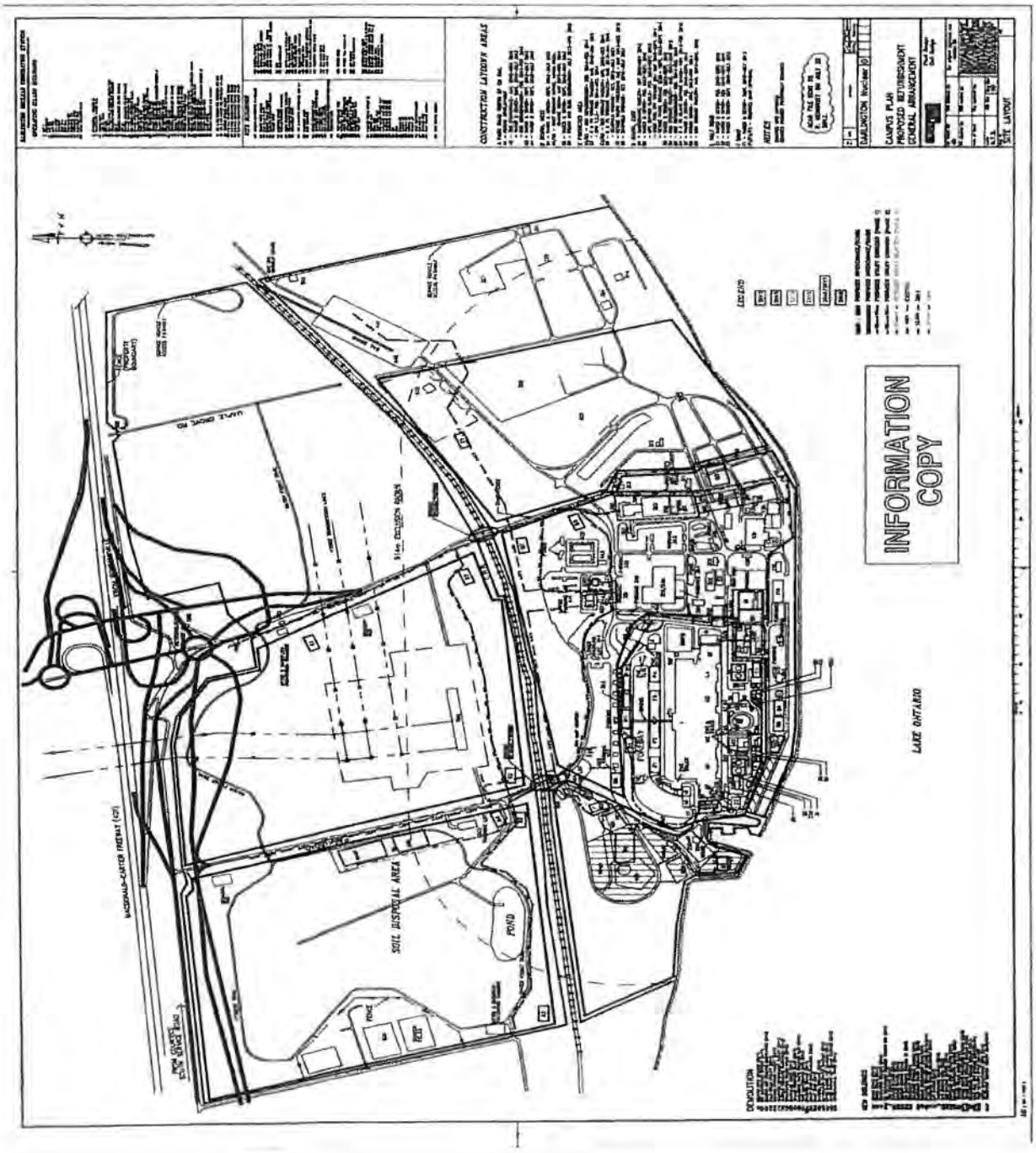
Area C13 which is approximately 80m x 80m will be divided into areas to keep soil from different areas without cross contamination. See appendix "B" for tritium limits.
To contain the daylighted material of approximately 200cuM. An area pad 30mx40m shall be constructed of asphalt on the surface with a 400mm high berm on 3 sides (Appendix "C"). The area needs to slope towards a sump so that any water would naturally drain to the sump.

This is a temporary storage location and once the daylighting is complete and material dried, this material will be transported by truck to a clean landfill site. Based on Kinectrics report this material has been deemed "clean" as outlined in Kinectrics Report. (Ref 5.9)
A 20,000 litre storage tank (3wx6Lx2h) has to be in place so that the water collected in the sump can be pumped to the storage tank for sampling to determine its quality for disposal options. The tank should have an internal weir so the fines may settle out. Tank and sump should be checked regularly.

5.0 References

5.1) N-GUID-09701-10013	Environmental Requirements Guideline
5.2) D-INS-79000-10002	Waste Disposal Guidelines for Solid Waste and Recycling at Darlington
5.3) D-INS-07290-10000	Darlington Spill Prevention and Contingency Plan
5.4) B&M 48070038-Sketch 001	Soil Laydown Pad (C13) (Appendix "C)
5.5) B&M 48070014-CEMP	Contractor Environmental Management Plan
5.6) B&M 48070014-SPCP	Spill Prevention and Contingency Plan
5.7) B&M 48070014-GDP	Groundwater and Dewatering Plan
5.8) B&M 48070014-WMP	Waste Management Plan
5.9) Kinectrics K-415072-003 -TM-0001-R00	Shallow Soil Sampling (Appendix "B")

APPENDIX "A"



APPENDIX "B"

Heavy Water Storage Building Project: Shallow Soil Sampling during Daylighting Activities – Preliminary Results Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-003-TM-0001-R00
April 24, 2013

Kinectrics Inc
Analytical and Waste Services

Kinectrics Inc., 800 Kipling Avenue, Unit 2
Toronto, Ontario, Canada M8Z 5G5

Heavy Water Storage Building Project: Shallow Soil Sampling during Daylighting Activities – Preliminary Results Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report:

K-415072-003-TM-0001-R00
April 24, 2013

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Dated: April 24, 2013

DISCLAIMER

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REVISIONS

Revision Number	Date	Comments	Approved
DRAFT	March 28, 2013	DRAFT RELEASE	OH
R00	April 24, 2013	FINAL RELEASE	OH

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Memo

PGL File #: 3821-01.02

DATE: April 23, 2013

TO: Ruth Burany, Kinectrics Inc

FROM: Salima Jaffer, PGL
John DeWilde, PGL

**Re: Heavy Water Storage Building Project:
Shallow Soil Sampling during Daylighting Activites
Ontario Power Generation – Darlington Nuclear (OPG-DN)**

Pottinger Gaherty Environmental Consultants Ltd. (PGL) has conducted shallow-soil sampling during daylighting activities to provide disposal options as a part of the Heavy Water Storage Building (HWSB) construction project at OPG DN. A summary of our work, results and conclusions is provided herein.

Background

A historic spill in December 2009 from Injection Water Storage Tanks (IWST) occurred in the area of the proposed HWSB excavation. The IWST water was primarily demineralized water containing 44,807,000Bq/L of tritium and 58.8mg/kg of hydrazine.

Twenty-nine boreholes and 28 wells have been installed since, in the area to investigate impacts from the spill event. The investigation identified tritium impacts to both soil and groundwater in the area of the HWSB and beyond. The investigation also identified petroleum hydrocarbons (PHC) and limited volatile organic compounds (VOC) impacts. The soil and groundwater quality were evaluated against Ontario Regulation 153/04 Table 3 industrial/commercial/community standards for coarse-textured soil in a non-potable groundwater condition.

PGL was contracted to evaluate the asphalt, soil, bedrock and groundwater as part of the excavation and disposal work required for the construction project. Our sampling program for these materials was outlined in our *Sampling and Analysis Plan (SAP), Heavy Water Storage Building, Ontario Power Generation, Darlington Nuclear Generating Station, Bowmanville ON*, dated January 23, 2013 previously submitted under separate cover.

Sampling Rationale

PGL recommended completing an *in situ* sampling and scan survey to collect data that will allow for offsite disposal of soils. It is intended that after the collection of this data, soils can be cleared directly for disposal onsite or offsite either under a Conditional Transfer Permit (CTP) or Unconditional Transfer Permit (UTP).

As identified in our Sampling and Analysis Plan, five boreholes in the area of the proposed building footprint were to be completed to augment existing soil and groundwater data collected this past year (2012) at the Site. The first 3m (10') of each borehole location was daylighted using a vacuum truck operated by Badger Daylighting Inc. This preliminary technical memo details the results of the sampling during daylighting activities. The rest of the soil and bedrock sampling associated with drilling activities will be reported under separate cover.

To assess disposal options, PGL compared the conventional analysis data with the Ministry of Environment's (MOE) standards found in *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, April 15, 2011. We compared data to both Table 1 Full Depth Background Site Condition Standards and Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition. For Table 3 we used coarse-grained soil standards for an industrial/commercial/community use.

Work Program: Shallow Soil Sampling

As a part of this work, PGL conducted the following tasks:

- Prepared a Sampling and Analysis Plan as required by Ontario Regulation 153/04;
- Prepared both a health and safety plan and Job Safety Analysis form;
- Attended a Project Readiness meeting February 15, 2013;
- Collected shallow-soil samples during daylighting work at the five proposed borehole locations (BH281 to BH285)
- Sampled soil at 0.5m intervals using a hand auger;
- Logged and screened samples using a Model 3 Ludlum Analog Ratemeter with Model 44-9 pancake detector and screened for organic vapours with the use of an RKI Eagle 2 equipped with both photoionization device sensor and LEL/PPM catalytic sensor;
- Collected soil samples in laboratory supplies bottles, labelled the bottles and kept samples refrigerated or on ice until submission to the laboratory;
- Submitted soil samples based on elevated Ludlum Ratemeter results, elevated photoionization device results and to provide vertical coverage, to be representative for the full length of the borehole at each location;
- Collected composite soil samples and submitted them to OPG chem lab for tritium and gross gamma screening. These results were provided to OPG Health Physics to assess the type of release permit for the samples prior to shipment to Kinectrics Inc. (Kinectrics) for analysis;
- Submitted six samples for radiological parameters and conventional parameters and two samples for TCLP analyses; and
- Evaluated the data and prepared this memo.

Findings

This technical memo presents the available results of the shallow soil sampling conducted. The results are included in Table 1 to 4 and laboratory certificates are attached.

The gross gamma and tritium results from the OPG chem lab for the composite soil samples required for shipping are presented in Table A below. PGL obtained confirmation from OPG on March 25, 2013 that composite soil samples for pre-laboratory shipment was not required if Kinectrics was performing gamma scans and tritium analysis of samples (see included correspondence). A standing conditional transfer permit (SCTP 29) was provided for use for the rest of the project work. The conditions of SCTP apply to soil only and no OPG Chem lab analysis of soil samples is required.

Table A: Gross Gamma and Tritium Composite Soil Results

OPG Chem Sample ID	Sample Date	Gross Gamma (µCi/L)	Tritium (µCi/kg)	S. Taras Review/Response
2013-02-G766	Feb 20, 2013	0.00428	0.144	H3 > UTP limit CTP required
2013-02-H111	Feb 21, 2013	0.0051	1.97	Activity and H3 > MDL CTP required
2013-02-H493	Feb 22, 2013	0.00474	<0.003	activity > MDL CTP required
2013-02-H494	Feb 22, 2013	0.00283	<0.003	activity > MDL CTP required
2013-02-I427	Feb 25, 2013	0.00533	0.365	Review not required

Radiological Parameter Results

Most of the radionuclide results were less than the laboratory detection limits with the exception of Potassium-40 (K-40), Thorium-series (Th-series), uranium-series (U-series), and tritium (H3). Tritium results in the shallow soil samples ranged from 18.2 to 291Bq/kg. All tritium results were less than 0.02µCi/kg (740 Bq/kg). Refer to Table 1.

PGL also compared the tritium data collected with that obtained in previous investigations. All tritium results from CH2M Hill's investigations of the top 3m of soil from the area are also below 0.02uCi/kg.

The tritium results from the OPG Chem Lab (Table A) vary from the data provided by Kinectrics. PGL understands, based on a conversation with Chris Wood (OPG), that this is typical and that the Kinectrics data is considered to supersede the OPG Chem Lab data.

Conventional Parameter Results

BTEX and PHC F1-F4 Results

All the sample results were below the laboratory method detection limits for the samples submitted.

Refer to Table 2.

VOC Results

All the sample results were below the laboratory method detection limits for the samples submitted.

Refer to Table 3.

Metals Results

All the sample results were below MOE Table 1 and 3 standards except for one sample. Sample BH285-2 from 0.8m to 1m below ground surface (bgs) exceeded the MOE Table 1 standard for electrical conductivity. Electrical conductivity is a measure of soil salinity and excess salts have an adverse affect on plants. This standard is intended to be protective of agricultural habitat which is not the case here. PGL would argue that since only one in

six samples exceeded electrical conductivity that this is not considered an issue for soil disposal. PGL does not believe that this result will affect offsite soil disposal options as landfills do not request this analysis for soil disposal. Refer to Table 4.

Results for sodium absorption ratio are outstanding and will be provided as a part of the investigation report when data is available.

Hydrazine was not detected in soil with the exception of a field blank. This result was only slightly over the detection limit and is likely an instrument issue.

TCLP

The Ontario Regulation 347/588 leachate extraction data is attached. The soil was evaluated against Schedule 4 and is not leachate toxic. These soils are classified as non-hazardous and maybe disposed of at an MOE approved landfill.

QA/QC

For ease of use, a detailed discussion on quality assurance and quality control is not included in this technical memo. Instead it will be included in the larger investigation report for the full borehole drilling program. In general however, the data meets quality assurance/quality objectives and is suitable for use in assessing disposal options.

Recommendation

PGL recommends that this memo and results be submitted to OPG Health Physics to assess the type of release permit for the material.

Standard Limitations

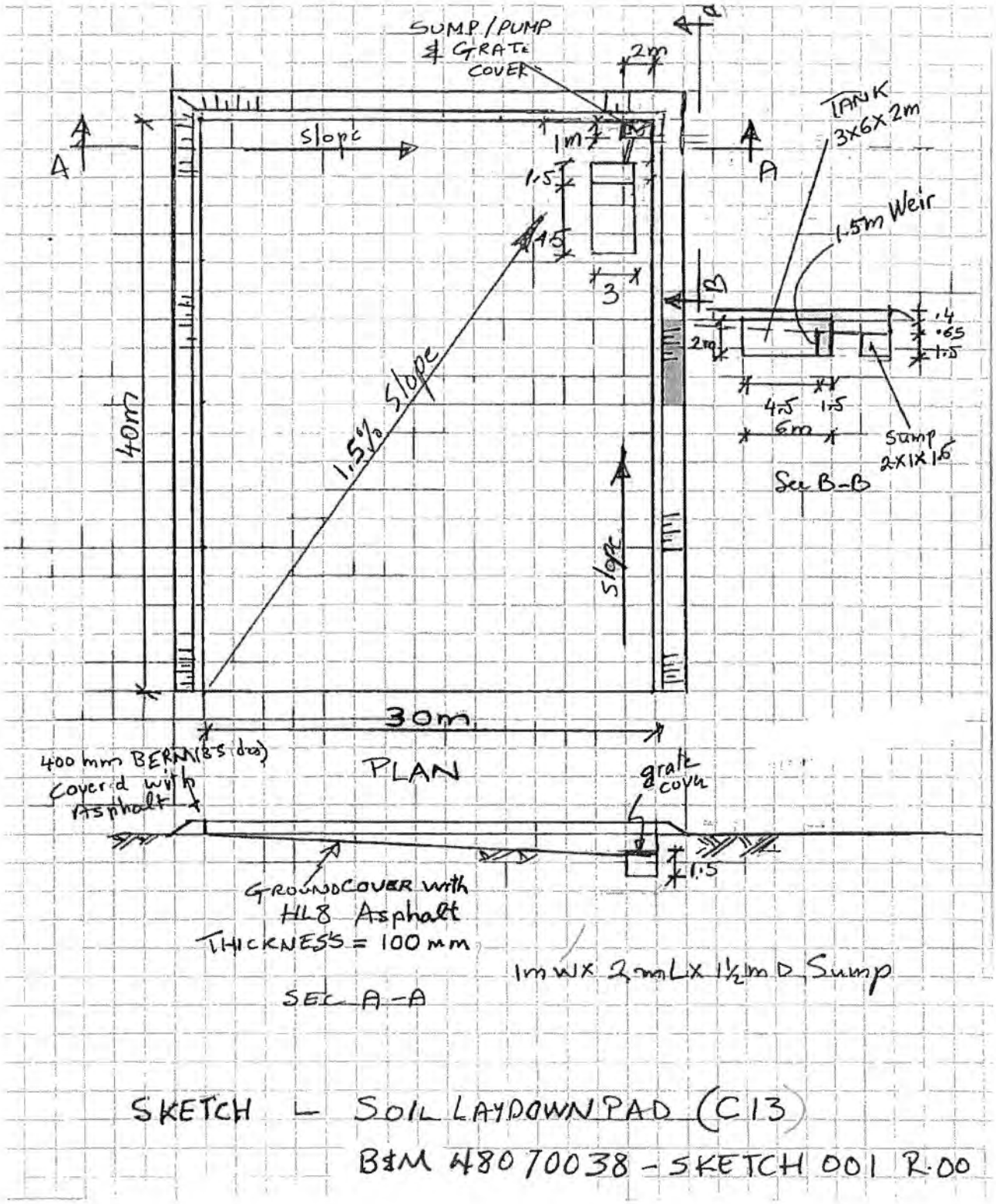
PGL prepared this memo for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report. The memo's purpose is to transmit and interpret monitoring data and so will need to be used in conjunction with previous reports by PGL or others. As is true for all environmental investigations, potential remains for the presence of unknown, unidentified, or unforeseen surface or subsurface contamination. More or different investigation may be required if other risks are identified. The data presented in this report is valid for the date of sampling, but site conditions may change with time.

The findings and conclusions are Site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this memo is for use now. The memo should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions and limitations on our liability are set forth in our work program/contract. No warranty, express or implied, is made.

Attachments: Correspondence
Tables
Soil Lab Results
TCLP Lab Results

APPENDIX "C"



SKETCH – SOIL LAYDOWN PAD (C13)

B&M 480700038 - SKETCH 001 R.00

Soil Management Plan
for
PROJECT
Heavy Water Management Building (HWMB)
D2O Storage Facility
Purchase Order No 00217807

Black & McDonald Limited
Power Generation Region
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Pickering, Ontario L1W 3N6
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DOCUMENT NUMBER 48070014-SMP
OPG Number NK38-PLAN-38000-10004

Rev.#	Date	Prepared by:	Reviewed by:
5	12-Sep-2013	Roger Luck Engineering & Procurement Date 20 Sep 13	Magdi Chidiac Project Engineer Date Sept 25, 13

Approved by:

Bruce Smith
Project Manager
Date 25-Sep-13

Acceptance by OPG

Name	Title	Date
ROGER DALY	MNGR. CHEM & ENV.	30SEP 13

Confidentiality

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REVISION LIST

REV #	DESCRIPTION OF CHANGE	REVISION PREPARED BY	AMENDMENT DATE
0	Original Issue	Roger Luck	3 Apr 2013
1	a. Revised Sec. 2.0 b. Revised Sec. 3.1 c. Revised Ref. 10.4 d. Appendix "B" final issue added e. Added Appendix "C"	Roger Luck	25 Apr 2013
2	a. Revised Sec. 1.2 b. Revised Sec. 1.3 c. Added Sec. 3.3; 5.0; 6.0; 7.0; 8.0; 9.0 d. Changed Sec. 5.0 to 10.0	Roger Luck	21 May 2013
3	a. Section 4.0 revised paragraph 2 b. Sec 4.0 added paragraph 3 & 4 c. Revised Appendix "C"	Roger Luck	11June2013
4	a. Added Section 1.4 b. Revised Section 3.3 c. Added Section 3.4; 5.4; 6.4; 7.3; 7.4; 8.3; 11.0 d. Revised Section 5.1; 5.3 e. Revised Section 6.2; 6.3 f. Revised section 8.1 g. Changed Section 9 to Sump and Tank water sampling h. Changed Section 10 to Backout Provisions i. Added Table A j. Added Table B k. Revised Appendix "C" l. Added Appendix "D" m. Added Appendix "E" n. Added Appendix "F" o. Added Appendix "G" p. Added Appendix "H" q. Added Appendix "I" r. Added Appendix "J"	Roger Luck	14 June 2013
5	a. Revised section 1.2 b. Removed section 1.4 c. Removed section 3.4 d. Revised sections 3.1;3.2;3.3 e. Revised section 4.2,4.3,4.4		20 Sep 2013

5	f. Revised sections 5.1;5.2;5.3 g. Removed sections 6.2; 6.3 h. Revised section 6.1 i. Moved section 6.3 to 4.2 j. Removed section 8 "Monitoring and active management of tritiated soil", Table A moved to section 6 k. Revised Table B l. Added Table C m. Added Backout Provision 8.5 n. Revised title Soil Management Plan for C13 Area o. Revised section 7.0		

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1.0 General

The scope of this plan is to provide a means for Black and McDonald to inform all interested parties of B&M's intended methods and means for handling the excavated soil for the new Heavy Water Management Building.

1.1 Purpose

The purpose/objective of the Soil Management Plan is to:

a. Ensure compliance with environmental legislation, regulations and conditions of approval.
b. Ensure proper records are maintained to meet regulatory environmental requirements.

1.2 Scope

Phase 1

The scope of this issue of the plan deals with the following excavated materials:

1. Daylighting using vacuum truck (Top 3 metres)
2. Daylighting using vacuum truck (3m to 5.5m depth)

This plan is to be used in conjunction with 48070014-CEMP "Contractor Environmental Management Plan" (Ref 9.5)

The scope of this Revision addresses Phase 2 of the HWMB construction schedule.

1.3 Phase 2

Phase 2 of this plan addresses the relocation of buried underground services, required to be relocated in order to build the new HWMB. These services include the following:

1. Relocation of the Argon and Oxygen tanks
2. TMOD for SG Cable Duct Bank relocation
3. Cut and cap for 6"air line, 12" steam line, 3" condensate line and 8" water line
4. PMOD for yard drainage
5. Relocation of underground inactive drainage line
6. Removal of underground miscellaneous fire protection line
7. Relocation of LPSW line

The details for these activities are covered in various work plans. Items 1 through 6 above reach no deeper than 3m in depth from grade.

2.0 Roles and Responsibilities:

1. Project Manager (PM) – responsible for the overall SMP, ensuring that it is prepared, approved and followed. (Bruce Smith 416-791-1898)
2. Work Coordinator (WC) – responsible for the implementation of the SMP on the project. (Kurt McDonald 416-677-7273)
3. Construction Superintendent (CS) – Responsible for all site construction activities. (Kurt McDonald 416-677-7273)
4. Environmental Consultant – responsible for soil / water sampling as required (Salima Jaffer – 905-668-4908 x 113)
5. All onsite personnel - All personnel are responsible for identifying and reporting any adverse conditions or issues that could affect soil management.

3.0 Daylighting and Excavation

3.1 Phase 1

Daylighting
In order to confirm that there are no underground services that enter the footprint of the new HWMB building a vacuum truck will be used to daylight the first three (3) metres depth of the foot print. This will be done in a trench like fashion. B&M and field engineering shall verify that there are no services and if declared clear the trench will be back filled with lean concrete (0.7Mpa). This is to ensure that the area is stable and avoid cave-ins during the main excavation with excavators.
The daylighting will continue around the perimeter of the building foot print, and when an underground service is encountered the area around the underground service will be further daylighted in order to allow a construction crew access to relocate the service. The area will be fenced off for safety.

3.2 B&M has contracted Kinectrics Inc / PGL to sample the first 3 metre depth at 5 borehole locations. The test results have indicated that the top 3 metres of soil is below the allowable limit of tritium, confirmed with a report. Appendix "B" provides the conclusion of the report only. The full report (172 pages) is available upon request. (Ref 9.9)
Based on the results of the tests the daylighted material will be transported by truck to a temporary laydown area (C13 on the campus plan).

3.3 Phase 2

1. Daylighting of scopes 1 through 6 will be done using a vacuum truck. None of the daylighting for these services will be below the 3 metre depth. All soil removed for

these activities will be taken to the temporary laydown pad inside the PA identified as C13. Once on the pad the soil will be dewatered, tested by Kinectrics Inc / PGL or OPG Chem Lab and if radiological testing identifies that the material is not tritiated it will be moved to a MOE licensed facility, or to outside the PA (F1 site).

2. Daylighting of scope 7 (LPSW) will be done using a vacuum truck. The top 3 metres will be treated the same as scopes 1 through 6. The top 3 metres of excavated soil from the LPSW can be reused as back fill of the LPSW trench provided the soil meets the conditions listed below. The daylighting of the LPSW system is expected to go to a depth of 5.5 metres. In order to daylight to that depth a dewatering system needs to be in place, see ref 9.7 for the dewatering system details. The soil from the 3 metre depth to the 5.5 metre depth will be removed by vacuum truck and taken to area C13 pad. This soil will be segregated on the pad from the balance of soil which is above the 3 metres depth. Once on the pad the soil will be dewatered, tested and if deemed clean it will be moved to an appropriate disposal location. Soil is considered dewatered at the discretion of the superintendent.

   Conditions for Excavated material at C13 lay down area to be reused as backfill:

- Meet Engineering conditions for backfill
- Meet the following parameters:
  - Gross Gamma is LESS THAN MDA.
  - IF gamma activity is GREATER THAN MDA,
    THEN Gamma Scan for Naturally Occurring Radioactive Material (NORM).
    Consultation with Responsible Health Physicist is required.
  - Tritium is LESS THAN 4000 Bq/L
  - IF Hydrocarbon contamination is evident and/or hydrocarbon spill occurred and/or suspected,
    THEN, test for MOE Table 3 parameters. (Soil that has exceeded MOE Table 3 parameters generally cannot be used for backfill).
  - C13 soil to be used for backfill is free of odours, visible staining or debris (i.e. garbage, shingles, painted wood, other waste, etc).
  - Note: Consult with Rad Protection (RP) for the number of samples required for radiological samples required.

3. The "TMOD for SG Cable Duct Bank Relocation" scope of work is running outside the footprint of the new HWMB so PGL was contracted to perform some additional soil sampling along the proposed cable route. Ref 9.10 Appendix "D" provides the results of this sampling and concludes that the soil is clean.

4.0 Laydown Area C13 Future site of Rad Waste Processing Building (RWPB)

4.1 The temporary laydown area inside the PA is identified as C13 on the Darlington Nuclear Campus Plan Proposed Refurbishment General Arrangement. (Appendix "A")

4.2 Area C13 is approximately 80m x 80m and will be divided into areas to hold soil from different areas without cross contamination. See appendix "B" for preliminary testing tritium results.
To contain the daylighted material of approximately 200cuM, an area pad 30mx40m shall be constructed of an impermeable membrane on the surface with a 400mm high berm on 3 sides (Appendix "C"). The area will slope towards a sump so that any water would naturally drain to the sump.

The volume of soil for each area will be tracked by monitoring the number of trucks for each area being excavated and/or calculation of area excavated. A truck tracking form may be used to document this information if the need arises. A copy of this form is included in Appendix "G". After a truck has dumped soil onto C13, the wheels will be washed off while it is still on the pad to ensure no soil from C13 is tracked elsewhere on site. Vacuum trucks have a pressurized hose system to facilitate this.

The C13 area will be graded with gravel and sloped towards the sump. This will be covered with a 16 oz non-woven geotextile, this will then be covered with 1 layer of Enviro Liner 3040 followed by another layer of 16 oz non-woven geotextile. To protect the liner, a 4-inch Geoweb (Geo Cell) will be in placed on top of the liner, filled with granular b and compacted. This Geoweb is rated for 40,000 lbs and will protect the liner from possible damage from equipment.

In order to anchor the Enviro Liner the liner has to overlap the berm and jersey barriers will be placed on the overlapped liner. In addition, some sand bags will be placed in the centre area.

Sediment run-off will be prevented by using a geotextile filter to prevent any sediment from flowing out of C-13.

4.3 This is a temporary storage location and once the daylighting is complete and material dried, this material will be transported by truck to a MOE approved landfill site.. Based on a Kinectrics Inc report this material has been deemed "clean" as outlined in Appendix "B".
A 68,000 litre storage tank will be in place so that the water collected in the sump can be pumped to the storage tank for sampling to determine its quality for disposal options. Disposal pathways will be implemented according to the Groundwater and Dewatering Plan, Ref 9.7. The tank will have an internal weir so the fines may settle out. Tank and sump should be checked daily to ensure proper operation according to the CEMP checklist, Ref 9.5.

4.4 Soil sent to the C13 area from the footprint needs to be separated based on depth. (i.e. Pile 1) 0-3m bgs and Pile 2) 3m bgs and deeper).

5.0 Soil Sampling Protocol

5.1 Ontario Regulation 153/04 characterizes imported fill at a site for purposes of filing an RSC. It is also used as an industry standard for providing an acceptable level of characterizing soil. The Regulation specifies sampling requirements if soil is to be re-used as clean fill onsite or offsite. If offsite, one sample is required for every 160cuM for the first 5,000cuM and one

sample per 300cuM after that. The Regulation also identifies the number of samples required to re-use soil onsite. This consists of field screening 50 soil samples and analyzing 10 samples for every 1,000cuM. Based on the nature of the work and the potential contaminants we recommend that 10 soil samples be analyzed for every 1,000cuM.

5.2 The estimated quantity of soil that will be moved to temporary laydown pad C13 is 700cuM. Soil samples (following RP requirements in Appendix I) will be taken from various areas of the pile and sent to the Chem lab or Kinectrics Inc for testing of contaminants of concern (radiological and conventional parameters as shown in Table A). Kinectrics Inc/PGL will track the soil samples and issue a report summarizing their findings. Soil samples collected for soil intended to be shipped offsite to a MOE approved landfill must be submitted to and external lab for testing.

Table A: Soil Parameter Summary

Parameter Type	Analytical Testing
Radiological Parameters	H3 = Tritium GG = Gross Gamma GS = Gamma Spectroscopy
Conventional Parameters	PHC = Petroleum Hydrocarbons F1 to F4 M&I= Metals and inorganics VOC =volatile organic compounds (including benzene, toluene, ethyl benzene and xylenes)
TCLP	TCLP = metals and inorganics, VOC, sVOC, bulk and leachate PCBs, soil pH and ignitibility

5.3 To be taken to a landfill disposal site, the soil must fall within the following specified limits:

- Gross Beta/Gamma and Gamma scan must show GG<MDA/NORM
- Tritium (H_3) levels must be less than 0.02 µCi/kg
- The TCLP test should identify the soil as non-hazardous

Soil samples will be collected by PGL and soil will be analyzed by the OPG Chem Lab or Kinectrics Inc.

If soil has GG>MDA, RP/Health Physics will be consulted regarding next steps.

If soil passes Gross Beta/Gamma scans but contains unacceptable levels of Tritium, the soil will remain on C13 until the F1 site is ready. The soil will be processed with the rest of the soil at F1.

If soil passes radiological analysis but is identified as hazardous (i.e. fails TCLP tests), it will be disposed of at a hazardous landfill.

5.4 Radiological and TCLP parameters will be tested and results evaluated prior to determining offsite shipment from Area C13 to a MOE approved land fill facility. Additional testing for conventional parameters will be required for material to be reused at Darlington, outlined in Table A above.
Once soil is tested, newly excavated material should not be mixed with tested material. If newly excavated material is mixed in, the soil pile would require retesting.

6.0 Approved Designated Laydown Area

6.1 The temporary approved designated laydown area is C13 inside the PA. This location has to be vacated by October 2013. The plan for soil segregation is as follows for Phase 1 and 2 work:

1. Soil from grade to 3 metre depth.
2. Soil below 3 metre depth for the LPSW system.

The soil will be left on the pad until it is dewatered. Soil is considered dewatered at the discretion of the construction supervisor.

7.0 Sump and Tank Water Sampling

7.1 The C13 soil storage pad will have a sump to collect water from the soil and a limited amount of rainwater. The water will be held in aboveground tanks. The Tank and Sump will be inspected daily and an inspection checklist will be completed. The checklist will include the following items: date/time, personnel name, observed leaks/accumulated debris, condition of tank and sump, volume in tank. (See ref 9.5 for check list)

7.2 The tank will be sampled when it is 50% full. The sampling parameters are provided in the Table B and Table C below. The samples will be submitted to the OPG Chem lab for analysis.

Table B. Dewatering collection tank parameter part (1 of 2)

Parameter	OPG Limits
Gross Gamma	GG < MDA/NORM
Total Suspected Solids*	≤70mg/L
Visible Oil*	No visible sheen
Total Organic Carbon	≤15mg/L
Oil in water	≤15mg/L
pH	6.0-9.5

* Effluent shall be essentially free of floating and settleable solids and cannot contain oil or any other substance in amounts of sufficient to create a visible film sheen foam or discolouration to receiving waters

Table C. Dewatering collection tank parameter part (2 of 2)

Tritium Level	Action
< 0.108 uC/kg (or 4000 Bq/L)	Pump out water via Yard Drainage
>0.108 µCi/kg	See Section 7.4, Section 7.5

7.3 IF the sample results are below the limits in Table B AND Table C THEN the water can be disposed to yard drainage.

7.4 IF the sample results are below the limits in Table B, BUT exceed the limit in Table C for yard drainage pump-out , AND it is not feasible to dilute the water with dewatering waste water, THEN complete the following:

Pre-requisite conditions:

a) Ensure dedicated Vac truck is used for all transfers. If a new vac truck is required, then sample must be submitted for Table B parameters again (i.e. start from step 7.4.2).

b) The Aquatech holding tank cannot be filled with water during this period. If it is refilled then the water will need to be tested for Table B and Table C parameters

c) The vac truck cannot be used for other work until this tote transfer of approx. 80,000L is complete. IF the vac truck is used for other work in between, then, start at step 7.4.2.

7.4.1 B&M: Use dedicated Clean Vac truck for all Aquatech holding tank water transfers.

7.4.2 B&M: Vac water out of holding tank (about 10 minutes).

7.4.3 PGL: Sample water in vac truck for Table B parameters and Table C (tritium).

7.4.4 PGL: Obtain results from OPG Chem lab, keep results as part of OWRA Minor Mod notification.

7.4.5 IF the test results meet Table B discharge limits, THEN Go to step 7.4.6.
IF the test results do not meet Table B discharge limits, THEN Go to step 7.5.

7.4.6 B&M: Discharge water from the vac truck to the forebay at the same location as the Box Drain Pump out in a controlled manner (1hour discharge).

7.4.7 PGL: Complete Vac truck tracking form (Appendix J)

7.4.8 B&M: B&M supervisor to sign off on form (Appendix J).

7.4.9 Vac water out of holding tank (about 10 minutes).

7.4.10 Repeat steps 7.4.6 to 7.4.10 until holding tank is empty and as long as the prerequisite conditions are met.

7.5 IF the sample results exceed the limits in Table B and/or Table C, consult with NR-Environment. Disposal via Detox to Clean Harbours may be required.

8.0 Backout Provisions

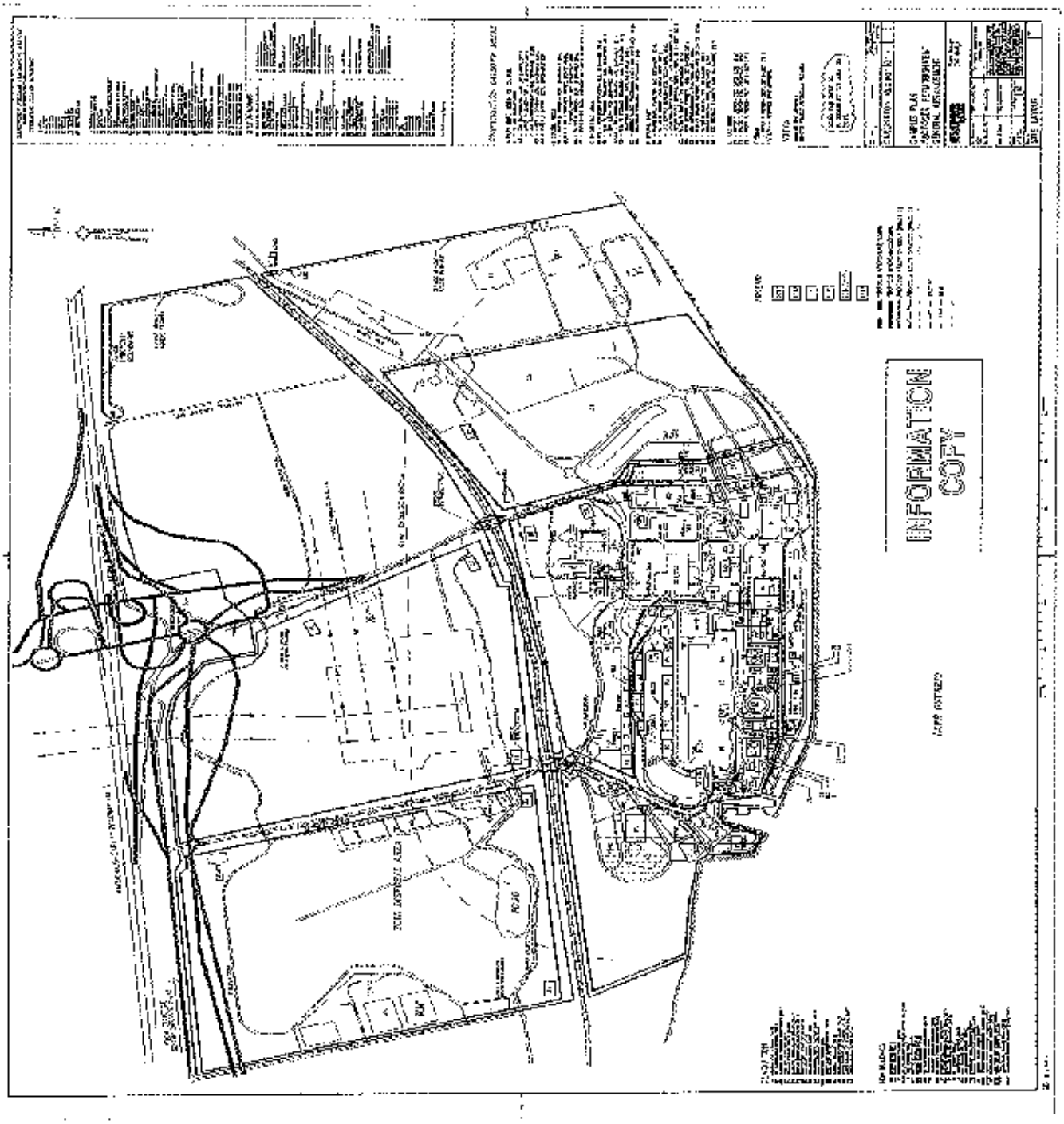
In the event that backout condition occurs, excavation equipment should be left in a safe state.

1. Backout in the case of fire or personal injury. In addition to backout procedures, workers will immediately notify the CMO who will immediately notify the shift manager. If the CMO is not immediately available, contact the Shift Manager directly (x4500).
2. Backout in the case of an electrical storm or unsafe weather conditions such as high winds, rain or snow.
3. Backout if petroleum products, oils or contaminated soil is discovered. See N-PROC-OP-0044 (Contaminated Lands and Groundwater Management)
4. In the event of a station alarm: Stop work, listen and follow instructions given on the public address system. Ensure that the work area does not pose a safety hazard, cover any open areas. All workers shall proceed to the designated assembly area identified in the daily pre-job briefing.
5. Backout in the case of a spill event. Follow spill plan actions outlined in Ref 9.6.

9.0 References

9.1	N-GUID-09701-10013	Environmental Requirements Guideline
9.2	D-INS-79000-10002	Waste Disposal Guidelines for Solid Waste and Recycling at Darlington
9.3	D-INS-07290-10000	Darlington Spill Prevention and Contingency Plan
9.4	B&M 48070038-Sketch 001	Soil Laydown Pad (C13) (Appendix "C")
9.5	B&M 48070014-CEMP	Contractor Environmental Management Plan
9.6	B&M 48070014-SPCP	Spill Prevention and Contingency Plan
9.7	B&M 48070014-GDP	Groundwater and Dewatering Plan
9.8	B&M 48070014-WMP	Waste Management Plan
9.9	Kinectrics K-415072-003 -TM-0001-R00	Shallow Soil Sampling (Appendix "B")
9.10	Memo PGL File 3821-01.02	Cable Trench Sampling (SGTMOD)(Appendix "D")
9.11	Kinectrics K-415072-002 -RA-0001-R00	Borehole Drilling investigation (Appendix "E")
9.12	J.D. Barnes 11-25-432-07-A	Decommissioned Well Diagram (Appendix "F")
9.13	B&M	Truck Tracking Form (Appendix "G")
9.14	Darlington Environmental Review Tool	DERT Guidelines (Appendix "H")

APPEND



APPENDIX "B"

Heavy Water Storage Building Project: Shallow Soil Sampling during Daylighting Activities -- Preliminary Results Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-003-TM-0001-R00
April 24, 2013

Kinectrics Inc
Analytical and Waste Services

Kinectrics Inc., 800 Kipling Avenue, Unit 2
Toronto, Ontario, Canada M8Z 5G5

Heavy Water Storage Building Project: Shallow Soil Sampling during Daylighting Activities – Preliminary Results Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report:

K-415072-003-TM-0001-R00
April 24, 2013

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Dated: April 24, 2013

DISCLAIMER

This report was prepared for Black and McDonald under the Kinectrics Inc ISO 9001 Quality Program Registered with QMI. Kinectrics Inc. takes reasonable steps to ensure that all work performed shall meet the industry standards, and that all reports shall be reasonably free of errors, inaccuracies or omissions. This report was prepared in accordance with Purchase Order Number 4800512108R002.

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REVISIONS

Revision Number	Date	Comments	Approved
DRAFT	March 28, 2013	DRAFT RELEASE	OH
R00	April 24, 2013	FINAL RELEASE	OH

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Memo

PGL File #: 3821-01.02

DATE: April 23, 2013

TO: Ruth Burany, Kinectrics Inc.

FROM: Salma Jaffer, PGL
John DeWilde, PGL

**Re: Heavy Water Storage Building Project:
Shallow Soil Sampling during Daylighting Activites
Ontario Power Generation – Darlington Nuclear (OPG-DN)**

Pottinger Gaherty Environmental Consultants Ltd. (PGL) has conducted shallow-soil sampling during daylighting activities to provide disposal options as a part of the Heavy Water Storage Building (HWSB) construction project at OPG DN. A summary of our work, results and conclusions is provided herein.

Background

A historic spill in December 2009 from Injection Water Storage Tanks (IWST) occurred in the area of the proposed HWSB excavation. The IWST water was primarily demineralized water containing 44,807,000Bq/L of tritium and 58.8mg/kg of hydrazine.

Twenty-nine boreholes and 28 wells have been installed since, in the area to investigate impacts from the spill event. The investigation identified tritium impacts to both soil and groundwater in the area of the HWSB and beyond. The investigation also identified petroleum hydrocarbons (PHC) and limited volatile organic compounds (VOC) impacts. The soil and groundwater quality were evaluated against Ontario Regulation 153/04 Table 3 Industrial/commercial/community standards for coarse-textured soil in a non-potable groundwater condition.

PGL was contracted to evaluate the asphalt, soil, bedrock and groundwater as part of the excavation and disposal work required for the construction project. Our sampling program for these materials was outlined in our *Sampling and Analysis Plan (SAP), Heavy Water Storage Building, Ontario Power Generation, Darlington Nuclear Generating Station, Bowmanville ON*, dated January 23, 2013 previously submitted under separate cover.

Sampling Rationale

PGL recommended completing an *in situ* sampling and scan survey to collect data that will allow for offsite disposal of soils. It is intended that after the collection of this data, soils can be cleared directly for disposal onsite or offsite either under a Conditional Transfer Permit (CTP) or Unconditional Transfer Permit (UTP).

As identified in our Sampling and Analysis Plan, five boreholes in the area of the proposed building footprint were to be completed to augment existing soil and groundwater data collected this past year (2012) at the Site. The first 3m (10') of each borehole location was daylighted using a vacuum truck operated by Badger Daylighting Inc. This preliminary technical memo details the results of the sampling during daylighting activities. The rest of the soil and bedrock sampling associated with drilling activities will be reported under separate cover.

To assess disposal options, PGL compared the conventional analysis data with the Ministry of Environment's (MOE) standards found in *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, April 15, 2011. We compared data to both Table 1 Full Depth Background Site Condition Standards and Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition. For Table 3 we used coarse-grained soil standards for an industrial/commercial/community use.

Work Program: Shallow Soil Sampling

As a part of this work, PGL conducted the following tasks:

- Prepared a Sampling and Analysis Plan as required by Ontario Regulation 153/04;
- Prepared both a health and safety plan and Job Safety Analysis form;
- Attended a Project Readiness meeting February 15, 2013;
- Collected shallow-soil samples during daylighting work at the five proposed borehole locations (BH281 to BH285)
- Sampled soil at 0.5m intervals using a hand auger;
- Logged and screened samples using a Model 3 Ludlum Analog Ratemeter with Model 44-9 pancake detector and screened for organic vapours with the use of an RKI Eagle 2 equipped with both photolonization device sensor and LEL/PPM catalytic sensor;
- Collected soil samples in laboratory supplies bottles, labelled the bottles and kept samples refrigerated or on ice until submission to the laboratory;
- Submitted soil samples based on elevated Ludlum Ratemeter results, elevated photoionization device results and to provide vertical coverage, to be representative for the full length of the borehole at each location;
- Collected composite soil samples and submitted them to OPG chem lab for tritium and gross gamma screening. These results were provided to OPG Health Physics to assess the type of release permit for the samples prior to shipment to Kinectrics Inc. (Kinectrics) for analysis;
- Submitted six samples for radiological parameters and conventional parameters and two samples for TCLP analyses; and
- Evaluated the data and prepared this memo.

Findings

This technical memo presents the available results of the shallow soil sampling conducted. The results are included in Table 1 to 4 and laboratory certificates are attached.

The gross gamma and tritium results from the OPG chem lab for the composite soil samples required for shipping are presented in Table A below. PGL obtained confirmation from OPG on March 25, 2013 that composite soil samples for pre-laboratory shipment was not required if Kinectrics was performing gamma scans and tritium analysis of samples (see included correspondence). A standing conditional transfer permit (SCTP 29) was provided for use for the rest of the project work. The conditions of SCTP apply to soil only and no OPG Chem lab analysis of soil samples is required.

Table A: Gross Gamma and Tritium Composite Soil Results

OPG Chem Sample ID	Sample Date	Gross Gamma (µCi/L)	Tritium (µCi/kg)	S. Taras Review/Response
2013-02-G766	Feb 20, 2013	0.00428	0.144	H3 > UTP limit CTP required
2013-02-H111	Feb 21, 2013	0.0051	1.97	Activity and H3 > MDL CTP required
2013-02-H493	Feb 22, 2013	0.00474	<0.003	activity > MDL CTP required
2013-02-H494	Feb 22, 2013	0.00283	<0.003	activity > MDL CTP required
2013-02-I427	Feb 25, 2013	0.00633	0.365	Review not required

Radiological Parameter Results

Most of the radionuclide results were less than the laboratory detection limits with the exception of Potassium-40 (K-40), Thorium-series (Th-series), uranium-series (U-series), and tritium (H3). Tritium results in the shallow soil samples ranged from 18.2 to 291Bq/kg. All tritium results were less than 0.02µCi/kg (740 Bq/kg). Refer to Table 1.

PGL also compared the tritium data collected with that obtained in previous investigations. All tritium results from CH2M Hill's investigations of the top 3m of soil from the area are also below 0.02uCi/kg.

The tritium results from the OPG Chem Lab (Table A) vary from the data provided by Kinectrics. PGL understands, based on a conversation with Chris Wood (OPG), that this is typical and that the Kinectrics data is considered to supersede the OPG Chem Lab data.

Conventional Parameter Results

BTEX and PHC F1-F4 Results

All the sample results were below the laboratory method detection limits for the samples submitted.

Refer to Table 2.

VOC Results

All the sample results were below the laboratory method detection limits for the samples submitted.

Refer to Table 3.

Metals Results

All the sample results were below MOE Table 1 and 3 standards except for one sample. Sample BH280-2 from 0.8m to 1m below ground surface (bgs) exceeded the MOE Table 1 standard for electrical conductivity. Electrical conductivity is a measure of soil salinity and excess salts have an adverse affect on plants. This standard is intended to be protective of agricultural habitat which is not the case here. PGL would argue that since only one in

six samples exceeded electrical conductivity that this is not considered an issue for soil disposal. PGL does not believe that this result will affect offsite soil disposal options as landfills do not request this analysis for soil disposal. Refer to Table 4.

Results for sodium absorption ratio are outstanding and will be provided as a part of the investigation report when data is available.

Hydrazine was not detected in soil with the exception of a field blank. This result was only slightly over the detection limit and is likely an instrument issue.

TCLP

The Ontario Regulation 347/558 leachate extraction data is attached. The soil was evaluated against Schedule 4 and is not leachate toxic. These soils are classified as non-hazardous and maybe disposed of at an MOE approved landfill.

QA/QC

For ease of use, a detailed discussion on quality assurance and quality control is not included in this technical memo. Instead it will be included in the larger investigation report for the full borehole drilling program. In general however, the data meets quality assurance/quality objectives and is suitable for use in assessing disposal options.

Recommendation

PGL recommends that this memo and results be submitted to OPG Health Physics to assess the type of release permit for the material.

Standard Limitations

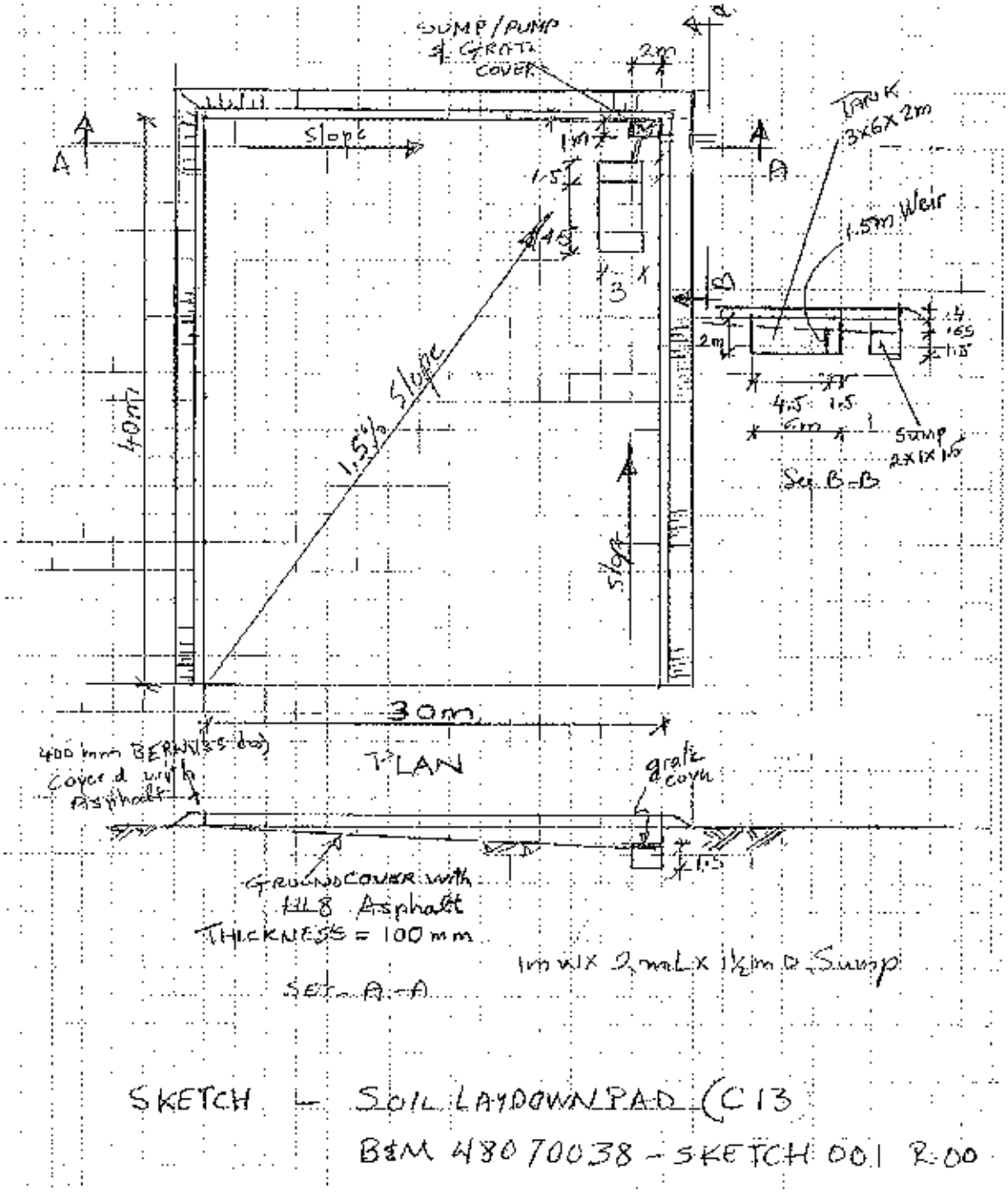
PGL prepared this memo for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report. The memo's purpose is to transmit and interpret monitoring data and so will need to be used in conjunction with previous reports by PGL or others. As is true for all environmental investigations, potential remains for the presence of unknown, unidentified, or unforeseen surface or subsurface contamination. More or different investigation may be required if other risks are identified. The data presented in this report is valid for the date of sampling, but site conditions may change with time.

The findings and conclusions are Site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this memo is for use now. The memo should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions and limitations on our liability are set forth in our work program/contract. No warranty, express or implied, is made.

Attachments: Correspondence
Tables
Soil Lab Results
TCLP Lab Results

APPENDIX "C"



SKETCH – SOIL LAYDOWN PAD (C13

B&M 480700038 - SKETCH 001 R:00

PPENDIX "D"

PGL
Pottinger Gaherty
Environmental Consultants Ltd
250 Water Street, Unit 102
Whitby, ON Canada L1N 0G5
T 905.668 4908
F 905.668 4909
www.pgl.ca

Memo

PGL File #: 3021-01.02 Cable Trench

DATE: May 24, 2013

TO: Ruth Burany, Kinectrics Inc.

FROM: Sallina Jaffer, PGL
Will Gaherty, PGL

**Re: Heavy Water Management Building Project:
Cable Trench Sampling (SG TMOD)
Ontario Power Generation – Darlington Nuclear (OPG-DN)**

Pottinger Gaherty Environmental Consultants Ltd. (PGL) sampled shallow soil in advance of daylighting activities to support relocation of utility service cables as a part of the Heavy Water Management Building (HWMB) construction project at OPG DN. This summarizes our work, results and conclusions.

Background

A historical spill in December 2009 from Injection Water Storage Tanks (IWST) occurred in the area of the proposed HWMB excavation. The IWST water was primarily demineralized water containing 44,807,000Bq/l. of tritium and 58.8mg/kg of hydrazine.

Twenty-nine boreholes and 28 wells have been installed in the area to investigate impacts from the spill. The investigation identified tritium impacts to both soil and groundwater in the area of the HWSB and beyond. The investigation also identified petroleum hydrocarbons (PHC) and limited volatile organic compounds (VOC) impacts. The soil and groundwater quality were evaluated against Ontario Regulation 153/04 Table 3 Industrial/commercial/community standards for coarse-textured soil in a non-potable groundwater condition.

PGL was contracted to evaluate the asphalt, soil, bedrock and groundwater as part of the excavation and disposal work required for the construction project. Our sampling program for these materials was outlined in our January 23, 2013 *Sampling and Analysis Plan (SAP), Heavy Water Storage Building, Ontario Power Generation, Darlington Nuclear Generating Station, Bowmanville ON.*

As an added scope item, PGL was requested to collect additional soil samples to characterize shallow soils that are to be removed during daylighting activities for a utility service cable trench. This additional work was requested by Black & McDonald (B&M). The trench is estimated to be 200m long by 450mm deep by 900mm wide. The volume of material to be excavated for the trench is 85m^3. The material will eventually be disposed of offsite but will be temporarily stored within the Protected Area (PA) on an asphalt pad in a designated area called C13.

Material Categorization

To assess disposal options, PGL compared the conventional analysis data with the Ministry of Environment's (MOE) standards *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act*, April 15, 2011. We compared data to both Table 1 Full Depth Background Site Condition Standards and Table 3 Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition. For Table 3 we used coarse-grained soil standards for an industrial/commercial/community use.

Work Program: Cable Trench Sampling

PGL recommended composite sampling, as detailed in a February 4, 2013 email, and revised March 15, 2013 (Attachment – Correspondence). As a part of this work, PGL conducted the following tasks:

- Attended a pre-job brief on April 24, 2013, however, work authorization and the completed dig card were delayed;
- Collected two composite soil samples (comp1-0.2 and comp2-0.45) from three separate holes in the proposed trench location on April 25, 2013 from two depth intervals; 0.2m to 0.4m and 0.45m to 0.6m below ground surface at each of the three locations;
- Soil was collected in laboratory-supplied bottles and were labelled;
- Cleared samples offsite by RP under a standing Conditional Transfer Permit;
- Transferred samples in a cooler packed with ice under chain of custody to Kinectrics Inc.;
- Requested radiological and conventional parameters analysis on two samples (comp1-0.2 and comp2-0.45) and one duplicate; and
- Evaluated the data and prepared this memo.

Findings

Conventional parameters met applicable standards except chromium and nickel while several radiological standards exceeded detection limits. The results are included in Table 1 to 4 and laboratory certificates are attached. The soil in the three holes was similar and comprised of sand and gravel fill with occasional cobbles.

Radiological Parameter Results

Most of the radionuclide results were less than the laboratory detection limits except
- Potassium-40 (K-40);
- Thorium-series (Th-series);
- Uranium-series (U-series); and
- Tritium (H3).

Tritium results in the composite soil samples ranged from 11.4 to 15.4Bq/kg. All tritium results were less than 0.02µCi/kg (740 Bq/kg) (Table 1). PGL compared the tritium data collected with previous investigations. All tritium results from CH2M Hill's investigations of the top 3m of soil from the area of the proposed HWMB are also below 0.02uCi/kg.

Conventional Parameter Results

BTEX and PHC F1-F4 Results

All the sample results were below the laboratory method detection limits for the samples submitted (Table 2).

VOC Results

All the sample results were below the laboratory method detection limits for the samples submitted (Table 3).

Metals Results

All the sample results were below MOE Table 1 and 3 standards except for two analytical parameters; chromium and nickel (Table 4). Comp1-0.2 and its duplicate sample exceeded the MOE Table 1 standard for chromium and the duplicate also exceeded the MOE Table 3 standard. The duplicate sample also exceeded the MOE Table 1 standard for nickel.

TCLP

The Ontario Regulation 347/588 leachate extraction data was completed due to the chromium exceedence and is attached. The soil was evaluated against Schedule 4 and is not leachate toxic. These soils are classified as non-hazardous and maybe disposed of at an MOE approved landfill.

QA/QC

For ease of use, a detailed discussion on quality assurance and quality control is not included in this technical memo. A duplicate sample was collected for soil sample comp1-0.2, however, since the sampling methodology was composite sampling, the samples are a mixture of soil collected from there different spots from the same depth interval and are non-homogenous. The relative percent difference for the duplicate sample does not meet the generally acceptable range for soil samples. However, the data meets quality assurance/quality objectives and is suitable for use in assessing disposal options. Discussion with the laboratory indicated that the variation in chromium results are due to non-homogeneous samples, a common issue with solids.

Conclusion/Recommendation

PGL understand that the soil will be temporarily stored at C13 within the PA. The material will eventually be removed from the PA to a new holding area outside the PA on the east side of the OPG-DN property. This area is called F1. The soils from F1 will be re-sampled and disposal options will be re-evaluated at that time.

PGL recommends that this memo and results be submitted to OPG Health Physics for evaluation of results. Additional samples may be necessary to assess the type of release permit for the material prior to removal from the PA.

Standard Limitations

PGL prepared this memo for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report. The memo's purpose is to transmit and interpret monitoring data and so will need to be used in conjunction with previous reports by PGL or others. As is true for all environmental investigations, potential remains for the presence of unknown, unidentified, or unforeseen surface or subsurface contamination. More or different investigation may be required if other risks are identified. The data presented in this report is valid for the date of sampling, but site conditions may change with time.

The findings and conclusions are Site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this memo is for use now. The memo should not be used after that without PGL review/approval.

R. Durany *May 24, 2013*
PGL File: 3821-01.02

The project has been conducted according to our instructions and work program. Additional conditions and limitations on our liability are set forth in our work program/contract. No warranty, express or implied, is made.

Attachments: Correspondence
Tables
Field Sketch
Soil Lab Results
TCLP Lab Results

APPENDIX "E"

Heavy Water Storage Building Project: Borehole Drilling Investigation Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-002-RA-0001-R00
June 4, 2013

Prepared by: Pottinger Gaherty Environmental Consultants Ltd
Unit 102-250 Water Street
Whitby, ON, L1N 0G5

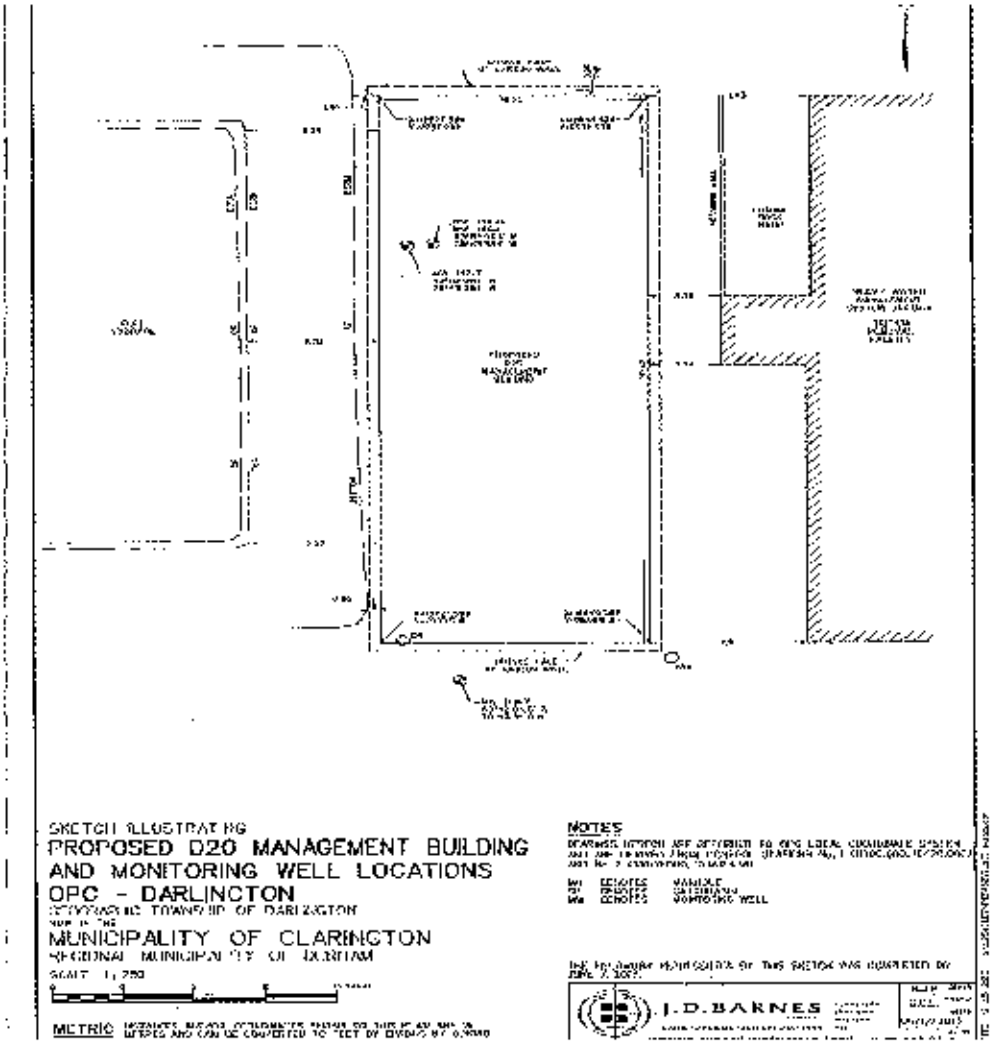
Reviewed by: _____
Ruth Burany, PhD, P.Ag.
Engineer
Analytical and Waste Services
Kinectrics Inc.

Approved by: _____
Otto Herrmann, PhD
Department Manager
Analytical and Waste Services
Kinectrics Inc.

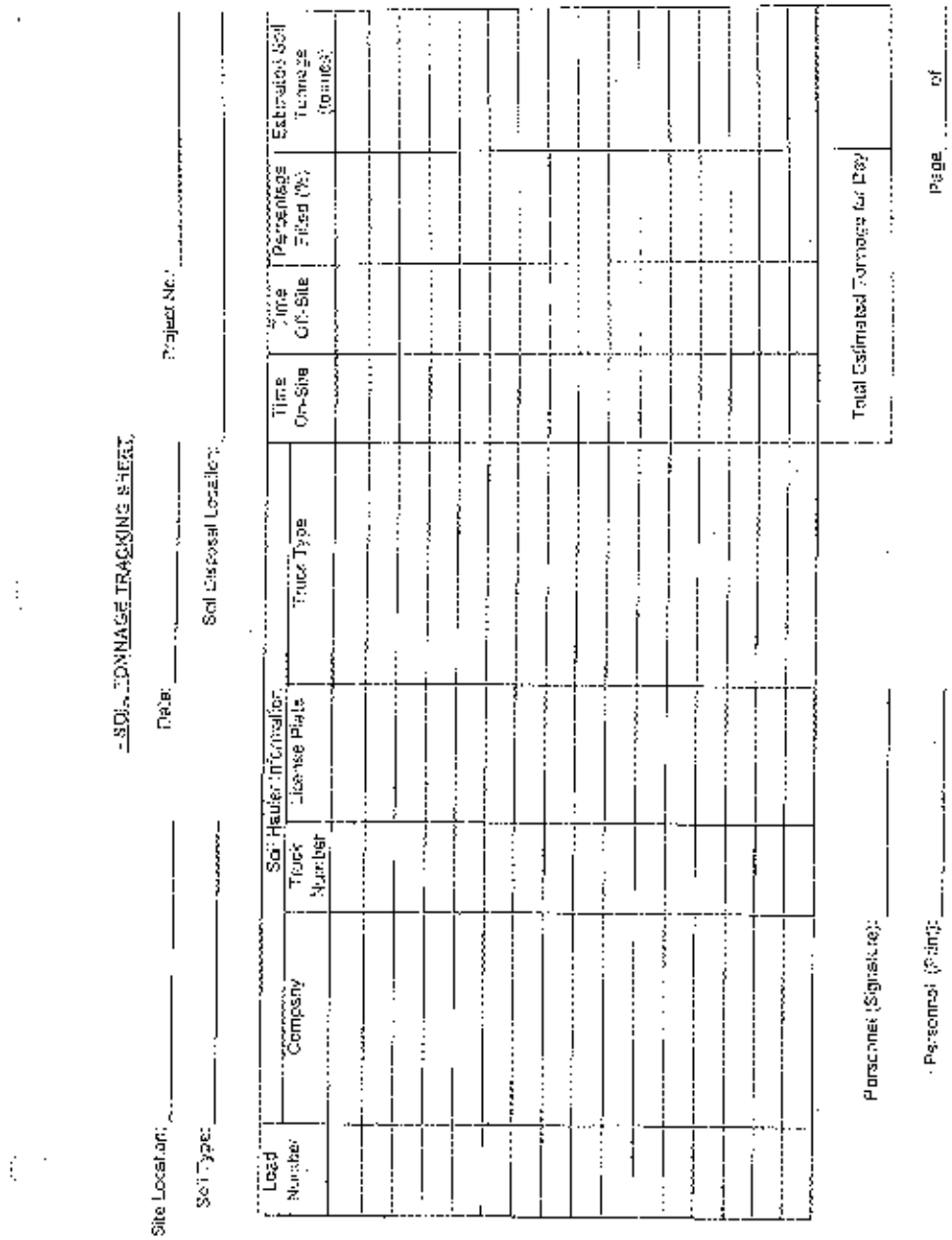
Dated: June 4, 2013

Report is included in Rev 4. The scope of this plan has been changed, so this cover page is being kept for reference purposes only.

APPENDIX "F"


SKETCH ILLUSTRATING
PROPOSED D20 MANAGEMENT BUILDING
AND MONITORING WELL LOCATIONS
OPC - DARLINGTON
MUNICIPALITY OF CLARINGTON
NOTES
J.D.BARNES

APPENDIX "G"



SOIL TONNAGE TRACKING SHEET

Site Location: _____ Date: _____ Project No.: _____

Soil Type: _____ Soil Disposal Location: _____

Load Number	Soil Hauler Information: Company	Truck Number	License Plate	Truck Type	Time On-Site	Time Off-Site	Percentage Filled (%)	Estimated Soil Tonnage (tonnes)

Total Estimated Tonnage for Day: _____

Personnel (Signature): _____

Personnel (Print): _____

Page ____ of ____

Appendix "H"

ONTARIO POWER GENERATION

Darlington Environmental Review Tool (DERT)

Waste	Conventional	Will quantities of conventional waste be potentially large enough to exercise further review?	Yes	See Waste Management Plan BSM 46070014-WMP
		Will asphalt, soil, or concrete waste be generated?	Yes	
		Will wastewater be generated? (i.e., washing equipment, septic work, etc.)	Yes	See Groundwater and Dewatering Plan BSM 46070014-GDP
	Radiological	Will liquid or solid radiological waste be generated?	No	
		Will work be taking place in Zone 3?	Yes	New HWMB
	Chemical (Asbestos)	Will hazardous/chemical waste be generated?	No	
		Will Banned substances (PCBs, CFCs) be generated?	No	
Air	Conventional	Will asbestos, paints, or degreasing chemicals be used?	Yes (paint)	See Waste Management Plan BSM 46070014-WMP
		Are there airborne contaminants possible? (e.g.: dust, steam, engine emissions, etc.)	Yes	
		Is there a possibility for the release (spill) of air contaminants?	Yes	
	Radiological	Is there a risk of tritium or contaminants being released to atmosphere?	Yes	
Water	Conventional	Does the work take place in or around the water, shoreline, storm water ponds	No	
		Does the work have potential for dewatering, foam, sheen, chemicals, or odours to reach receiving waters or groundwater?	Yes	See Groundwater and Dewatering Plan BSM 46070014-GDP
		Will the work involve drilling of wells around water (i.e., invasive dredging, tiling, or erosion?	No	
	Radiological	Is there a risk of tritium or contaminants being released to groundwater, yard drainage, or lake?	Yes	See Groundwater and Dewatering Plan BSM 46070014-GDP
Spills	Conventional	Is there a risk of spills? Contained indoors? Outdoors?	Outdoors	See Spill Prevention and Contingency Plan BSM 46070014-SPCP
		Will on-site fueling or the use of heavy equipment be required?	Yes	
		Is the spill risk addressed in the Darlington Spill Risk Assessment?	Yes	
Contaminated Lands & Groundwater	Could project activities result in disturbance or release of contamination present in soil?		Yes	See Soil Management Plan 46070014-SMP
	Could the project activities result in a spill to soil and/or groundwater?		Yes	See Spill Prevention and Contingency Plan BSM 46070014-SPCP
	Does the project take place near, under, or above any equipment (i.e., tanks, trees), whether drained or not, that could contain contaminants?		Yes	
Biodiversity	Will the planned activities impact site flora or fauna?		Yes, FI	
	Will the project require land development? (e.g., does it result in destruction of or changes to habitat)		Yes	
General	Approvals (e.g.: EA, Species at Risk permits, etc.)	Will the planned activities have an impact on current regulatory approvals?	No	
		Will modifications be made to equipment, systems, or practices that could change current approvals?	No	
		Are environmental approvals required for the planned activities (Conservation Authority, Provincial, Federal)?	CLOCA FI, DNE FTTA	
	Reporting	Do the planned activities include substances or events that require reporting?	No	
	Environmental Management System (EMS)	Do EMS aspects require updating?	No	
	Community Impact	Is there potential for noise, traffic, dust, light, noise, odour, or other pollutants to migrate offsite?	No	
		Is there any risk to historical or archaeological significant sites?	No	

Appendix "I"

ONTARIO POWER GENERATION

Darlington Nuclear P.O. Box 4000 Bowmanville, Ontario L1C 3Z8

MEMORANDUM

April 23, 2013

File: NK38-03426 P

Special Instructions to Complete N-FORM-11113

Material: **Excavation materials (gravel, asphalt, soil, concrete, etc)**

Conditions: Excavation materials from the Unzoned area only.
Material will be disposed of off-site.

1. Prior to excavation, perform direct contamination check of area using Hilly floor monitor and GR series meter. The UTP process may continue if unable to perform initial surveys due to weather conditions, surface configuration or if excavation has been initiated.

2. After excavation, obtain representative samples (1000 ml nalgene bottle, 12 samples per pile, labeled to identify pile, location and sample number) of excavation material. Sample collection may require breaking/crushing materials in order to fill sample bottles.

3. Submit to Darlington Chemistry lab for gamma scan and tritium analysis using the Request for Chemical Analysis form. On the form, request the Chemistry lab to perform a 3000 second gamma scan on samples using the NORM library.

4. Submit Chemistry lab analysis reports to Health Physicist for review and interpretation.

5. Monitor large pieces of material (i.e. concrete, asphalt, etc.) with a contamination meter (25% of surfaces) and GR series meter (100% of surfaces) as material is being loaded into disposal bin.

6. Perform verification surveys on the disposal bins containing excavation materials using a GR series meter.

S. Taras

Steve Taras
Health Physicist
Darlington Nuclear

Appendix J

PGL Vac Truck Tracking Form

PGL

Project Information

Project Number: 2021-01.03 C13 Tote discharge

Site Address: OPG-DX Bowmanville, ON

Notes:
1. Sample first round in Vac truck - confirm lab data before discharge.
2. Same truck must be used, if not water to be re-tested.
3. Discharge flow rate must be monitored and reduced to take 1 hour.

Vac Truck #	Date of Discharge	Sample Collection (Y/N)	Volume Discharged (L)	B&K Supervisor		
				Name	Signature	Date

Page ____ of ____

ONTARIO POWER GENERATION

OPG Proprietary
Commercially Sensitive

June 21, 2013

Memo to file No.: NK38-CORR-38000-0465273

Re: D2O Storage Project 16-31555 Soil Sampling Management

Sampling and Analysis:

Sampling consists of removing a portion of the material being surveyed for separate laboratory analysis and is usually the most sensitive technique for assessing radioactivity levels. Laboratory analysis provides a means of identifying complicated radionuclide mixtures, difficult-to-measure radionuclides, and very low concentrations of residual radioactivity. Sampling is used to provide an estimate of the average radionuclide concentration or level of radioactivity for a specified area or volume of material and may be used to validate the results of in-situ or scanning surveys.

Appropriate sample locations are usually identified in the survey design when the locations are part of a random or systematic grid approach.

Samples will be required at elevated areas identified during a scanning survey to quantify the level of activity present. Sampling and detailed laboratory analysis is typically the most expensive and time consuming method of obtaining survey results

Asphalt:

Asphalt samples have been taken to bring the total number up to the 20 samples as requested by Radiation Protection. The asphalt is currently stored in Campus Site C4 inside the PA. The D_2O Storage project has arranged for additional samples to be taken to Kinectrics for laboratory analysis. Monitor large pieces of material (i.e. concrete, asphalt, etc) with a contamination meter (25% of surface) and GR series meter (100% of surfaces) as material is being loaded into disposal bin.

Soil:

The soil which will be exposed once the asphalt is fully removed will then be accessible. Additional soil samples have been taken to bring the total number up to the 20 samples as requested by Radiation Protection. The D_2O Storage project has arranged for additional samples to be taken to Kinectrics for laboratory analysis.

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Bedrock:

PGL will grab 15 additional samples of bedrock once the excavation starts to bring us up to the minimum 20 samples. Since the bedrock will be remaining on OPG property the bedrock can be shipped and segregated on the Campus Plan Site F1. Although there is no reason to anticipate those samples having any activity based on current results, should activity be present, the project will bring back the affected bedrock.

Risk:

The number of samples determine here is based on the understanding that there is only tritium in the soil. This is a reasonable assumption based on the source of the tritium (IWST spill) and the fact that there has been no identification of other isotopes in the site water samples to date. The determination of the recommended sample size is based on the fact that only tritium will be found in the samples. If, at the time of sampling, further isotopes beyond tritium are found or if the determined variability or shift in the initial sampling is significantly higher, then the number of samples to represent the data units will need to be increased.

Sampling during excavation:

It would be prudent though to collect samples of this material as the job progresses to clearly demonstrate all initial sampling and assumptions hold throughout the process, as this is a large volume of material that is to be relocated at Campus Plant Site F1. It is understood that approximately 2000 truckloads of material are expected to be transferred during this project. Projects and Modifications suggest we sample about 2% of these vehicles or nominally one sample per day during the excavation. These extra samples will not be required to be analyzed and reviewed prior to any vehicle leaving the protected area but needs to be analyzed in a manner that would permit the taking of any mitigating actions should these samples indicate the initial sampling had gaps. This is anticipated to be of the order of an additional 40 samples over the course of the excavation.

In addition to the sampling there is a requirement to have the surface layer scanned with both beta and gamma sensitive monitors to ensure no contamination is present on the surface layer (most likely contaminated layer from beta gamma emitters). Surveys are to be performed in the area around the HWMB just west of the TRF/HWMB. Other areas around this building were shown to be free of contamination but the surface will need to be surveyed at the time of the excavation. This is also recommended in the COG report.

MOE Guidelines:

Both the Senes and COG reports references MOE based guidelines on sample selection based on the volume of the material. There is some inconsistency here based on the recommendations of the NRC guidance vs. the MOE guidance with regards to sampling based on volume or mass. For completeness the guidelines from the MOE tables were used and extrapolated to the proposed 22000 cubic meters of soil and material intended to be transferred on this project. The result of using the MOE guidance would lead us to select about 62 samples. This is in line with the 60 samples recommended based on the MARSIMM tables and the COG report.

Mechanism for Transfer:

N-PROC-RA-0014, Radiological Zoning, Personnel/Material Monitoring and Transfer Permits, provides provision in Section 1.6.6 for the transfer of materials that cannot be released in accordance with N-PROC-RA-0124, Unconditional Transfers of Materials from Radiological Zones. Such material shall be released under N-FORM-10243, Conditional Transfer Permit. The conditions to be applied would include, as understood from the project team, that the material will be controlled from further release from OPG control pending further processing and sampling for final release and monitored to ensure such material does not cross contaminate other grounds or materials while at its proposed holding area.

Table 1: Waste Type and Disposal Options

Waste Soil	**Disposal Option**
H3 <0.02 µCi/kg and GG<MDA/NORM	Can dispose outside of PA either on or offsite
H3 < 0.108 µCi/kg	Can be disposed outside of PA but onsite (i.e. Campus Plan Site F1) removed from PA under a conditional transfer permit.
Wastewater	**Disposal Option**
IF H3 < 0.108 µCi/kg and GG < MDA/NORM and no PHC	Soil infiltration or to yard drainage
IF H3 < 0.108 µCi/kg and GG < MDA/NORM and evidence of PHC OR IF H3 between 0.108 and 2 µCi/kg and GG < MDA/NORM regardless of PHC impacts	Disposal via Detox to Clean Harbours-final disposal via incineration
IF H3 > 2 µCi/kg and GG > MDA/NORM regardless of PHC	Consult and typically solidify ship to Nuclear Waste Management Division

Prepared by: Tom Minos
Projects and Modifications

Reviewed by: Julian Read
Section Manager Projects and Modifications

Reviewed by: Rick Fedorowicz
Section Manager Radiation Protection Programming

ONTARIO POWER GENERATION

OPG Proprietary
Commercially Sensitive

August 07, 2013

Memo to file No.: NK38-CORR-38000-0465273

Re: D2O Storage Project 16-31555 Soil Sampling Management

Sampling and Analysis:

Sampling consists of removing a portion of the material being surveyed for separate laboratory analysis and is usually the most sensitive technique for assessing radioactivity levels. Laboratory analysis provides a means of identifying complicated radionuclide mixtures, difficult-to-measure radionuclides, and very low concentrations of residual radioactivity. Sampling is used to provide an estimate of the average radionuclide concentration or level of radioactivity for a specified area or volume of material and may be used to validate the results of in-situ or scanning surveys.

Appropriate sample locations are usually identified in the survey design when the locations are part of a random or systematic grid approach.

Samples will be required at elevated areas identified during a scanning survey to quantify the level of activity present. Sampling and detailed laboratory analysis is typically the most expensive and time consuming method of obtaining survey results

Asphalt:

Asphalt samples have been taken to bring the total number up to the 20 samples as requested by Radiation Protection. The asphalt is currently stored in Campus Site C4 inside the PA. The D_2O Storage project has arranged for additional samples to be taken to Kinectrics for laboratory analysis. Monitor large pieces of material (i.e. concrete, asphalt, etc) with a contamination meter (25% of surface) and GR series meter (100% of surfaces) as material is being loaded into disposal bin.

Soil:

The soil which will be exposed once the asphalt is fully removed will then be accessible. Additional soil samples have been taken to bring the total number up to the 20 samples as requested by Radiation Protection. The D_2O Storage project has arranged for additional samples to be taken to Kinectrics for laboratory analysis.

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Bedrock:

PGL will grab 15 additional samples of bedrock once the excavation starts to bring us up to the minimum 20 samples. Since the bedrock will be remaining on OPG property the bedrock can be shipped and segregated on the Campus Plan Site F1. Although there is no reason to anticipate those samples having any activity based on current results, should activity be present, the project will bring back the affected bedrock.

Risk:

The number of samples determine here is based on the understanding that there is only tritium in the soil. This is a reasonable assumption based on the source of the tritium (IWST spill) and the fact that there has been no identification of other isotopes in the site water samples to date. The determination of the recommended sample size is based on the fact that only tritium will be found in the samples. If, at the time of sampling, further isotopes beyond tritium are found or if the determined variability or shift in the initial sampling is significantly higher, then the number of samples to represent the data units will need to be increased.

Sampling during excavation:

It would be prudent though to collect samples of this material as the job progresses to clearly demonstrate all initial sampling and assumptions hold throughout the process, as this is a large volume of material that is to be relocated at Campus Plant Site F1. It is understood that approximately 2000 truckloads of material are expected to be transferred during this project. Projects and Modifications suggest we sample about 2% of these vehicles or nominally one sample per day during the excavation. These extra samples will not be required to be analyzed and reviewed prior to any vehicle leaving the protected area but needs to be analyzed in a manner that would permit the taking of any mitigating actions should these samples indicate the initial sampling had gaps. This is anticipated to be of the order of an additional 40 samples over the course of the excavation.

In addition to the sampling there is a requirement to have the surface layer scanned with both beta and gamma sensitive monitors to ensure no contamination is present on the surface layer (most likely contaminated layer from beta gamma emitters). Surveys are to be performed in the area around the HWMB just west of the TRF/HWMB. Other areas around this building were shown to be free of contamination but the surface will need to be surveyed at the time of the excavation. This is also recommended in the COG report.

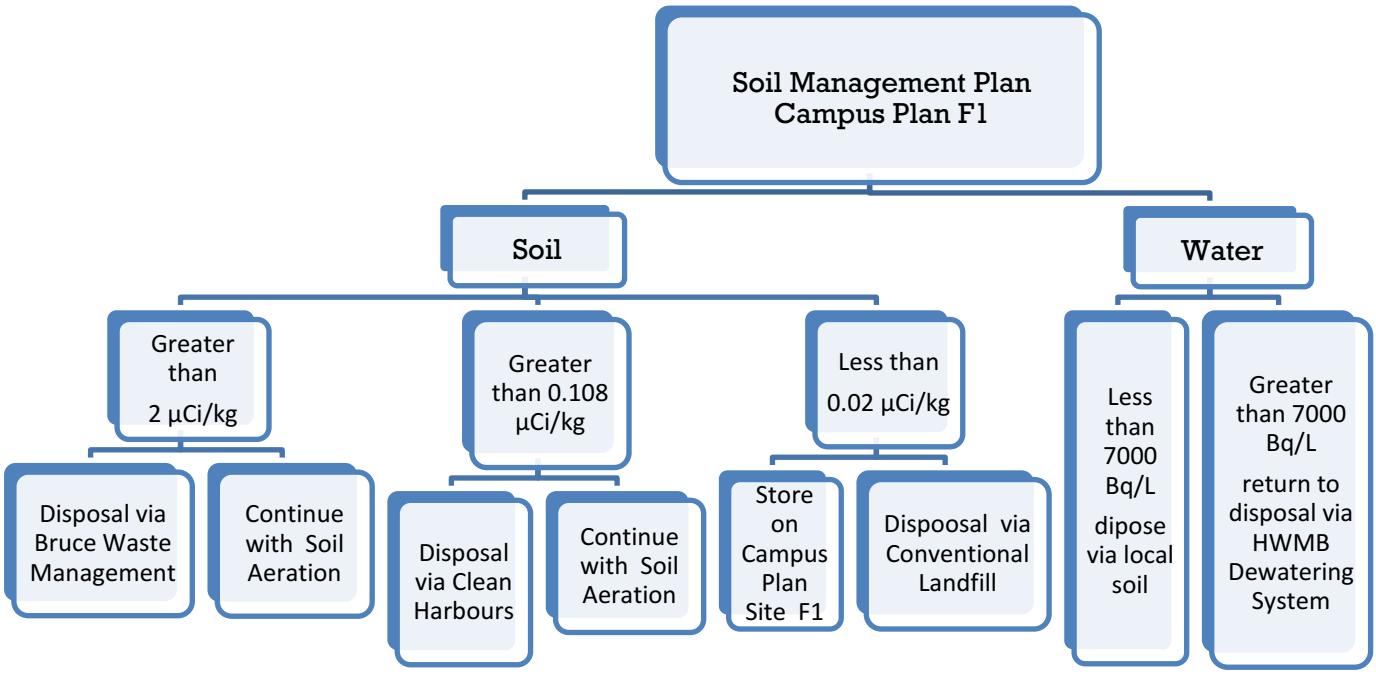
MOE Guidelines:

Both the Senes and COG reports references MOE based guidelines on sample selection based on the volume of the material. There is some inconsistency here based on the recommendations of the NRC guidance vs. the MOE guidance with regards to sampling based on volume or mass. For completeness the guidelines from the MOE tables were used and extrapolated to the proposed 22000 cubic meters of soil and material intended to be transferred on this project. The result of using the MOE guidance would lead us to select about 62 samples. This is in line with the 60 samples recommended based on the MARSIMM tables and the COG report.

Mechanism for Transfer:

N-PROC-RA-0014, Radiological Zoning, Personnel/Material Monitoring and Transfer Permits, provides provision in Section 1.6.6 for the transfer of materials that cannot be released in accordance with N-PROC-RA-0124, Unconditional Transfers of Materials from Radiological Zones. Such material shall be released under N-FORM-10243, Conditional Transfer Permit. The conditions to be applied would include, as understood from the project team, that the material will be controlled from further release from OPG control pending further processing and sampling for final release and monitored to ensure such material does not cross contaminate other grounds or materials while at its proposed holding area.

Table 1: Waste Type and Disposal Options



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~~NK38-38000-10001~~

Trow

GEOTECHNICAL INVESTIGATION PROPOSED HEAVY WATER MANAGEMENT BUILDING DARLINGTON NUCLEAR PLANT DARLINGTON, ONTARIO

NK38-REP-38000-10001-R00

ONTARIOPOWER GENERATION — Darlington Nuclear

ACCEPTED ☒
ACCEPTED AS NOTED ☐
REVISE AND RESUBMIT ☐

John O'Neill — Signature
2 May 2011 — Date

Name: John O'Neill

Department: Design Projects

THIS ACCEPTANCE DOES NOT RELIEVE THE CONTRACTOR FROM RESPONSIBILITY FOR ERRORS OR OMISSIONS OR FROM ANY OBLIGATIONS OR LIABILITY UNDER THIS CONTRACT

Prepared for:

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This document has a total of 32 physical pages

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Trow

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1. Introduction

This report presents the results of a geotechnical investigation conducted for the proposed Heavy Water Management Building located at the Darlington Nuclear Plant in Darlington, Ontario. The work was authorized by Mr. Eric Jok, P. Eng. of Ontario Power Generation (OPG).

The project involves the design and construction of the proposed Heavy Water Management Building at the existing Darlington Nuclear Plant in Darlington. It is understood that the proposed structure will provide housing for heavy water storage units. The design of the structure has not been finalized.

The purpose of the geotechnical investigation was to determine the subsoil and groundwater conditions at the site by putting down a limited number of sampled boreholes and, based on an assessment of the factual borehole data, provide an engineering report with geotechnical recommendations pertinent to design and construction of the proposed structures.

Our Terms of Reference do not include a Phase I Environmental Site Assessment of the site. However, our Terms of Reference include limited environmental testing on selected soil samples to assess the environmental quality of the soils at the site for general disposal purposes.

The comments and recommendations given in this report are based on the assumption that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The proposed Heavy Water Management Building is to be located on the west side of the existing D20 Management Building inside the restricted area.

The site currently comprised open land with a gravel covered surface. The ground surface in the area was generally flat.

3. Procedure

The fieldwork for the geotechnical investigation was carried out during the period between September 11 and 15, 2007. At that time, a total of three (3) sampled boreholes were drilled to depths ranging from 12.85 to 19.60 m below existing grade at the approximate locations shown on the attached Borehole Location Plan (Drawing No. 1). The coordinates of each borehole are also shown in the following Table 1.

Table 1
Summary of Borehole Locations

Borehole No.	Easting	Northing	Ground Elevation (m)
1	10052.0	9937.0	99.381
2	10044.0	9926.0	99.701
3	10045.0	9910.0	99.594

The boreholes were advanced using continuous flight solid stem augering equipment owned and operated by a specialist drilling contractor. In each borehole, samples were recovered using conventional split spoon equipment and standard penetration test methods. No relatively undistrubed samples in cohesive soils were successfully recovered using thin-wall shelby tube due to the stiffness of the soil. Pocket penetration testing was conducted on cohesive soils samples to determine the in-situ shear strength.

Water levels were observed in the open boreholes during the course of the fieldwork. At each borehole location, tests for the concentration of flammable gases were carried out using a portable combustible gas tester (MSA Model 60).

At the end of drilling, all the boreholes were backfilled with compacted bentonite pellets.

The fieldwork was supervised by a Trow geotechnical engineer who monitored the drilling operations and logged the borings. All split spoon samples were transported to our laboratory for detailed examination following the clearance from OPG. Laboratory testing included moisture content determination on all recovered soil samples, natural unit weights and grain size analyses on selected soil samples and compressive strength on selected rock samples. In addition, one (1) soil sample was tested for pH and sulphate content. Two (2) soil samples were analyzed for inorganic parameters for soil disposal purposes.

The location and ground surface elevation of the boreholes listed in Table 1 were established in the field and provided by personnel from OPG. It is understood that the ground elevations are referenced to a local datum.

4. Subsurface Conditions

4.1 Soil

The detailed soil and rock profile encountered in each borehole and the results of laboratory moisture content determinations are indicated on the attached borehole logs (Drawing Nos. 2 to 4). It should be noted the soil and rock boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change. The "Notes on Sample Descriptions" preceding the borehole logs form an integral part of and should be read in conjunction with this report.

The stratigraphy of the site, as revealed in the boreholes, comprised surficial granular fill/fill over deposits of clayey silt till, silt and clayey silt underlain by shale bedrock.

A brief description of the soil and rock profiles, in order of depth, follows.

Granular Fill

Surficially, granular fill was encountered in all the boreholes, extending to depths of about 4.2 to 5.8 m below existing grade. The granular fill comprised sand and gravel, trace shale fragments. Based on the standard penetration 'N' values, the granular fill appeared to be in a compact state. Moisture contents of the granular fill ranged from 3 to 8 %. The granular fill was generally wet in the lower zone.

Fill

Locally at Borehole 1, a fill unit was encountered below the surficial granular fill extending to a depth of about 10.5 m below existing grade. The fill comprised black crushed shale and appeared in a compact state. Moisture contents of the shale fill ranged from 7 to 10 %.

Clayey Silt Till

A clayey silt till deposit was encountered below the granular fill and fill units. The till deposit comprised grey clayey silt, trace sand and gravel with scattered wet fine sand and silt seams, cobbles and boulders. The consistency of the clayey silt till was found to be very stiff to hard. Pocket penetrometer testing carried out on the recovered soil samples yielded in-situ shear strengths ranging from about 125 to in excess of 200 kPa. Natural unit weight of the fill ranged from about 21.1 to 23.0 kN/m^3. Moisture contents of the clayey silt till ranged from about 13 to 18 %. The clayey silt till extended to depths of about 7.3 to 11.5 m below existing grade.

A grain size distribution curve for the clayey silt till is included in Appendix A.

Silt

Below the clayey silt till in Borehole 2 and 3, a deposit of silt was encountered and extending to depths of 10.1 to 11.8 m below existing grade. The relative density of the silt deposit was found to be very dense. Unit weight of the soil ranged from 21.4 to 22.9 kN/m^3. Moisture contents of the silt ranged from 12 to 17 %, indicating a wet to saturated condition.

A grain size distribution curve for the silt deposit is included in Appendix A.

Clayey Silt

In Borehole 2, a clayey silt deposit was encountered below the clayey silt till unit and extending to a depth of about 11.8 m below existing grade. The consistency of the clayey silt deposit was found to be very stiff. Pocket penetrometer testing carried out on a soil sample yielded in-situ shear strength of about 150 kPa. Moisture content of the clayey silt unit was about 18 %.

Shale Bedrock

Shale bedrock was encountered below the clayey silt till, silt or clayey silt deposits at depths of about 11.5 to 11.8 m below existing grade. The shale bedrock was penetrated by coring in NQ size using diamond drilling equipment. The core lengths recovered in Boreholes 1 and 3 were about 1.5 m, and about 7.6 m in Borehole 2.

Details of the core logging are recorded on the attached Borehole Logs. Based on the recovery and Rock Quality Designation (RQD), the shale bedrock was weathered to moderately weathered in the upper 1.0 to 2.0 m, becoming sound with depth. It is not unusual to find random clay seams and rubble zones within the shale mass.

The bedrock is of the Georgian Bay formation (Ordovician period) and underlies this site to a significant depth. The predominate rock type is shale, but this shale is interbedded with limestone and shaley limestone. Typically, Trow has found that the shale component in this formation is of the order of 80 percent in GTA excavations. M.T.C. publication RR229 "Evaluation of Shales for Construction Projects", indicates a nominal 80 to 90 percent shale component in this formation. The limestone and shaley limestone components are generally 50 to 300 mm thick. Laboratory compressive strength testing carried out for four (4) rock core samples indicated compressive strengths ranging from 64.5 to 105.4 MPa. The results are presented in the enclosed borehole logs and Appendix A.

4.2 Groundwater

Groundwater conditions were observed in the open boreholes during the course of the fieldwork. End-of-hole groundwater measurements are included in the attached borehole logs.

Free groundwater was encountered in all the boreholes upon completion of drilling. The water level was observed at depths of about 2.08 to 2.54 m below existing grade.

The observed groundwater appeared to be derived from water perched within the granular fill material and from wet sand and silt seams within the native till. It is likely that this level represents the permanent groundwater level at the site which is inferred to be at a depth of about 2.5 m below existing grade.

A record search of the Lake Ontario level data established that the recorded highest water level at the GTA area since 1906 was at about Elevation 75.90 m. Please note that this elevation is recorded in geodetic, and not the local datum established by OPG.

The groundwater levels reflect conditions at the time of investigation. Groundwater levels are subject to seasonal fluctuations.

4.3 Gas Vapour

Monitoring for explosive gases was carried out at each borehole location using a MSA combustible gas indicator Model 60 calibrated for methane.

Generally, methane gas was not detected in any of the boreholes. However, methane gas may be present in localized pockets.

5. Engineering Discussion and Recommendations

5.1 General

The project involves the design and construction of the proposed Heavy Water Management Building at the existing Darlington Nuclear Plant in Darlington.

It is understood that the proposed structure will provide housing for heavy water storage units. The design of the housing structure has not been finalized. However, it is understood that some storage units may extend onto the underlying bedrock.

5.2 Building Construction

5.2.1 Foundation Considerations

Based on the results of the borehole investigation, it is considered that the site is generally suitable for the construction of the proposed building and storage units. The proposed structures may be supported on either shallow footing foundation, mat foundation, or caisson foundation.

It should be noted that the site is underlain by a deep fill material. The integrity of the fill was evaluated based on the results of the field standard penetration tests. The fill material was generally found to be in a compact to very dense state of compactness. However, the owner should be aware that unless records are kept during placement of the existing fill, this material should be considered as uncontrolled. There is the possibility of the presence of voided material occurring locally which can lead to isolated areas of distress in the footing foundation. If the foregoing is considered to be an unacceptable risk, then it may be necessary to support the proposed structures on mat foundation or caisson foundation.

The preferred means of supporting the structures will be dictated by economics and construction constraints.

Footing Foundation

The proposed structures may be supported on conventional footings founded on the compacted granular fill at or below a depth of about 1.0 m below existing grade. The following bearing capacities may be used in the design.

Factored Capacity at Ultimate Limit State (U.L.S.) =	300 kPa
Bearing Capacity at Serviceability Limit State (S.L.S.) =	200 kPa

It is understood that some storage units may extend onto the underlying bedrock. As such, foundations set on the weathered bedrock may be designed using the following bearing capacities:

Factored Capacity at Ultimate Limit State (U.L.S.) = 2,400 kPa

Bearing Capacity at Serviceability Limit State (S.L.S.) = 1,500 kPa

For S.L.S., the total and differential settlements of well designed and constructed footing are expected to be less than 25 mm and 20 mm, respectively.

Mat Foundation

For design of a mat foundation for the support of the structures, an average modulus of subgrade reaction value of 39,000 kN/m^3 may be used, assuming a Poisson's ratio value of 0.3 and a uniform contact stress of 200 kPa. It is anticipated the mat foundation will be founded at a depth of about 2.0 m below existing grade. The base of the mat foundation should comprise compacted granular fill. Since the fill subgrade material may be wet below a depth of about 2.0 to 2.5 m, the subgrade should be immediately protected with a concrete mud slab upon excavation and inspection and approval by Trow. During winter construction, care should be taken to ensure that the base of the excavation is protected with an insulation blanket at all times to prevent soil from freezing.

Based on the anticipated mat dimensions, the estimated settlement at the centre of the mat is in the range of 20 to 25 mm, and about 10 to 15 mm along the outer edges.

Caisson Foundation

Alternatively, the proposed structures may be supported on augered straight shafted cast-in-place concrete caissons founded into the underlying sound bedrock. The depth to the surface of the bedrock is about 11.5 to 11.8 m below existing grade.

The straight shafted cast-in-place concrete caissons should be extended below the weathered zone to a depth of about 2.0 m into the underlying shale bedrock. An allowable bearing pressure of 4,800 kPa (S.L.S.) may be used in the design for the caissons founded in the sound bedrock at a depth of about 13.5 to 14.0 m below existing grade, subject to inspection during construction. The factored bearing pressure at ultimate limit state (U.L.S.) is 7,600 kPa.

The caissons should be at least 760 mm in diameter and have a minimum length to base diameter ratio of at least 3. Temporary safety liners must be installed to prevent water and wet/loose soil from sloughing into the drilled shaft, and to allow down-hole cleaning and inspection. Hard augering resistance should be expected since crushed shale, cobbles and boulders were encountered in the boreholes. A 150 mm slump for the concrete is recommended for use to prevent the concrete from having a honeycombed structure or 'hang-up' in the liner during withdrawal.

Each caisson base must be properly hand cleaned and then inspected and approved by geotechnical personnel from Trow Associates Inc. prior to placing concrete.

The total and differential settlements of well designed and constructed caisson foundations placed in accordance with the above recommendations are expected to be less than 15 mm and 10 mm, respectively.

For resistance against uplift pressure, an allowable cohesion value of 50 kPa may be used in the calculation for the shaft of the caisson in contact with soil. For the portion of the caisson embedded in the bedrock, a bond resistance of concrete to weathered rock of 0.4 MPa may be used. A minimum of one diameter socket length is required for load transfer to take place.

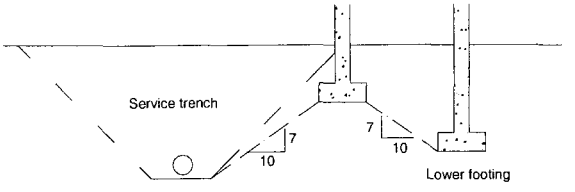
For instantaneous, non-sustained loading condition (i.e., seismic loads), it is estimated that the bearing pressures may be subjected to 30 % additional loading without significant effect to the foundations in limit states design.

Pile Foundation

Pile installation will generate significant noise and vibration. In view of adjacent sensitive structures, the use of driven pile foundation is not recommended for this site.

5.2.1.1 Foundation General

Footings or caissons which are to be placed at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing, as indicated on the following sketch:



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footings and grade beams exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements.

It should be noted that the recommended bearing capacities have been calculated by Trow from the borehole information for the design stage only. The investigation and comments are necessarily ongoing as new information on underground conditions becomes available. For example, it should be appreciated that modifications to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason this office should be retained to review final foundation drawings and to examine footing conditions.

5.2.2 Groundwater Control

Provided the excavations do not extent below the observed groundwater level (i.e. 2.5 m below existing grade), no major groundwater dewatering is anticipated. Seepage from perched water in the fill or surface water run-off should be anticipated during construction. It should be possible to control and drain the seepage water using conventional construction dewatering techniques, i.e. pumping from sumps.

For excavations extended to below 2.5 m depth, it is anticipated that significant water seepage will be encountered within the granular and rock fill layers. It is therefore recommended that the groundwater be lowered by a vacuum well point dewatering system prior to excavation. The well points should be installed down to below the granular and/or rock fill layer. Within the native clayey silt till, clayey silt and silt, the permeability of these soils are relatively impervious, and groundwater seepage may be controlled and drained using conventional construction dewatering techniques, i.e. pumping from sumps. For flow rate calculation purposes, the coefficient of hydraulic conductivity for the granular/rock fill, silt and clayey silt till/clayey silt are about $1x10^{-2}$, $1x10^{-5}$ and $1x10^{-6}$ cm/sec, respectively.

Dewatering should be carried out by a special contractor familiar with the site and groundwater conditions using their own equipment and expertise.

5.2.3 Excavation and Shoring

No special problems are envisaged in constructing the shallow foundation for the proposed structure. The bulk excavation is expected to be carried out within the granular fill material. Excavation should be relatively straightforward and must be carried out in accordance with the latest Occupational Health and Safety Act. In this regard, the compacted fill is considered to be a Type 2 soil.

For guidance, side slopes of 1 vertical to 1 horizontal may be used for the shallow temporary excavation anticipated subject to geotechnical inspection. Where loose soil is encountered at shallow depths or within zones of persistent seepage, it may be necessary to locally flatten the side slopes.

Deeper excavations should be adequately sloped. Shoring will be required where there is a space restriction. For calculations of the triangular lateral earth pressure acting on the shoring system, the following values may be used:

Unit weight of soils	$\gamma = 20.5$ kN/m^3
Coefficient of active earth pressure	$K_a = 0.33$
Coefficient of passive earth pressure	$K_p = 3.0$
Surcharge loads (i.e. equipment or fill stockpiles)	$q = 10$ kPa

The shoring system should be designed by a qualified structural engineer and executed by specialist contractors with experience in projects of similar magnitude.

It should be noted that cobbles and boulders occur in glacial deposits and their presence may influence the progress of excavation. Methane gas was not encountered in the boreholes, but could be present in isolated pockets embedded in the bedrock. Consequently, provisions should be made in the contract documents to cover any delays caused by boulder obstructions or occurrence of methane gas pockets.

5.2.4 Floor Slab Construction and Permanent Drainage

Based on the finding in the boreholes, slab-on-grade construction is feasible at the site and may be carried out in accordance with the following recommendations.

Following removal of unsuitable surficial material and rough grading the exposed subgrade should be surface compacted and proofrolled with a heavy vibratory roller under the full-time supervision of Trow Associates Inc. Any soft spots detected should be sub-excavated and the area brought up to design grade using clean approved fill compacted to at least 98 % of its standard Proctor maximum dry density.

All backfilling and compaction operations should be monitored on a full-time basis by geotechnical staff to approve material and to ensure the specified degree of compaction has been achieved.

A 200 mm layer of 19 mm clear stone should be placed between the prepared subgrade and the floor slab to serve as a moisture barrier. Also, within any unheated areas and service entrances to the building, 25 mm of Styrofoam insulation should be provided below the floor slab to protect against frost heave.

For the design of the slab-on-grade construction, an average modulus of subgrade reaction value of 39,000 kN/m^3 may be used, with a maximum allowable bearing pressure of 200 kPa.

The ground floor slab should be set above the exterior finished grade. Around the perimeter of the building the ground surface should be sloped on a positive grade away from the structure to promote surface water run-off and reduce groundwater infiltration adjacent to the foundations.

5.2.5 Additional Earth Pressure on Subsurface Walls

Design ground acceleration for the project site was determined from the Earthquake Hazards Program website by interpolating 2005 National Building Code of Canada Seismic hazards values. The map indicates a peak horizontal ground acceleration (PHGA) value of approximately 0.122 g at the project site. The value is associated with an earthquake having 2 percent probability of exceedance in a 50 – year period (0.000404 per annum probability).

Based on the peak horizontal ground acceleration, the additional inverted earth pressure of 37 pounds per cubic feet (6 kN/m^3) should be included in subsurface wall design.

5.2.6 Backfill Considerations

Backfill used to satisfy underfloor slab requirements, in footings and service trenches, etc., should be compactible fill, i.e. inorganic soil with its moisture content close to its optimum moisture content as determined in the standard Proctor maximum dry density test. The backfill against subsurface walls should be a free draining granular material conforming to OPSS Granular 'B'.

The majority of the excavated material will consist of granular fill. It is considered that the excavated granular fill material would generally be suitable for reuse as backfill.

Any material containing organic or excessively wet or otherwise deleterious material should not be used for backfilling purposes. Any shortfall of suitable on-site excavated material can be made up with imported granular material, OPSS Granular 'B' or equivalent. The backfill should be placed in lifts not more than 300 mm thick in the loose state with each lift being compacted to at least 98 % standard Proctor maximum dry density within the building area before subsequent lifts are placed. The degree of compaction achieved in the field should be checked by in-place density tests.

In general, the overburden soils are not free draining and therefore should not be used where this characteristic is required, or in confined areas. Imported granular material conforming to OPSS Granular 'B' specifications would also be suitable for this purpose.

In areas where substantial cutting and filling is required, the compaction of the fill should be monitored full-time by a representative of this office. This is particularly important under the building where slab-on-grade will be constructed.

5.2.7 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

5.2.7.1 Subsoil Conditions

The subsoil and groundwater information at this site have been examined in relation to Section 4.1.8.4 of the OBC 2006. The subsoil generally consisted of, in succession, fill, native clayey silt till and silt. The shallow foundations, such as footing or raft, will be founded in the compacted granular fill. The reported N-values for the soil below the founding level ranged from 16 to 90.

There have been no shear wave velocity measurements carried out at this site and therefore, undrained shear strength and N-values will have to be used to determine the site classification.

5.2.7.2 Corrected N-Values N_{60}

The Average Standard Penetration Resistance shown in Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2006 refers to N_{60} which is defined as "Average Standard Penetration Resistance for the top 30m, corrected to a rod energy efficiency of 60% of the theoretical maximum". It should be noted that the drillers in the GTA area do not have their rod energy efficiencies measured and therefore, computed N_{60} values are not available for this site.

For the CME automatic hammer used by the driller for the boreholes at this site, the energy transfer compiled by Utah State and reported by GRL in Cleveland, Ohio, indicated that the range would be 67-83% and 59-91% for one and two standard deviations respectively. In our opinion, the reported N-value would therefore be approximately equivalent to the normalized N_{60} values as noted in the OBC 2006 for the purpose of establishing the site classification.

For the purpose of determining the averaged N-values, only the overburden values were used. Where the split spoon met refusal in the overburden soil, the N-value has been taken as 100.

5.2.7.3 Depth of Boreholes

Table 4.1.8.4.A. Site Classification for Seismic Site Response in OBC 2006 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The boreholes advanced at the site were to a maximum depth of about 19.60 m depth as per the terms of references. Bedrock was encountered within the depths investigated (i.e. about 11.5 to 11.8 m below existing grade). The site classification recommendation is based on the available information as well as our interpretation of conditions below the boreholes.

5.2.7.4 Site Classification

Based on the above assumptions and interpretations and the known soil conditions, and in accordance with Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2006, the Site Class for this site is "D". However, where the entire structure (i.e., building and floor loads) is supported on the sound bedrock, the Site Class 'B' may be used in seismic design.

5.2.8 Subsurface Concrete

One (1) soil sample from Borehole 2 was submitted for analysis of pH, sulphate and chloride content. The test results indicated a pH value of 8.3 and sulphate content of 27.3 ppm as SO_4, indicating a "negligible" degree of sulphate attack on subsurface concrete structures. The chloride content was 11.0 ppm, indicating a "negligible" degree of chloride attack on subsurface steel reinforcing. For information regarding selection of cement type for subsurface concrete structures, reference is made to C.S.A. Standard CAN3-A23. The results are enclosed in Appendix B for reference.

5.3 Limited Environmental Testing

Two (2) soil samples were tested for general inorganic parameters in the MOE "Guideline For Use At Contaminated Sites In Ontario" revised February 1997. Sample location and analytical data and the results of the chemical testing (Certificates of Analysis) are compiled in Appendix B.

The two (2) soil samples analyzed for general inorganic parameters met fine to medium grained commercial/industrial land use criteria in Table B of the MOE Guideline for sites in a non-potable groundwater condition. Therefore, any excess soils requiring disposal during construction may be taken to any land based site (except for sensitive sites) accepting fill, subject to the individual site owner's approval.

6. General Comments

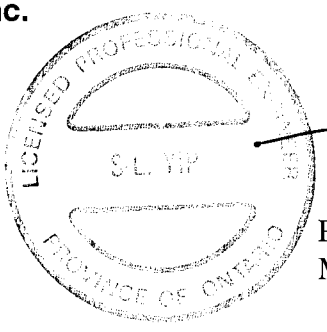
Trow Associates Inc. should be retained for a general review of the final design and specifications to verify this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Trow Associates Inc. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, Trow Associates Inc. should be contacted to assess the situation, and additional testing and reporting may be required. Trow has qualified personnel to provide assistance in regard to future geotechnical issues related to this property.

Yours truly,

Trow Associates Inc.



So-Lim Yip, P. Eng.
Project Manager

Peter Chan, P.Eng.
Manager, Markham Office

Distribution:

OPG	(5)
Trow Markham	(1)
Trow Brampton	(1)

Appendix A

Laboratory Soil/Rock Testing
Grain Size Analysis
Compressive Testing

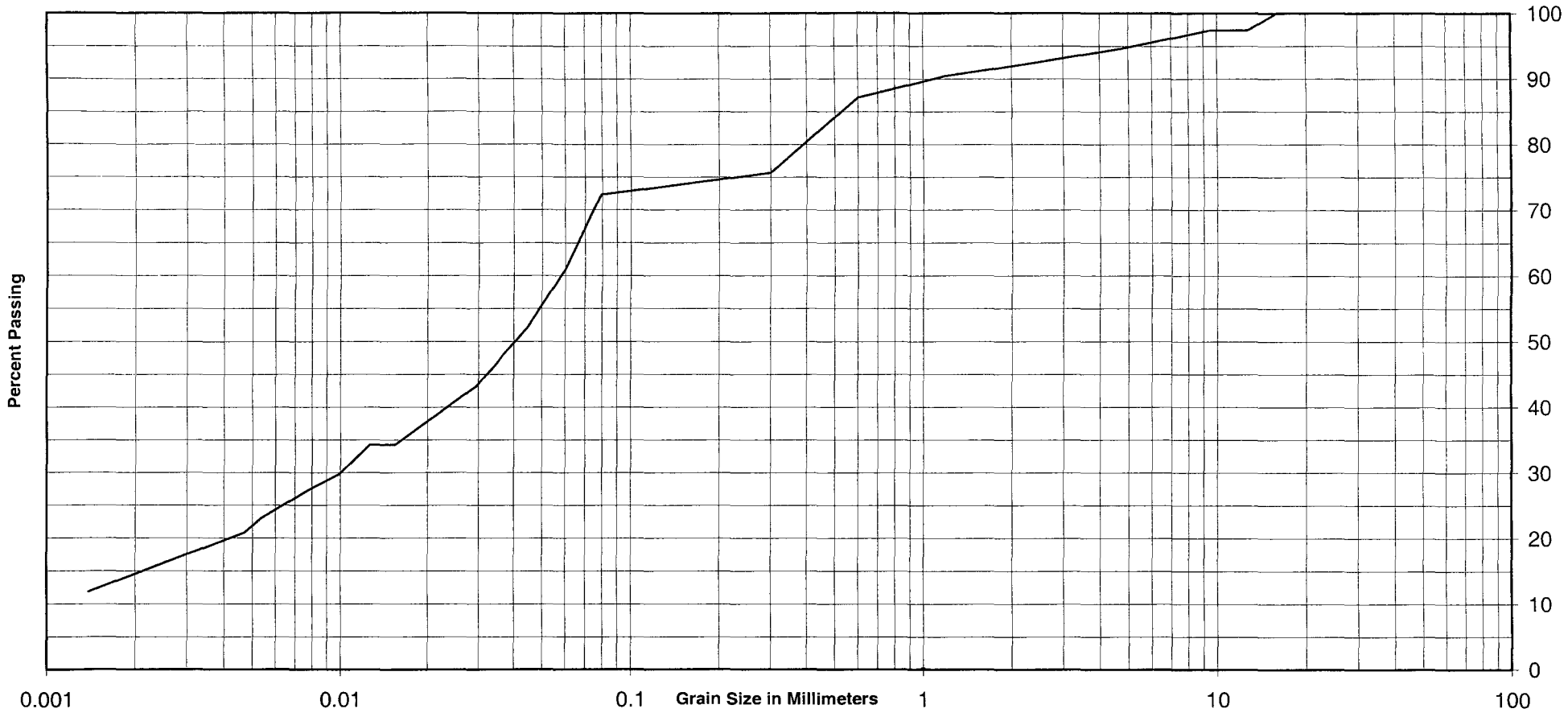
Trow

UNIFIED SOIL CLASSIFICATION SYSTEM

GRAIN SIZE DISTRIBUTION

PROJECT NO: BRGE 00287536A

SILT & CLAY	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE



PROJECT: Heavy Water Management Building
LOCATION: Darlington Nuclear Plant
BOREHOLE #:2
SAMPLE #: 7
DEPTH: 20-21.5ft
ELEVATION:

Classification of Sample:

Clayey Silt, trace sand, some gravel

ENCLOSURE No.:

Trow

UNIFIED SOIL CLASSIFICATION SYSTEM

GRAIN SIZE DISTRIBUTION

PROJECT NO: BRGE 00287536A

SILT & CLAY	SAND			GRAVEL	
	FINE	MEDIUM	COARSE	FINE	COARSE

PROJECT: Heavy Water Management Building
LOCATION: Darlington Nuclear Plant
BOREHOLE #: 3
SAMPLE #: 9
DEPTH: 25 - 26.5 ft
ELEVATION:

Classification of Sample:

Silt, trace clay and sand

ENCLOSURE No.:

Trow

Compressive Strength of Rock Cores

Project No.: BRGE00287536a

Project Name: OPG - Darlington

Date: September 24, 2007

Core No.	BH 1 Sample 1	BH 2 Sample 1	BH 2 Sample 2	BH 3 Sample 1
Location	39'4"	45'1"	54'9"	41'2"
Date Cored				
Date Tested	Sep. 21, 2007	Sept. 21, 2007	Sept. 21, 2007	Sept. 21, 2007
Height - (mm)	47.8	43.0	85.0	44.0
Average Diameter - (mm)	47.5	47.5	47.5	47.5
Area (mm^2)	1772	1772	1772	1772
L/D Ratio (2.5 - 3.0)	1.01*	0.91*	1.79*	0.93*
Failure Load (kN)	131.11	201.14	152.47	186.83
Compressive Strength - (MPa)	64.5	98.8	84.7	105.4
Remarks				

* The length too short, the L/D should have between 2.5-3.0. We getting higher results on the shorter samples.

Laboratory Representative Signature

Sept. 25/07
Date

Appendix B

pH and Sulphate Chemical Analysis

ENTECH
A Division of Agri-Service Laboratory Inc.

6820 Kitimat Rd., Unit #4
Mississauga, Ontario, Canada
L5N 5M3

TEL: (905) 821-1112
FAX: (905) 821-2095

LABORATORY USE ONLY
Work Order#:
Comments:

CHAIN OF CUSTODY RECORD[QC-2(2)]

Client: **Trow Markham**
Address: 70 Gibson Gibson Drive, Unit 12, Markham, Ontario L3R 4C2
Contact: So-Lim Yip
Tel: 905-470-0073 Fax: 905-470-9848
Invoice to (if other than the client)

Client P.O.#:
Client Project #: BRGE00287536A
Entech Quote#:
Sampled by: Raymond Lam
Guidelines needed:

Total # of Samples:
Anticipated health or chemical hazard:

Analysis Required

Entech's Bottles YES (NO)

Sample #	Client Sample I.D.	Date Sampled	Sample Matrix *	Sampling Information (W) Filtered Yes/No ***	Sampling Information (W) Preserved Yes/No	Specify details if SDWA i.e Reg.170 /03 applies+	Decom. Guidelines (General+Inorganics)	Reg. 558 + PCBs	BTEX/PHC(F1-F4)	pH + SO_4 + Chloride	Corrosivity						Sample Temp °C	Number of Containers	LAB USE ONLY Lab Number
1	BH 2 SS 7	12Sept07	SOIL	N	N					X								1	
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

Turn Around Time
(STD: 5-7 Working Days)
RUSH: Specify ¤ _____
¤ Contact Lab
Rush Charges Apply for <5 days Turnaround Time.

Relinquished to Entech (sign): Raymond Lam — Date: Sept 21 — Time: AM — Method of Shipment: Pick-up
Received by Entech (sign): — Date: — Time: — Condition:
Samples Logged By: — Date: — Time:

NOTE: Samples will only be retained for 30 days after reporting of results unless specifically requested by client. (Storage charges may then be applicable.)
*** 1) Soil/Sediment/Groundwater/Surface Water/Effluent/Drinking Water etc. - Pls. Specify.**
**** 2) Please call the laboratory BEFORE submitting any samples which fall under Safe Drinking Water Act-2002/Reg. 169/03**
***** 3) Please specify if water samples are to be filtered by lab before analysis.**
+4) Unless specified otherwise, all water samples will not be considered as Drinking Water.as defined in R170/03.

See Overleaf

ENTECH
A Division of Agri-Service Laboratory Inc.
6820 Kitimat Rd., Unit #4
Mississauga, Ontario, Canada
L5N 5M3
TEL: (905) 821-1112
FAX: (905) 821-2095

LABORATORY USE ONLY
Work Order#:
Comments:

CHAIN OF CUSTODY RECORD[QC-2(2)]

Client: **Trow Markham**
Address: 70 Gibson Gibson Drive, Unit 12, Markham, Ontario L3R 4C2
Contact: So-Lim Yip
Tel: 905-470-0073 Fax: 905-470-9848
Invoice to (if other than the client)

Client P.O.#:
Client Project #: BRGE00287536A
Entech Quote#:
Sampled by: Raymond Lam
Guidelines needed:

Total # of Samples:
Anticipated health or chemical hazard:

Analysis Required

Sample #	Client Sample I.D.	Date Sampled	Sample Matrix *	Sampling Information (W) Filtered Yes/No ***	Preserved Yes/No	Specify details if SDWA i.e Reg.170 /03 applies+	Decom. Guidelines (General+Inorganics)	Reg. 558 + PCBs	BTEX/PHC(F1-F4)	pH + Sulphate	Corrosivity						Entech's Bottles YES NO Sample Temp °C	Number of Containers	LAB USE ONLY Lab Number
1	BH 2 SS 8	Sept 12	Soil	N	N		X											1	
2	BH 3 SS 4	Sept 13	Soil	N	N		X											1	
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

Turn Around Time
STD: 5-7 Working Days
RUSH: Specify ☐ _____
☐ Contact Lab
Rush Charges Apply for <5 days Turnaround Time.

Relinquished to Entech (sign): Date: Sept 25 Time: PM Method of Shipment: Pick-up
Received by Entech (sign): Date: Time: Condition:
Samples Logged By: Date: Time:

NOTE: Samples will only be retained for 30 days after reporting of results unless specifically requested by client. (Storage charges may then be applicable.)
*** 1) Soil/Sediment/Groundwater/Surface Water/Effluent/Drinking Water etc. - Pls. Specify.**
**** 2) Please call the laboratory BEFORE submitting any samples which fall under Safe Drinking Water Act-2002/Reg. 169/03**
***** 3) Please specify if water samples are to be filtered by lab before analysis.**
+4) Unless specified otherwise, all water samples will not be considered as Drinking Water.as defined in R170/03.

See Overleaf

Rev. 4.0 (21 Apr. 2004)

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ONT L5N 5M3
TEL: (905) 821-1112

TOTAL P.03

Client: **Trow - Markham**
Attention: **So-Lim Yip**
Project: **BRGE00287536A**
P.O.:
Sample Type: **Soil**
Date Received: **Sept. 21, 2007**
Date Analysed: **Sept. 26, 2007**
Date Reported: **Sept. 28, 2007**

Certificate of Analysis

Data Pertain To Specific Sample(s) Tested

PARAMETER	MDL	CONTROL SAMPLE			SAMPLE DATA						
		Expected	Found	Recovery %	Blank	80591 BH2 SS7	80591 BH2 SS7 Duplicate				
Sulphate (µg/g)	0.25	16.7	16.9	101	<0.25	27.3	27.4				
pH (units)	-	7.41	7.37	99	-	8.3	8.3				
Chloride (µg/g)	0.25	11.0	11.3	102	<0.25	11.0	11.1				

Sample Disposal: 30 Days from the Reporting Date.
Analyst: MA, OZ

Method :
Anions - Extraction / Ion Chromatography (EPA 300.0)
pH: Electrometric/pH-Meter (EPA 150.1)

Asit Raksit, Ph. D., C. Chem
Manager

ENTECH
A Division of Agri-Service Lab Inc.
6820 Kitimat Rd., Unit #4
Mississauga, ON L5N 5M3

TEL: (905) 821-1112
FAX: (905) 821-2095

Client: Trow - Markham
Attention: So-Lim Yip
Project: BRGE00287536A
P.O. :
Sample Type: Soil
Date Received: Sept. 25, 2007
Date Analysed: Sept. 24-28, 2007
Date Reported: Oct. 01, 2007

CERTIFICATE OF ANALYSIS - SOIL STANDARDS FOR USE UNDER PART XV.I OF THE ENVIRONMENTAL PROTECTION ACT (GENL. & INORGANIC)

Data Pertain To Specific Sample(s) Tested

PARAMETER	Standards (µg/g)			Method Detection Limit (µg/g)	CONTROL SAMPLE			SAMPLE DATA (µg/g)			
					Expected Concentration (µg/g)	Concentration Found (µg/g)	Recovery %	Blank	80640 BH2 SS8	80641 BH3 SS4	
	Tables 2 Agricultural & Other Prop. Use.	Tables 2 & 3 Res./Ind. Comm	Tables 4 & 5 Res./Ind. Comm								
Dry Matter (%)	-	-	-	-	-	-	-	-	99.7	96.4	
pH (units)	5 to 9	5 to 9	5 to 11	-	7.41	7.37	-	-	8.9	8.7	
E C (mS/cm)	0.7	0.7/1.4	N.A./N.A.	-	0.15	0.15	-	-	0.09	0.12	
SAR	5	5/12	N.A./N.A.	-	-	-	-	-	0.56	0.61	
Arsenic	20	20/40	40/N.V.	1	75.0	74.8	100	<1	<1	<1	
Cadmium	3	12/12	41/41	1	34.0	34.7	102	<1	<1	<1	
Chromium (VI) *	8	8/8	600/1100	1	23.0	20.0	87	<1	<1	<1	
Chromium (total)	750	750/750	2500/5000	1	64.0	59.3	93	<1	12.0	6.5	
Cobalt	40	40/80	2500/3400	1	28.0	29.8	106	<1	4.6	3.0	
Copper	150	225/225	2500/2500	1	690	798	116	<1	8.4	4.9	
Lead	200	200/1000	1000/N.V.	2	233	219	94	<2	2.6	<2	
Mercury	10	10/10	57/57	0.05	0.19	0.18	95	<0.05	<0.05	<0.05	
Molybdenum	5	40/40	550/550	2	48.7	52.1	107	<2	<2	<2	
Nickel	150	150/150	710/710	2	231	203	88	<2	6.4	2.9	
Boron(HWE) *	1.5	1.5/2.0	2.0/N.V.	0.02	1.00	1.02	102	<0.02	0.08	0.10	
Cyanide Free	100	100/100	100/390	0.1	0.10	0.10	100	<0.1	<0.1	<0.1	
Selenium	2	10/10	2500/2500	1	0.80	0.75	94	<1	<1	<1	
Silver	20	20/40	240/240	0.3	1.90	1.86	98	<0.3	<0.3	<0.3	
Zinc	600	600/600	2500/5000	1	177	195	110	<1	29	21	
Antimony *	13	13/40	44/44	1	0.0100	0.0098	98	<1	<1	<1	
Barium	750	750/1500	2500/4100	1	102	102	100	<1	57.6	35.3	
Beryllium	1.2	1.2/1.2	1.2/3.1	0.5	0.50	0.49	98	<0.5	<0.5	<0.5	
Vanadium	200	200/200	910/910	1	19.0	21.7	114	<1	20.3	15.4	
Thallium	4.1	4.1/32	32/150	1	133	110	82	<1	<1	<1	

a) Table 2: Full Depth Generic Site Condition Standards in a potable groundwater condition
b) Table 3: Full Depth Generic Site Condition Standards in a non-potable groundwater condition
c) Table 4: Stratified Site Condition Standards in a potable groundwater condition (subsurface soil)
d) Table 5: Stratified Site Condition Standards in a non-potable groundwater condition (subsurface soil)

All guideline criteria are for coarse textured soil
HWE - Hot water extractable
Sample data and MDL units are in µg/g unless otherwise specified

Sample Disposal: 30 Days from the Reporting Date.

Analyst(s): PZ, QS, OZ, MA

*** Control Sample Unit is µg/mL for the specified parameter instead of µg/g unless otherwise specified.***

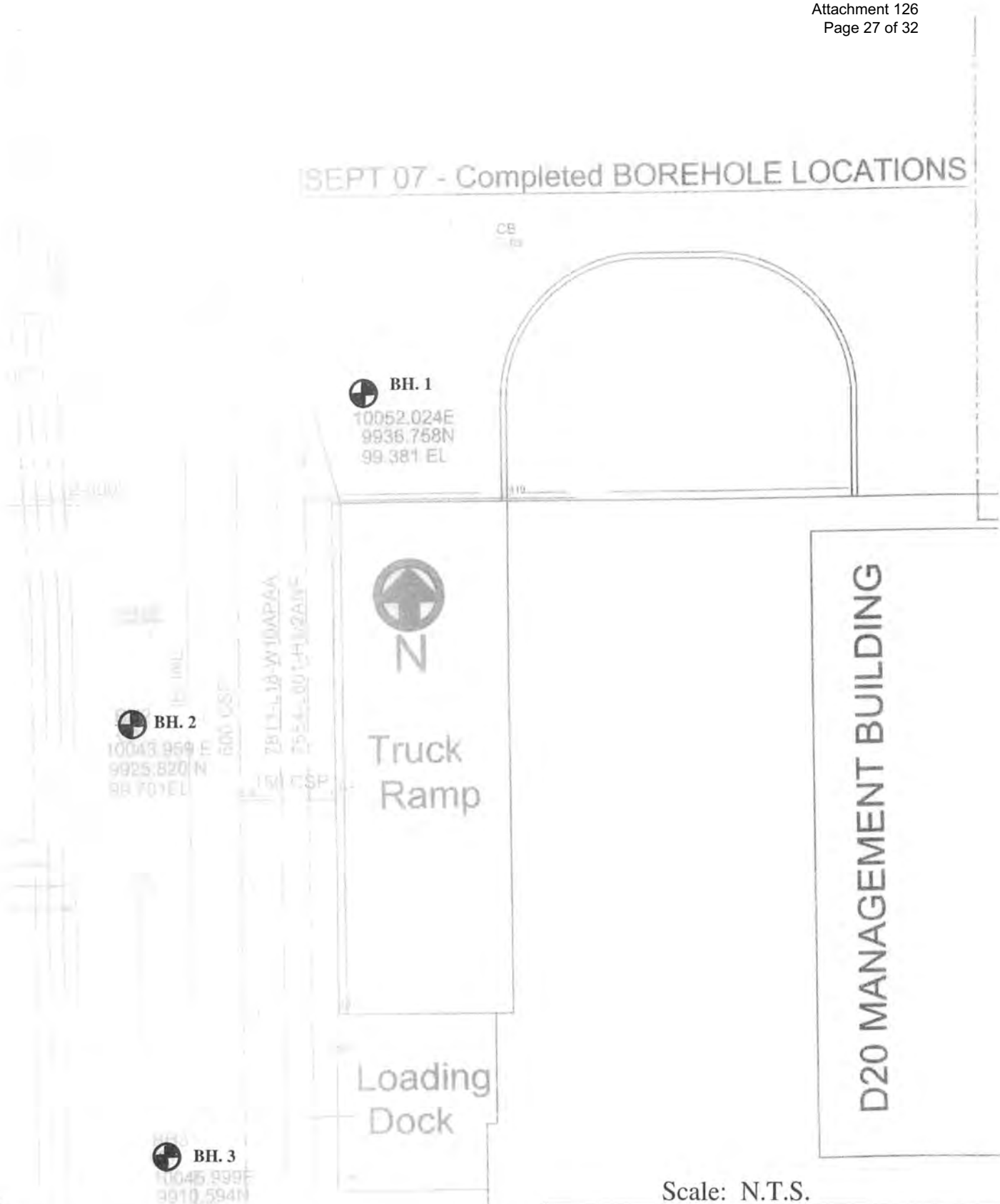
Method:

pH: Extraction/Electrometric (EPA 9045)
EC: Extraction/Electrometric (EPA 120.1)
As, Se, Sb: Digestion/HGFAAS (EPA 3050A/7062/7742)
Hg: Digestion/CV-AAS (EPA 7471A/245.5)
SAR: Extraction/ICP-AES (EPA 200.7)
Metals: Digestion/ICP-AES (EPA 3050A/200.7)
Cyanide Free: Extraction/Auto-Color (EPA 335.4)
B (HWE): Extraction/ICP-AES
Cr(VI): Alkaline Digestion/Colorimetry (EPA 3060A/7196)

Asif Raksit, Ph. D., C. Chem
Manager

Drawings

Borehole Location Plan
Borehole Logs



Scale: N.T.S.

NOTES:

1. The boundaries and soil types have been established only at Borehole locations. Between Boreholes they are assumed and may be subject to considerable error.
2. Soil samples will be retained in storage for 3 months and then destroyed unless client advises that an extended time period is required.
3. Borehole locations are approximate.
4. Borehole elevations should not be used to design building(s) or floor slab(s) or parking lot(s) grades.

GEOTECHNICAL INVESTIGATION
HEAVY WATER MANAGEMENT BUILDING
DARLINGTON NUCLEAR POWER PLANT
DARLINGTON, ONTARIO

BOREHOLE LOCATION PLAN

BRGE00287536A	Date : September 2004	Drawing No. 1

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by Trow also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETERS

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole 1

Project No. BRGE00287536A
Drawing No. 2
Project: Geotechnical Investigation - Proposed Addition
Sheet No. 1 of 1
Location: Heavy Water Management Building, Darlington Nuclear Power Plant

Date Drilled: September 15, 2007
Drill Type: Hollow Stem Augers (CME 75)
Datum: existing grade

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
▼		**GRANULAR FILL** - sand and gravel, scattered shale fragments; brown, moist to very moist	99.38	0	65			
				1	57			
				2	90			
			96.79		68			
				3	89			
				4				
				5	62			
			93.6					
		FILL - crushed shale; black, very moist to wet		6	76			
				7				
				8	88			
				9				
					61			
			88.9	10				
		CLAYEY SILT TILL - trace gravel; grey, about plastic limit, hard		11	32 / >			23.8
			87.9					
		SHALE BEDROCK - black shale, low to medium strength, highly weathered, scattered 5 to 10 mm thick limestone seams, poor to fair quality (Georgian Bay Formation)		12	64.5 MPa			REC 96% RQD 35%
			86.5					

END OF BOREHOLE

NOTES:
1. REC: Recovery
   RQD: Rock Quality Designation
2. Water Return for all coring was 100%
3. Gas reading in open borehole: 0% using MSA Model 60
4. NQ Rock Core Barrel was used

LAGWGL02 GE00287536A.GPJ NEW.GDT 10/1/07

Time	Water Level (m)	Depth to Cave (m)
Prior to rock coring	2.59	

Trow

Log of Borehole 2

Project No. BRGE00287536A
Drawing No. 3
Project: Geotechnical Investigation - Proposed Addition
Sheet No. 1 of 2
Location: Heavy Water Management Building, Darlington Nuclear Power Plant

Date Drilled: September 13, 2007
Drill Type: Hollow Stem Augers (CME 75)
Datum: existing grade

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test
Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

Soil Description	ELEV. m
GRANULAR FILL - sand and gravel, scattered shale fragments; brown, moist	99.70
	97.62
CLAYEY SILT TILL - trace gravel, scattered fine sand partings; grey, about plastic limit, very stiff	95.6
	91.1
SILT - occasional wet silty fine sand seams; grey, moist, very dense	89.6
CLAYEY SILT - with saturated silt seams; grey, about plastic limit, very stiff	87.9
SHALE BEDROCK - black shale, low to medium strength, highly weathered in upper 2 m, moderatedly to slightly weathered below, scattered 5 to 10 mm thick limestone seams, poor to fair quality to about 16.5 m, good quality below (Georgian Bay Formation)	

N Value: Shear Strength 20 40 60 80 MPa 0.1 0.2
Combustible Vapour Reading (ppm) 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight) 10 20 30

DEPTH	N Value	Natural Unit Weight kN/m³
0	72	
1	65	
2	70	
3	60	
4	77	
5	16	21.7
6	16	21.4
7		
8	24	23.0
9	60	22.1
10		
11	28	21.3
12	50/80 mm	REC 91% RQD 25%
13		
14	98.8 MPa	REC 100% RQD 34%
15		
16		REC 97% RQD 50 %

Continued Next Page

Time	Water Level (m)	Depth to Cave (m)
Prior to rock coring	Dry	
September 14, 2007	2.08	

Trow

LAGWGL02_GE00287536A.GPJ_NEW.GDT_10/1/07

Log of Borehole 2

Project No. BRGE00287536A

Drawing No. 3

Project: Geotechnical Investigation - Proposed Addition

Sheet No. 2 of 2

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH	N Value / Shear Strength (MPa)	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Weight kN/m³
			83.20		20 40 60 80 / 0.1 0.2 / 0.47 MPa	250 500 750 / 10 20 30		
				17				REC 100 % RQD 78%
				18				
				19				REC 100 % RQD 66%
			80.1					
		END OF BOREHOLE						

NOTES:
1. REC: Recovery
   RQD: Rock Quality Designation
2. Water Return for all coring was 100%
3. Gas reading in open borehole: 0% using MSA Model 60
4. NQ Rock Core Barrel was used

LAGWGL02 GE00287536A.GPJ NEW.GDT 10/1/07

Trow

Time	Water Level (m)	Depth to Cave (m)
Prior to rock coring	Dry	
September 14, 2007	2.08	

Log of Borehole 3

Project No. BRGE00287536A
Drawing No. 4
Project: Geotechnical Investigation - Proposed Addition
Sheet No. 1 of 1
Location: Heavy Water Management Building, Darlington Nuclear Power Plant

Date Drilled: September 14, 2007
Drill Type: Hollow Stem Augers (CME 75)
Datum: existing grade

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test S_u

Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer

GWL	Soil Description	ELEV. m	Natural Unit Weight kN/m³
	GRANULAR FILL - sand and gravel, scattered shale fragments; brown, moist to very moist	99.59	
▼		97.05	
		94.9	
	CLAYEY SILT TILL - trace gravel, with fine sand and silt seams; grey, about plastic limit, very stiff		22.4
		92.3	21.1
	SILT - occasional clayey silt seams and layers; grey, moist to saturated, very dense		22.4
		87.8	21.4
	SHALE BEDROCK - black shale, low to medium strength, highly weathered, scattered 5 to 10 mm thick limestone seams, poor to fair quality (Georgian Bay Formation)		22.9
		86.1	
	END OF BOREHOLE		

N Value: 20 40 60 80
Shear Strength: 0.1 0.2 MPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 10 20 30
DEPTH: 0 1 2 3 4 5 6 7 8 9 10 11 12 13
SAMPLES

N values: 56, 65, 81, 68, 50, 20, 17, 60, 93, 57
105.4 MPa

REC 100%
RQD 36%

NOTES:
1. REC: Recovery
   RQD: Rock Quality Designation
2. Water Return for all coring was 100%
3. Gas reading in open borehole: 0% using MSA Model 60
4. NQ Rock Core Barrel was used

Time	Water Level (m)	Depth to Cave (m)
Prior to rock coring	2.54	

Trow

LAGWGL02 GE00287536A.GPJ NEW.GDT 10/1/07

Engineering Specification
Darlington Nuclear

OPG Proprietary		
Document Number: NK38-TSM-38000-10001		
Sheet Number: N/A	Revision: R00	Page 1 of 17

Title:
SUPPLEMENTARY TECHNICAL SPECIFICATION FOR NUCLEAR CLASS 3 TANKS FOR WEST ANNEX BUILDING

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ONTARIO POWER GENERATION Darlington Nuclear

☑ ACCEPTED
☐ ACCEPTED AS NOTED
☐ REVISE AND RESUBMIT

Signature: B Livingstone Date: 12-NOV-2012
Name: A. Dutkay/B Livingstone
Department: OPG Reliability Design

THIS ACCEPTANCE DOES NOT RELIEVE THE CONTRACTOR FROM RESPONSIBILITY FOR ERRORS OR OMISSIONS OR FROM ANY OBLIGATIONS OR LIABILITY UNDER THIS CONTRACT

LICENSED PROFESSIONAL ENGINEER
S. JACENKO
100050653
31 OCT, 2012
PROVINCE OF ONTARIO

Supplementary Technical Specification for Nuclear Class 3 Tanks for West Annex Building

NK38-TSM-38000-10001-R00

Supersedes: N/A
Implementation Date: N/A
Review Date: 26-OCT-2012

Master EC Number: 88528
Other Reference Number: N/A

OPG Proprietary

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Foreword

This document, the associated Design Specifications NK38-DS-38500-10001, NK38-DS-38500-10002, NK38-DS-38410-10002, NK38-DS-38110-10003 and other referenced technical documents form part of design specifications that establish requirements for the design, manufacture, inspection, testing, cleaning, and packaging of nuclear class 3 D_2O storage tanks to be used within the new D_2O storage facility to be constructed at Darlington Nuclear Generating Station.

Engineering Specification
Darlington Nuclear

OPG Proprietary		
Document Number: NK38-TSM-38000-10001		
Sheet Number: N/A	Revision: R00	Page 5 of 17

Title:
SUPPLEMENTARY TECHNICAL SPECIFICATION FOR NUCLEAR CLASS 3 TANKS FOR WEST ANNEX BUILDING

Revision Summary

Revision Number	Date	Comments
R00	2012-10-26	Initial issue.

1.0 SCOPE

This document, the associated Design Specifications referenced in Section 2.0(a) and other referenced technical documents form part of design specifications that establish requirements for the design, manufacture, inspection, testing, cleaning, and packaging of the following nuclear class 3 D2O storage tanks to be used in the new D2O storage facility at Darlington Nuclear Generating Station:

- Nuclear Class 3, 50m3 Downgraded D2O Storage Tank of West Annex Building
- Nuclear Class 3, 25m3 Downgraded D2O Storage Tank of West Annex Building
- Nuclear Class 3, 25m3 Clean-up D2O Storage Tanks of West Annex Building
- Nuclear Class 3, 100m3 Moderator Grade & TRF Outgoing and Incoming D2O Storage Tank of West Annex Building

2.0 REFERENCE

This Engineering Specification was according to procedure N-PROC-MP-0059, "Preparation, Review and Approval of Engineering Specifications". The following documents are references in this specification. Unless otherwise stated in the technical specification, the latest issues, amendments and supplements of these referenced documents shall form part of this specification to the extent specified herein. Any conflict between the requirements of this document and the requirements of referenced documents shall be brought to the attention of RCM for resolution.

(a) Ontario Power generation

- NK38-DS-38500-10001 R000, Design Specifications for Class 3, 50m3 Downgraded D2O Storage Tank of West Annex Building
- NK38-DS-38500-10002 R000, Design Specifications for Class 3, 25m3 Downgraded D2O Storage Tank of West Annex Building
- NK38-DS-38410-10002 R000, Design Specifications for Class 3, 25m3 Clean-up D2O Storage Tanks of West Annex Building
- NK38-DS-38110-10003 R000, Design Specifications for Class 3, 100m3 Moderator Grade & TRF Outgoing and Incoming D2O Storage Tank of West Annex Building

(b) Canadian Standards Association (CSA)

- CSA N285.0-08 Update No.2

(c) American Society of Mechanical Engineers (ASME)

- ASME Section III, Division 1, Subsection ND, 2010 Edition with 2011a Addenda
- ASME Section III, Division 1, Subsection NF, 2010 Edition with 2011a Addenda
- ASME Boiler and Pressure Vessel Code, Section II, Part A, 2010 Edition with 2011a Addenda
- ASME Boiler and Pressure Vessel Code, Section II, Part D, 2010 Edition with 2011a Addenda
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2010 Edition with 2011a Addenda

3.0 QUALITY ASSURANCE (VENDOR AND MANUFACTURER)

The manufacturer of the tanks as specified in this document shall maintain a quality program in accordance with the following standard:

- CAN3-Z299.3-85: Quality Assurance Program

The manufacturer shall review all subcontracted products or services to determine whether a QA program is required. Where a QA program is required, the Manufacturer shall select the appropriate program, evaluate and audit potential suppliers as applicable and select suppliers based on their ability to meet QA requirements.

4.0 GENERAL

The design and manufacture of the tanks as specified in this document shall be performed according to all applicable codes, standards and quality requirements as specified within this document in conjunction with the Nuclear Design Specifications referenced in Section 2.0(a) for Nuclear Class 3 D2O storage tanks.

The purpose of this document is to outline all additional details necessary to perform work in accordance with Ontario Power Generation Quality Assurance standards for the design and manufacture of tanks as specified in this document. This document identifies codes and standards to be followed, vendor interface requirements, inspection and shipping details, engineering specifications for manufacture and documents to be submitted in accordance with Ontario Power Generation Quality Assurance.

5.0 DESIGN AND FABRICATION REQUIREMENTS

The design, materials selection, fabrication, examination, pressure testing, and certification of nuclear class 3 tanks shall be in accordance with the Subsections ND and NF of Section III of the ASME Code, referenced Nuclear Design Specifications under Section 2.0(a), and the additional requirements of this document, provided the additional requirements do not violate the code requirements. Any conflicts between the requirements of this document and those of the code shall be brought to the attention of RCM.

5.1 Supplementary Specifications

5.1.1 Laws, Standards and Codes

See Section 2.0(b) and 2.0(c) above for all applicable codes and standards to adhere to regarding the design and manufacture of the tanks as specified in this document.

5.1.2 Interface Requirements

In the event the vendor subcontracts activities, the vendor's QA program must include provisions for the control of all activities of the subcontractor to ensure all design or fabrication by the subcontractor is in compliance with the vendor's QA program, or shall be performed under the vendors QA program.

5.1.3 Registration Requirements

Construction of the tanks shall be in accordance with requirements of ASME Section III, Division 1, Subsections ND and NF, 2010 Edition with 2011a Addenda. Tank design shall be registered with the Technical Standards and Safety Authority (TSSA).

5.1.4 Environmental Qualification Requirements

There are no environmental qualification requirements for these tanks.

5.1.5 Changes in Design and Substitution of Materials

Specific requirements, design and operating conditions are found on the Design Specifications referenced under Section 2.0(b). If there is any change in design, materials, etc. to what is specified, the vendor must receive approval of the changes before proceeding with manufacture. The vendor shall ensure contractual provisions and QA program requirements imposed on suppliers and sub-suppliers is such that the vendor shall be notified of any such changes that may occur within the supply chain. In the case of revisions to maintenance manuals, the vendor shall send copies to the buyer.

Alternatively, the vendor shall notify the buyer using the same forms if, for any reason, it is unable to provide assurance that there have been no such changes.

The buyer will forward all such notifications to the design authority. Although the design authority may solicit the vendor's input, the decision of the design authority shall be final on acceptability of changes and substitution.

For all quotations, the vendor is to provide the buyer with the following:

name, title, phone number, fax number, and E-mail address of the vendor's responsible engineer for use by RCM engineering department representatives.

5.1.6 Reliability and Maintainability Requirements

A reliability and maintainability (R&M) data report is required prior to manufacture and delivery.

The R&M data report shall include the following information:

1) A description of the company's (and sub-contractor's, where applicable), organization and procedures by which reliability and maintainability is incorporated in the design process and processing of data.

2) A reliability prediction including:

   (a) A list of failure modes. Ways in which a part or component can fail to perform its intended function.
   (b) Estimated failure rates for each mode (failures per hour) - Mean Time To Failure (MTTF).
   (c) Life expectancy of critical parts and component.
   (d) Method of detecting failed components.

3) A maintainability prediction including:

   (e) Estimated repair times for each failure mode (man-hours per occurrence) Mean Time To Repair (MTTR).
   (f) Routine maintenance schedule.
   (g) Estimated routine maintenance times in man-hours per year, assuming normal maintenance conditions and non-hazardous environment.
   (h) A list of special tools, training and skills required to meet MTTR.

4) Comparison of R&M values for the component originally supplied and the replacement.
5) A description of the service organization, including availability of service engineers, spare parts and stocking arrangements.
6) The vendor shall state the basis for his R&M prediction. Field data from similar equipment in similar applications is preferred.

Mean Time To Failure (MTTF) – The average operating time at which a component fails. An estimate of MTTF is given by the cumulative operating time divided by the total number of failures during that operating time.

Mean Time to Repair (MTTR) - The average time required to restore a component, to service from a failed condition, excluding logistic time, i.e. waiting for spare parts, preparation time.

5.1.7 Safety Requirements

Grounding connection shall be provided. There are no other safety requirements for these tanks.

5.1.8 Radiation Safety Requirements

There are no radiation safety requirements for these tanks.

5.1.9 Protective Coating Requirements

There are no protective coating requirements for these tanks.

5.1.10 Workmanship Requirements

No special workmanship requirements. Workmanship shall be in compliance with Quality Assurance and Quality Control procedures of the vendor and manufacturer.

5.1.11 Welding

Welding including the design, qualification and inspection of welded joints shall be in accordance with the requirements of ASME Section III Division 1, Subsection ND. Welding procedure and Welder performance qualification testing shall be in accordance with ASME Section IX.

All welding shall be performed in accordance with written procedures. The procedures shall be submitted to RCM for acceptance, and, if applicable, the Jurisdictional Authority for registration in accordance with the requirements CSA - N285.0-08 Update No.2 prior to the commencement of fabrication of the vessel.

5.1.12 Cleanliness

Shop conditions shall be appropriate for the production of nuclear power plant components and in accordance with the Quality Assurance requirements.

A clean area shall be provided in the Supplier's premises for storing the plates and for pack assembly. The room shall be so located that it is isolated from the normal flow of other materials or personnel. The adequacy of this clean area shall be subject to the approval of RCM.

Grease, oil, scale, sealing compound, grit, oxide, lead, weld spatter, NDT compounds, moisture, and other foreign materials shall be completely removed from all parts. All surfaces that cannot be cleaned and/or examined after assembly shall be cleaned prior to assembly.

Cleaning procedures and tests for determining cleanliness shall be subject to the acceptance of RCM. Any pickling and passivation procedures shall also be subject to the acceptance of RCM.

Processing and handling of parts shall be done so as to avoid contamination by material such as iron, grit, lead, mercury, halogens, or sulphur. Only clean silica sand or approved equivalent material shall be used for grit blasting. When liquid penetrant examination is to follow blasting, only sharp sand shall be used (i.e., shot blasting is not acceptable).

Only clean stainless-steel brushes and chip hammers and iron-free grinding wheels, not previously used on other material, shall be used on stainless-steel parts.

Precautions shall be taken to ensure that this state of cleanliness is maintained during manufacturing, testing, and through to completion of the work.

All parts shall be thoroughly cleaned prior to any heating operation.

The analysis for sulphur content shall be carried out in accordance with ASTM D129 or by acceptable equivalent methods.

5.1.13 Painting

All tank support exterior unfinished carbon steel surfaces shall be painted. Paints used are subject to acceptance by RCM. Inorganic zinc paint is preferred.

The Manufacturer shall thoroughly clean all surfaces of rust, scale, sand, grease, and other foreign material, remove burrs, and break sharp corners. The steel shall be blast cleaned to a good near-white surface conforming to SSPC-SP I0. Immediately after blast cleaning, the surface shall be blown, brushed or vacuumed free of dust and spent abrasive.

Priming shall immediately follow surface preparation. Surfaces to be primed shall be clean and dry. Priming shall be done by spray application of one coat of a commercially available Inorganic Zinc Primer, equivalent to one of those listed below, to a dry film thickness over all peaks of 40 to 50 µm;

- Dimetcote 9™ (Amercoat of Canada Ltd.)
- InterzinC™ (International Paints Ltd.)
- Carbozinc II (Corrosion Services Ltd.)

- Sherwin Williams ZINC CLAD II™ (B69V3 & B69D1)

From the beginning of metal preparation until the primer is dry to handle, all operations shall be done indoors with even temperature of not less than 10°C, humidity-control, and full protection against weather.

Preparation, application, and storage of primer materials shall be in accordance with the Manufacturer's instructions.

5.1.14 Special Tooling

The Supplier shall indicate whether special tooling is required for routine maintenance (including cleaning) of the tanks. If special tooling has been developed, the Supplier shall describe it. A power-operated pack-tightening mechanism shall be considered as a special tool.

The Supplier shall identify any other tooling that may be required for the routine maintenance of the tanks.

5.1.15 Non-Destructive Examination

The Manufacturer shall be responsible for and shall perform or have performed on his behalf all the non-destructive examination (NDE) required by CSA N285.0-08 Update No.2, ASME Section III along with the design specifications referenced in Section 2.0 (a).

All NDE shall be in accordance with written procedures. All written procedures shall be submitted to RCM for acceptance.

All personnel performing NDE to meet the requirements of this specification shall be qualified as follows, subject to acceptance by RCM:

- In Canada, personnel shall be qualified to CGSB qualifications as outlined in CSA N285.0-08 Update No.2
- In the United States of America, personnel shall be qualified to SNT-TC-1A.

Radiographic testing (RT) methods, Ultrasonic testing (UT) methods, Liquid Penetrant, Fluorescent Liquid Penetrant, and Magnetic Particle Testing and acceptance standards shall conform to the requirements of Section III.

5.1.16 Final Dimensional Inspection

The Supplier shall prepare an As-Built drawing/report listing overall dimensions, terminal point locations, thickness of the plate stack and other dimensions. This

inspection shall be carried out to a written procedure submitted to and accepted by RCM.

5.1.17 Testing Of Materials

The equipment supplied to the provisions of this specification shall be subject to the inspection and test requirements set forth below. Where functional or operating tests are performed, the product shall comply with all the provisions of this specification and with CSA CAN3-Z299.3.

Inspection and testing shall be conducted in a manner satisfactory to, and subject to the approval of RCM.

RCM or his authorized agent shall have access to the Supplier's premises at all reasonable times to the extent necessary for this specification.

In the event of failure of the product or any part thereof to meet fully an inspection or test requirement specified herein, the Supplier shall notify RCM, should he wish to repair and/or use such product or part.

At the discretion of RCM, suitable repairs and re-inspection and re-testing may be carried out, or concession granted.

If the repairs are likely to affect the results of tests or work previously completed, appropriate re-inspection or retesting shall be conducted.

The tanks shall be carefully examined to determine its conformity with this specification and the approved drawings, with respect to material, workmanship, finish, marking and dimensions, and to assess their conformity with other requirements stated, or reasonable implied, and not covered by specific tests.

At the conclusion of all inspection and test procedures described herein, the tanks shall be examined for signs of wear or cracks, distortion, or incipient damage of any sort.

5.1.18 Inspection or Test Failure

The Supplier shall obtain permission from RCM before repair or "use as is", of any part that fails to meet inspection or test requirements specified herein. If the repairs could affect the results of inspection tests, of work previously done, appropriate re-inspection and retesting shall be conducted.

6.0 PRODUCT FORM AND IDENTIFICATION

Marking shall satisfy the applicable requirements of CSA N285.0-08 Update No.2 and ASME Section III.

A nameplate(s) shall be attached to each tank. The attachment method shall not affect the integrity of the valve and shall be located in a conspicuous area where it is easy for inspection. The location shall be such that it will not be covered with insulation. Nameplates and attachments shall be of corrosion resistant materials. Marking on nameplates shall be stamped in characters not less than 2.3 - 2.5 mm high.

A metallic name plate shall be permanently attached to each tank and shall contain the information required by NCA-8211 and the following additional data:

(a) The name of the Supplier
(b) Supplier's part number
(c) Purchaser's P.O. Number
(d) Canadian Registration Number (CRN)
(e) Nominal volume Capasity;
(f) Cat ID
(g) Weight, lb
(h) Year built

7.0 SPECIAL PACKAGING AND SHIPPING, HANDLING AND STORAGE

Preparation for shipment shall be made in accordance with procedures prepared by the Supplier and accepted by RCM. The Supplier shall prepare detailed unloading, storage and installation procedures for acceptance by RCM.

All materials and parts shall be protected and covered so that no damage, corrosion or ingress of foreign material occurs during shipment.

All external unfinished carbon steel surfaces shall be coated with an epoxy based rust preventative primer and all external finished or machined surfaces shall be protected against corrosion with a coating of an easily removable compound.

All connections and machined surfaces shall be protected against mechanical damage.

The un-machined of all component supports shall be cleaned and scraped to provide a good commercial finish. A smooth coat of inorganic zinc coating (or equivalent protection) shall be applied over these surfaces in the shop before shipment. Unpainted machined surfaces shall be coated with a removable rust preventative and covered to prevent physical damage.

Adequate cushioning, blocking, bracing, skidding, hoisting and tie-down provisions shall be provided to ensure protection during transit.

Each component shall be packaged and supported for shipment so as to provide convenient lifting points and so as to prevent distortion or damage to the components. Lifting lugs, clearly marked and identified, suitable for off-loading and installation shall be provided.

Shipping containers shall be constructed to ensure acceptance and safe delivery. On the shipping container, in weatherproof lettering, the following minimum information shall be shown:

(a) Purchaser Requisition number
(b) Cat ID
(c) Purchaser's Purchase Order number
(d) Supplier's name
(e) Product name and size
(f) Quantity

8.0 MATERIAL SAFETY DATA SHEET (MSDS)

MSDS required:

☐ YES

☒ NO

9.0 DOCUMENTATION REQUIREMENTS

9.1 Design Documents

The Supplier shall submit the following reports for review and acceptance:

(a) Data Sheets;
(b) Design Report (including allowable loads on the nozzles);
(c) Spare Parts List with Part Numbers for 2 years of operation.

9.2 Drawings

The required drawings and data shall include, but not limited to, the following:

(a) General arrangement assembly drawing showing: overall dimensions and tolerances, clearance dimensions for maintenance and disassembly, all nozzles, torque required for all pressure retaining fasteners, mounting details, lifting lugs, dry and operating weights, liquid volumes for both the shell and the tube, and also drawings with the following information;
(b) Dimensions, types, orientation and ratings for all nozzles;
(c) 'As built' dimensions, orientation and location of the tank nozzles and its components;
(d) Name plate details;
(e) Complete bills of materials referenced to ASME/ASTM designations and Supplier's part numbers and part names;

As a minimum, each drawing and each document submitted to RCM shall bear the following data:

(a) System name;
(b) Purchase Order number;
(c) Registration numbers (CRN) assigned by the Jurisdictional Authority (TSSA);
(d) Cat ID number;
(e) Equipment tag number.

9.3 Procedures

The Supplier shall submit the following procedures for RCM's review and acceptance:

(a) Inspection Test Plan;
(b) Hydrostatic Test Procedures;
(c) Radiographic Examination Procedures;
(d) Magnetic Particle Examination Procedures;
(e) Liquid Penetrant Examination Procedures;
(f) Welding Procedures;
(g) Weld Repair Procedures;
(h) Stress Relieving Procedures;
(i) Painting/Protection Coating Procedures;
(j) Packing and Shipping Procedures;
(k) Unloading, Storage and Installation Procedures.

9.4 Manuals

The Supplier shall provide operating and maintenance manuals that shall include, but is not limited to, the following information:

(a) Descriptive data on the equipment;
(b) Detailed parts list for all equipment supplied including catalogue numbers and ASME/ASTM material designations;
(c) List of applicable drawings;
(d) Detailed instructions for handling, installation, operation and maintenance procedures including disassembly and reassembly of equipment and overhaul schedules.

9.5 Non Conformance Reporting

Non-conformances with a proposed disposition of use-as-is, repair, or equivalent item substitution shall be submitted to RCM for approval.

This applies to the circumstances where:

- Technical or material requirement is deviated;
- A requirement in a supplier documentation, which has previously been accepted by RCM, has been deviated;
- The non-conformance cannot be corrected by continuation of the original manufacturing process or by re-work.

The item does not conform to the original requirements, even though the item can be restored to a condition such that the capability of the item to the function is unimpaired.

ONTARIO POWER GENERATION

Darlington NGS

Heavy Water Management Building

Estimate Report

January 9, 2012

Prepared for
Ontario Power Generation

Prepared by
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FAITHFUL+GOULD
CONSTRUCTIVE EXPERTISE

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Synopsis

Faithful+Gould has been commissioned by Ontario Power Generation (OPG) under PO 00187402 Release 021 dated 22 November 2011 to provide estimating services for OPG Scope of Work 16-31555 D2O Storage Facility External Cost Estimate Preparation, for the Darlington Nuclear Generating Station.

Disclaimer

This document and its contents have been prepared and are intended solely for the client's information and use in relation to the Darlington NGS, D2O Storage Facility External Cost Estimate Preparation Report.

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Project ID: F+G Estimate Number: 100025545							
REV	**DESCRIPTION**	**ORIGINATOR**	**REVIEWER**	**F+G APPROVAL**	**DATE**	**CLIENT APPROVAL**	**DATE**
1	Initial submission to client	CJ	KN	TG	1/9/2012		

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DNGS Heavy Water Management Facility
External Cost Estimate

Estimate Report

1 Executive Summary

This Estimate Report is in support of Darlington D_2O Heavy Water Management and Drum Handling Project for partial release and full release BCS and is based on the design information provided by OPG, which is detailed in Appendix A.

The original brief for the estimate was to produce an estimate to an accuracy level in compliance of AACE Class 3 based on the information provided. The methods we have employed to develop the estimate are consistent with those of a Class 3 estimate, being a detailed line-item level build-up. However the information available to derive rates and quantities is not consistent with the information required to develop a Class 3 estimate and has required a number of assumptions regarding to be made regarding design and specification. This is particularly true for the building structure, which accounts for approximately half of total construction cost.

Based on this assessment and on our understanding of the AACE Classification system we believe this estimate should be classified as Class 4 (see Appendix H). In order for this estimate to be classified as Class 3 we would require further information in addition to that currently available, such as specification and data sheets, general equipment arrangement drawings, civil drawings and structural drawings.

This report and associated estimate describes the estimate Business Case Summary release funding to complete the following scopes:

Partial BCS Release:

- Issue contract with a design agency for completion of scope definition, modification planning, detailed design
- OPG to start procurement of long lead items
- Construction/installation/commissioning planning
- Issue RFP for construction/installation of new facility, and select preferred vendor
- Preparation for full BCS release

Full BCS Release:

The partial BCS release will ask for sufficient funding to cover the cost of future activities:-

- Finalise construction/installation/commissioning planning
- OPG to continue procurement of long lead materials
- OPG to procure all other materials
- Issue a contract with a construction company to construct/install the new facility

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- Commissioning of new facility and equipment
- Final AFS of new facility
- Design close-out
- Lessons learned report

It has been indicated by OPG that detailed Engineering will not be performed by the Contractor chosen to construct this project and is therefore excluded from the estimate. Interest, escalation and contingency are also excluded.

OPG have also indicated that procurement will be performed by OPG, rather than employing an EPC relationship with the Contractor. The OPG 'oversight' cost includes an allowance for procurement of all construction materials, including long lead and specialist items.

At all times during the establishment of this estimate, F+G were required to use their best efforts to secure independent cost information and this has been achieved with only one exception. Due to time restrictions the exception is that we have utilized the quotations for tanks which were previously provided directly to OPG. Based on our knowledge of the current market we believe these quotations are sufficiently recent to represent a current market value.

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2 Estimating Scope of Work

The Project Scope of Work is the DNGS Heavy Water Management Building and to support the project strategy Faithful+Gould (F+G) utilised best practice estimating techniques to develop a release quality estimate for the identified contract strategy.

The F+G independent estimate includes for:-

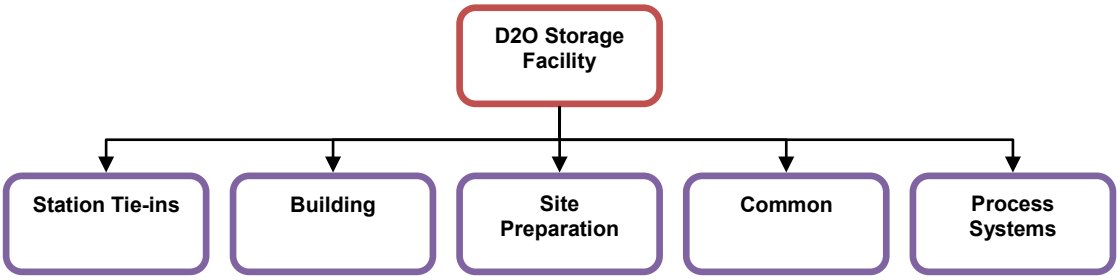
- OPG Costs including project management and supervision oversight, and procurement of all construction materials, including long lead and specialist items
- Construction labour, materials and equipment costs
- Commissioning
- Project close out cost
- EPSCA costs relating to the Principal Agreement between OPG and the Canadian Union of Skilled Workers
- SAVH allowances are included within the rate build-up of the individual craft labour rates
- CMO charges of 1.25% (percentage advised by OPG Project and Modifications) relating to the project cost

Principal Exclusions include interest, escalation, contingency, risk and historic project costs.

3 Estimate Methodology and Basis

3.1 Project Breakdown Structure (PBS)

The DNGS Heavy Water Management Building estimate has been constructed around the following Project Breakdown Structure (PBS). This structure was provided by OPG and has been used to summarise costs within the estimate:



3.2 Estimating Techniques

3.2.1 General

This project benefited by use of the latest agreed New Rules of Measurement for Order of Cost Estimating and Elemental Cost Planning as issued by the Royal Institution of Chartered Surveyors. This method of measurement ensures consistent assumptions across all building elements and provides structure to the estimate and clarity on the scope of work contained in each element.

In addition to the scope of work provided by OPG meetings were held with relevant OPG stakeholders to clarify and agree the detailed scope of work for the project, and to supplement the formal information provided.

Labour norm hours were established by use of the F+G library of past project experience for activity duration and costs and for expected deliverables. The F+G installation norm library is extensive and continues to grow, and this will be used for future sustainable estimating. Where norm hours were not available or not applicable all-in rates have been used based on industry data and experience from previous projects.

All F+G estimated contractor rates are inclusive of preliminaries to cover the anticipated costs for contractor management and staff, insurance, safety, health, welfare, impact for site agreements, protection of the works, security, small plant and tools, existing site regulations, etc.

3.2.2 Specific Estimating Method

Design reports and drawing information provided by OPG was used to produce detailed quantity and dimension measurement of the building structures and process and equipment layouts where possible. From available dimensions, all identified activity scopes per trade were measured using either imperial dimensions or the equivalent metric value.

The applied rules of building measurement were those established under Royal Institution of Chartered Surveyors New Rules of Measurement, 2010.These quantified measures were then allocated a labour norm from internationally accepted publications. The resultant base hours were then factored using a prepared Productivity Factor aligning to OPG practice and procedure (see Appendix E).

These productivity factor hours were then taken against an anticipated crew strength, taken from F+G knowledge, per category of work, to provide the total cost of each activity.

Costs for materials were realised in the general by utilising F+G data libraries and past experience, and supplemented in certain instances by contacting vendors. Rates for storage tanks were taken from the quotations previously provided to OPG and have been validated as representing current market value.

The structure of the construction works estimate follows a logical construction sequence as follows, and includes references to New Rules of Measurement and PBS to allow costs to be grouped differently if required:

- External works
- Site investigation
- Works to existing structures
- Substructures
- Superstructure

- Staircases
- Windows and external doors
- Internal walls and partitions
- Elevators, lifts and hoists
- Building services
- Miscellaneous metalwork
- Internal fittings, furnishings and equipment
- Process equipment
- Electrical control systems
- Specialist equipment

The estimate to be produced by F+G was intended to be at an AACE Class 3 level of detail. The characteristics of a Class 3 estimate are as follows:

End Usage: Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase control estimates against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.

Estimating Methods Used: Class 3 estimates usually involve more deterministic estimating methods than the stochastic methods that would be used for Class 4 of Class 5 estimates. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project.

Expected Accuracy Range: Typical accuracy ranges for Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

In conclusion from the foregoing, F+G believe that the Heavy Water Management Building estimate meets the Scope of Work requirement of +50% -30% and could be classified as overall meeting AACE Class 4 +30% -20% (low).

3.2.3 Stakeholder meetings

An initial meeting was held with OPG on Monday November 14th to introduce the project and discuss requirements. A formal kick-off meeting and site walk-down was then held on Tuesday November 22nd to discuss the scope of the project and to identify the physical location of activities on site.

Further meetings were also held on Tuesday December 20th and Thursday December 23rd with the OPG Project Team and Field Engineering, to obtain further clarification of scope and specification, to discuss progress and to clarify client requirements.

A final was convened on Friday January 6th to present the findings of the estimate and discuss final amendments before issue.

The purpose of the Stakeholder Meetings was to review the assumptions made in the Scope of Works and to verify installation scope parameters. This in turn established the confirmation of the

client requirements for the intended scope of work and/or provided an opportunity to review or revalidate previous assumptions.

3.2.4 Walk-down

The purpose of Heavy Water Management Facility site walk-down held on November 22nd 2011 was to identify and develop physical constraints, topography, site access, security requirements, material delivery and lay-down, constructability of the proposed concept scopes, confirm constraints within the installation areas, radiation protection measures, temporary power supply and service constraints, the route of safe access/egress in construction islands, existing road and ditches, demolition scopes and existing site conditions as access at height, overhead obstructions, etc. Representatives from the Project Team and the TRF attended.

The findings of the walk-down together with the assumptions made provided the F+G estimators with a degree of clarity to the proposed concepts, strategy and construction impact.

4 Estimate Assumptions

4.1 Developmental Current and Full BCS Releases

4.1.1 General

1. Norm hours have been established using F+G libraries of past experience of construction activities and as supplemented by stakeholder meetings.
2. Partial release and full release project management, procurement and close-out scope hours are as established / agreed on the relevant Scope ID Sheets.
3. All construction works are based on a single 10 hour shift, 5 days per week. This is based on a base 40 hour week, therefore an allowance is included for 2 hours overtime per day at the time-and-a-half rate. Labour rates are inclusive all burdens, overheads and profit.
4. No additional allowance has been made for extended weekend or premium time working beyond that identified above.
5. Allowance has been made for construction plant such as scaffolding, lifting platforms, excavators, generators, etc during construction.
6. Appointed Architect/Engineer design vendor will provide all issued final design with an approved Professional Engineers stamp and signature.
7. All construction areas are assumed to be classified as ‘un-zoned’ with the exception of final tie-ins and commissioning works which are Zone 3.
8. No allowance has been made for site security (other than temporary fencing).
9. No special allowance has been made for achieving LEED certification.
10. The estimate does not include costs associated with expediting procurement of long lead items. i.e. it assumes that all required materials are ready for incorporation into the works in accordance with the schedule.
11. Snow removal services are excluded and assumed to be provided by OPG.
12. Maintenance of the facility and decommissioning at end of life is excluded.

4.1.2 External Works and Site Investigation

1. There is assumed to be no asbestos or other hazardous material within the existing temporary office buildings.
2. The number and location of existing service to be removed and relocated are assumed to be as identified on information provided by the Project Team and Field Engineering. No allowance has been made for dealing with unidentified services.
3. Allowance has been made for hand excavation within a 1m width either side of identified existing services, the remained of the bulk excavation is by mechanical excavator.
4. Location and temporary diversion of identified (as advised by Field Engineering) existing underground electrical, telephone, fire hydrant and black water services. Note- permanent reinstallation is not included.
5. Allowance has been made for existing asphalt road surfaces to be removed in the area of the excavation, asphalt and kerbs are to be replaced along the two main roads on completion.
6. An allowance of 3nr portacabins for 24 months has been made to accommodate staff from the existing temporary buildings which are being removed as part of this project.
7. A CAT scan to locate existing buried services has not been included, this is assumed to be carried out by OPG.

4.1.3 Substructure

1. Earthwork support for basement excavations is assumed to be achieved using soldier piles and caisson walls, 450mm diameter concrete filled piles with waterproofing
2. Water table is assumed to be at the 97m level, dewatering has been included utilising two pumps, holding tanks, filter bags, generator set, and a 300m pipe run to dispose arisings to the intake.
3. Bulk excavation has been assumed to 84m level, with 1m being in rock. Rock anchors have been included.
4. Dike walls are assumed to be 1.5m thick.
5. There is assumed to be no interference to substructure construction activities due to inclement or winter weather conditions, although based on the proposed schedule we anticipate the impact to be minimal.
6. The total excavation volume is approximately 15,000m3; 50% of excavated material is assumed to be contaminated. Treatment of contaminated excavated material is excluded. Double handling is included for all excavated material to allow for monitoring in temporary stockpile prior to final disposal.
7. Although the volume of the tanks can be contained within a smaller volume the dike walls are assumed to continue to the 100m level. Dike walls utilise nuclear grade concrete and 150kg/m^3 epoxy coated reinforcement. Foundations for tanks include reinforcement at 120kg/m^3.

4.1.4 Superstructure

1. No allowance has been made for freight or passenger elevators
2. External walls above 100m level are assumed to be insitu concrete to 5m height, with insulated sheet metal cladding above. Concrete columns have been included to support the structural steel columns for the upper structure.

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3. 6nr intermediate columns have been included from the 87m level to support the floor above.
4. 18nr columns have been included on the 100m level (center and perimeter) to support the floor above.
5. Slab thickness on the 100m level is assumed to be 400mm to allow sufficient support for loading bay and drum handling activities above. Suspended slab at 107m level is assumed to be 300mm thick.
6. Allowance has been made for the platform of open grid flooring at the 94m level for tank inspection, with 2nr steel spiral staircases for emergency access/egress.
7. Gross floor areas are: Storage area 1010m2; Drum handling 530m2; Cleanup and down graded tanks 100m2; Offices 250m2; Electrical room 250m2; HVAC room 350m2.
8. Perimeter walls to offices are assumed to be concrete filled blockwork, with acoustic drywalls within, and acoustic ceilings.
9. Concrete pavers have been included at roof level for access to HVAC units, with hand-railings at roof perimeter.
10. A two-coat epoxy floor finish is included to storage, HVAC, electrical, drum handling and cleanup areas.
11. Wall finishes in storage area are assumed to be two-coat epoxy coated, no allowance has been made for any additional specialist material for containment of D2O.
12. Floor finishes are assumed to be: Office area, carpet tiles; Washrooms, ceramic tiles.
13. The existing loading bay has been demolished and a temporary loading bay included complete with dock leveller and rolling shutters.
14. Concrete grade for all concrete works is assumed to be M35mpa.
15. A lightning arrester has been included for the main structure.

4.1.5 Building services

1. The new building includes fire detection and alarm capability as well as public announcement.
2. New offices have been provided with a dedicated HVAC system, other areas on a common system.
3. All required services to the new building and temporary site accommodation are assumed to be available for tie-in within 10m of the new structures.

4.1.6 Process systems

1. Option B tanks have been assumed, as per the conceptual design report.
2. Tank sizes are 10% greater than the required storage capacity.
3. Process pipework is assumed to be stainless steel.
4. Cathodic protection is included on all tanks.
5. One demineralised water tank of 1000 litre capacity is included as per our discussions.
6. Block heaters are provided to the storage area.
7. 2nr stack monitors have been included at a rate of $275,000 as advised by OPG, ductwork is measured separately.

4.1.7 F+G Independence

1. F+G have produced this estimate in an independent manner and have not made reference to previous estimates produced for or by OPG for this scheme. All pricing has been produced independently from knowledge of the industry and similar projects and using recognised published data, with the exception of the tank quotations which have been provided by OPG.

4.2 Productivity Factor Calculation

Productivity factors are incorporated into the estimate to allow for the conversion of norms and costs from outside the OPG site to be utilised for pricing of works within the site. These factors are based on past experience and a detailed knowledge of OPG working practices. They are heavily influenced by OPG processes and procedures and by Union Agreements. The majority of work on this project has been classified as being carried out within 'unzoned' area, with a smaller amount being within Zone 3.

The resultant productivity factors are 1.70 for unzoned areas (5.87 productive hours from a 10 hour shift), and 2.33 for Zone 3 areas (4.28 productive hours from a 10 hour shift). A detailed build-up of productivity factors is attached in Appendix E.

4.3 Crew Rates

The labour rates utilised within the estimate are based on the latest information from tendered rates received by OPG and are available for individual trades types and qualification levels. These rates have been built up into crews for each particular type of work using our experience of OPG working practices and Union requirements (see Appendix F). The resultant crew rates are applied to each estimate line item, together with the productivity factor and quantity, to arrive at a total labour cost for each activity.

Rates are based on EPSCA schedules and are inclusive of union burdens and main contractor burdens such as CPP, EI and EHT, and are inclusive of

5 Other Estimate Details

5.1 SAVH

All SAVH allowances are included the labour rates.

5.2 CMO

CMO costs are included as allowance of 1.25% on total Project Cost within the F+G submitted overnight estimate.

5.3 Escalation

Escalation is excluded from the F+G submitted overnight estimate.

5.4 Contingency

Escalation is excluded from the F+G submitted overnight estimate. These costs will need to be determined from a robust Risk Management process.

5.5 Interest

Interest is excluded from the F+G submitted overnight estimate. To be determined based on project cash flows from P6 schedule.

5.6 EPSCA

EPSCA costs are included within the labour rates in the F+G submitted overnight estimate.

5.7 Engineering Documents

Engineering costs are excluded from the F+G submitted overnight estimate.

5.8 Request for Instructions

We confirm that we have incorporated the effect of all OPG responses contained within RFIs 1 and 2, including the following specific items:

- RFI 001
    - Item 1: Disposal of excavated material – We confirm that we have included for 50% of excavate material to be disposed as contaminated waste, and 50% as uncontaminated waste.
    - Item 4: Epoxy coated rebar – We confirm that we have incorporated epoxy coated reinforcement within the seismic dike (see estimate line item 133)
- RFI 002
    - Item 18: LEED certification – We confirm that as per verbal instruction we have made no special allowances for achieving LEED certification.

6 Recommendations and Conclusion

6.1 Recommendations

a) All assumptions made should be closely monitored against any revised engineering, design development or site conditions.

b) A Risk Review should be performed to determine the appropriate level of contingency against the assessed probability of success.

c) Several assumptions have been made regarding the design and specification of the substructure and superstructure. These should be reviewed in development of contingency.

d) The estimate assumes that groundwater arising from the dewatering operation can be pumped to the inlet works for disposal. We recommend that this assumption is checked with waste management as there could be a significant cost impact if water needs to be tinkered to an alternative location.

e) The provision of spares is excluded from the estimate. We recommend that a spares list be developed which can be individually priced.

f) The estimate currently assumes that all materials are to be procured by OPG and free issued to the contractor. We would recommend however that OPG procurement be limited to long lead and specialist materials and that the contractor be responsible for procurement of general materials such as concrete, reinforcement, steelwork and cladding. The contractor

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should be able to offer this service more cost effectively than OPG and may obtain preferential rates from their suppliers.

g) The estimate assumes that excavation around existing buried services is performed using vacuum excavation. We are aware that there has been difficulty in the past obtaining authorisation from waste management to utilise this technique due to the difficulty in monitoring waste material for contaminations. We recommend authorisation is sought from waste management to utilise this technique, otherwise a more costly and time consuming hand excavation will be required.

h) We have included in the estimate spreadsheet a brief summary of some life cycle costing considerations. These amount to approximately $1.2M at current day prices however we recommend that a more thorough life cycle costing exercise is carried out if these costs are required for project approval. These costs are not included in the total project cost.

i) Approximately half of the total project cost relates to excavation and substructure construction. However if the project were to be constructed above ground there would be a very substantial increase in cost for seismically qualified tanks. If OPG wishes to explore these options then more detailed value engineering exercise should be performed, taking into account construction costs, waste disposal issues and risk.

6.2 Conclusion

a) Estimates were completed for the DNGS Heavy water Management Building as summarized in Executive Summary showing a total estimated cost of $64,600,973.

b) Project scope activities and durations were established from F+ G library of past OPG projects as supplemented by stakeholder meetings. This provides a sustainable basis for Business Case submission.

c) Based on the level of design information available for estimation this estimate has been classified as AACE Class 4. However with a suitable contingency allowance derived from the estimate assumptions it should allow OPG to progress with funding approval. These costs can be further revised alongside with further developed scope and specification.

7 Appendix A – Document Register

7.1 Documents provided by OPG

The following documents were provided by OPG for use in production of this estimate:

Ref	Title
	000 Table of Contents.doc
N-FORM - 11056- R002*	00a Engineering Prejob Briefing.doc
N-FORM - 11056- R002*	00a N-FORM-11056 Eng Pre-Job Brief - Projects.pdf
N-FORM - 10958 R009*	03 N-FORM-10958 Modification Outline.doc
N-FORM - 10853 R002*	04 N-FORM-10853 PSR Determination.doc
N-FORM - 10853 R002*	04 N-FORM-10853 PSR Determination.docx
N-FORM - 10369 R011*	05 N-FORM-10369 CNSC Approvals and Notifications.doc
N-FORM - 10528 R001*	06 N-FORM-10528 Pressure Boundary Designer's Checklist.doc
N-FORM - 10560 R002*	07 N-FORM-10560 Chemistry Design Change Checklist.docx
N-FORM - 10287 R003*	09 N-FORM-10287 Fire Protection Impact Evaluation R01.docx
N-FORM - 10959 R010*	10 N-FORM-10959 Design Scoping Checklist.doc
N-FORM - 10521 R014*	12 N-FORM-10521 Document Scoping Checklist.docx
N-FORM - 10529 R002*	13 N-FORM-10529 Reactor Safety Designer's Checklist.doc
N-FORM - 10580 R005*	14 N-FORM-10580 Identifying Human Factors Level of Activity.doc
N-FORM - 10580 R005*	14 N-FORM-10580 Identifying Human Factors Level of Activity.pdf
N-FORM - 10422 R006*	15 N-FORM-10422 Environmental Impact Worksheet.doc.docx
	BOE.pdf
R00	D2O Storage Building SOW_21NOV11pdf.pdf
	Full Schedule.pdf
	Level 1 Schedule.pdf
N-FORM-10007 R016*	N-FORM-10007 (COMS Screen).docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 FINAL.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 1.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 2.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 3.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet.doc
NK 38-DR000-10001	NK38-DR-38000-10001 R000 Preliminary Design Requirements for the

Ref	Title
	Darlington Heavy Water Management Building West Annex Sigend.pdf
NK 38-REP-0971-02650	NK38-REP-09701-0265054 Darlington Refurbishment D2O Facility Evaluation.pdf
NK 38-REP-10002	NK38-REP-38000-10002 Conceptual Design Report for the Heavy Water Management Building West Annex Signed.pdf
NK 38-REP-10000	N-REP-38000-10000 OPG Heavy Water Storage Management and Drum Handling.pdf
K-015634-REP-0001-R00	OPG D2O Storage Facilities Costing-K-015634-REP-0001-R00 - final.pdf
N-PCH-09701-1001	Project Charter N-PCH-09701-10001-R001.pdf
	Scope ID Worksheet_D2O Storage Building_23NOV11.xlsm
NK38-SOW-38000-10003	NK38-SOW-38000-10003 R001.pdf
	SCOP-PROC-TP-002 - Scope Identification Worksheet V 2 1 (Full Implementation) _ Original (2)_29n0v2011.xlsm
2011-005 rep	2011-005 rep DNGS D20 Storage Facility VE Final Report 20110519.pdf
	Additional Activities_09dec2011.xlsx
	Full Schedule.pdf
	Level 1 Schedule.pdf
NK38-DR-38000-10001 R000	NK38-DR-38000-10001 R000 Preliminary Design Requirements for the Darlington Heavy Water Management Building West Annex Sigend.pdf
NK38-REP-09701-0265054	NK38-REP-09701-0265054 D2O Storage Facility Evaluation.pdf
N-REP-38000-10000	N-REP-38000-10000 OPG Heavy Water Storage Management and Drum Handling.pdf
N-PCH-09701-10001-R001	Project Charter N-PCH-09701-10001-R001.pdf
	SCOP-PROC-TP-002 - ScopeID WS - Full V 3 2 (2)_05dec2011.xlsm
	SCOP-PROC-TP-002 - ScopeID WS - Full V 3 2_original_07dec2011.xlsm

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8 Appendix B – Cost Summary

DNGS Heavy Water Management Building - Summary

Item	Cost		
OPG Project Management and Engineering Oversight and Procurement	$ 4,352,301	9.5% of DFC	[Benchmark: 5% to 10% DFC]
Project Management (including indirects, site based)	$ 9,120,825	20.0% of DFC	[Benchmark: 15% to 25% of DFC]
Engineering	Excluded		[Benchmark: 15% to 25% of DFC]
Construction Costs	$ 45,604,124		
Commissioning & Close out	$ 4,726,180	8.0% of TIC	[Benchmark: 4% to 8% of TIC]
Spares	Excluded		
Profit	Included		
SAVH	Included		
CMO	$ 797,543		
TOTAL	**$ 64,600,973**		

Construction Cost Summary	Cost	Labour	Materials	Construction Equipment	DFL Hours
EXTERNAL WORKS	$ 574,918	$ 171,253	$ 308,304	$ 95,361	3,216.0 hrs
SITE INVESTIGATION	$ -	$ -	$ -	$ -	-
WORKS TO EXISTING STRUCTURES	$ 33,411	$ 17,116	$ 8,225	$ 8,070	284.7 hrs
SUBSTRUCTURE	$ 11,691,224	$ 4,774,118	$ 2,534,689	$ 4,382,417	117,123.5 hrs
SUPERSTRUCTURE	$ 5,439,089	$ 3,684,953	$ 1,061,322	$ 692,814	93,998.5 hrs
STAIRCASES	$ 124,450	$ 37,335	$ 74,670	$ 12,445	555.2 hrs
WINDOWS AND EXTERNAL DOORS	$ 65,952	$ 19,786	$ 39,571	$ 6,595	327.4 hrs
INTERNAL WALLS AND PARTITIONS	$ 735,260	$ 425,016	$ 197,323	$ 112,921	10,671.0 hrs
ELEVATORS, LIFTS AND HOISTS	$ 28,602	$ 8,581	$ 17,161	$ 2,860	142.0 hrs
BUILDING SERVICES	$ 2,899,011	$ 934,863	$ 1,652,159	$ 311,989	14,937.9 hrs
MISCELLANEOUS METALWORK	$ 364,956	$ 109,487	$ 218,974	$ 36,496	1,628.2 hrs
INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT	$ 687,844	$ 220,930	$ 398,660	$ 68,255	3,623.3 hrs
PROCESS EQUIPMENT	$ 22,840,586	$ 4,586,536	$ 15,395,039	$ 2,859,011	96,310.4 hrs
ELECTRICAL CONTROL SYSTEMS	$ 104,179	$ 26,210	$ 51,075	$ 26,894	390.9 hrs
SPECIALIST EQUIPMENT	$ 14,643	$ 1,464	$ 11,714	$ 1,464	21.8 hrs
TOTAL	**$ 45,604,124**	**$ 15,017,646**	**$ 21,968,887**	**$ 8,617,592**	**343,230.9 hrs**

Construction Cost Summary by PBS	Cost	Labour	Materials	Construction Equipment	DFL Hours
Bldg 4.1.1.1	$ 338,003	$ 101,401	$ 202,802	$ 33,800	1,515.1 hrs
Bldg 4.1.1.2	$ 41,453	$ 17,072	$ -	$ 24,381	422.7 hrs
Bldg 4.1.1.5	$ 472,501	$ 141,750	$ 283,500	$ 47,250	2,077.4 hrs
Bldg 4.1.1.6	$ 104,179	$ 26,210	$ 51,075	$ 26,894	390.9 hrs
Bldg 4.1.2.1	$ 397,250	$ 119,175	$ 238,350	$ 39,725	1,746.6 hrs
Bldg 4.1.3.1	$ 142,649	$ 90,889	$ 32,405	$ 19,355	2,108.5 hrs
Bldg 4.1.3.2	$ 21,761	$ 6,528	$ 13,057	$ 2,176	95.7 hrs
Bldg 4.1.3.4	$ 54,367	$ 16,310	$ 32,620	$ 5,437	239.0 hrs
Bldg 4.1.3.5-O	$ 16,344	$ 4,903	$ 9,806	$ 1,634	71.9 hrs
Bldg 4.1.3.6-O	$ 63,560	$ 19,068	$ 32,870	$ 11,622	279.5 hrs
Bldg 4.1.3.8-O	$ 6,068	$ 1,820	$ 3,641	$ 607	26.7 hrs
Bldg 4.1.5.1	$ 79,164	$ 17,289	$ -	$ 61,875	428.1 hrs
Bldg 4.1.5.2	$ 250,025	$ 75,008	$ 150,015	$ 25,003	1,099.3 hrs
Bldg 4.1.5.2-O	$ 4,086	$ 1,226	$ 2,452	$ 409	18.0 hrs
Bldg 4.1.5.3-O	$ 54,076	$ 16,223	$ 32,445	$ 5,408	237.8 hrs
Bldg 4.1.6.1	$ 78,202	$ 23,460	$ 46,921	$ 7,820	359.9 hrs
Bldg 4.1.9.1	$ 100,906	$ 30,272	$ 60,544	$ 10,091	443.7 hrs
Bldg 4.2.1.10-O	$ 69,259	$ 20,778	$ 41,555	$ 6,926	304.5 hrs
Bldg 4.2.1.4	$ 15,460	$ 4,922	$ 8,708	$ 1,830	74.1 hrs
Bldg 4.2.10.1	$ 93,967	$ 28,190	$ 56,380	$ 9,397	407.9 hrs
Bldg 4.2.10.2	$ 4,859	$ 2,458	$ -	$ 2,402	62.5 hrs
Bldg 4.2.10.3-O	$ 10,487	$ 3,146	$ 6,292	$ 1,049	45.5 hrs
Bldg 4.2.2.1	$ -	$ -	$ -	$ -	-
Bldg 4.2.2.5	$ 374,550	$ 112,365	$ 224,730	$ 37,455	1,859.4 hrs
Bldg 4.2.2.7-O	$ 41,744	$ 12,523	$ 25,046	$ 4,174	181.2 hrs
Bldg 4.2.4.1	$ 120,000	$ -	$ -	$ 120,000	-
Bldg 4.2.4.3	$ 14,643	$ 1,464	$ 11,714	$ 1,464	21.8 hrs
Bldg 4.2.6.2	$ 24,245	$ 6,784	$ 12,258	$ 5,203	114.2 hrs
Bldg 4.4.1.1	$ 4,703,549	$ 2,807,545	$ 285,449	$ 1,610,555	75,533.6 hrs
Bldg 4.4.1.2	$ 2,677,230	$ 1,561,662	$ 122,317	$ 993,251	42,252.2 hrs
Bldg 4.4.1.3	$ 2,452	$ 735	$ 1,471	$ 245	10.9 hrs
Bldg 4.4.2.2	$ 41,983	$ 26,098	$ 947	$ 14,938	717.1 hrs
Bldg 4.4.2.2-O	$ 43,090	$ 30,786	$ -	$ 12,304	846.0 hrs
Bldg 4.4.3.1	$ 1,316,833	$ 397,007	$ 778,821	$ 141,005	6,022.5 hrs
Bldg 4.4.3.2	$ 34,398	$ 10,319	$ 20,639	$ 3,440	153.5 hrs
Bldg 4.4.3.3	$ 211,776	$ 63,533	$ 127,065	$ 21,178	946.2 hrs
Bldg 4.4.3.3-O	$ 12,461	$ 3,738	$ 7,477	$ 1,246	61.9 hrs
Bldg 4.4.3.4	$ 154,169	$ 46,251	$ 92,501	$ 15,417	684.0 hrs
Bldg 4.4.3.5-O	$ 97,815	$ 29,345	$ 58,689	$ 9,782	457.0 hrs
Bldg 4.4.5.1	$ 409,483	$ 124,581	$ 241,503	$ 43,398	2,159.6 hrs
Bldg 4.4.5.3	$ 43,458	$ 13,037	$ 26,075	$ 4,346	215.7 hrs
Bldg 4.4.6.1	$ 56,436	$ 16,931	$ 33,861	$ 5,644	280.2 hrs

Bldg 4.4.6.13-O	$ 180,041	$ 68,588	$ 93,978	$ 17,474	1,159.6 hrs
Bldg 4.4.6.14	$ -	$ -	$ -	$ -	-
Bldg 4.4.6.14-O	$ 92,006	$ 27,602	$ 55,204	$ 9,201	430.1 hrs
Bldg 4.4.6.15-O	$ 48,022	$ 43,373	$ -	$ 4,649	1,212.7 hrs
Bldg 4.4.6.1-O	$ 6,644	$ 1,993	$ 3,986	$ 664	33.0 hrs
Bldg 4.4.6.2	$ 28,876	$ 8,663	$ 17,326	$ 2,888	143.4 hrs
Bldg 4.4.6.2-O	$ 20,626	$ 6,188	$ 12,376	$ 2,063	102.4 hrs
Bldg 4.4.6.3	$ 179,538	$ 55,085	$ 106,594	$ 17,860	931.9 hrs
Bldg 4.4.6.3-O	$ 25,887	$ 12,010	$ 6,458	$ 7,419	286.7 hrs
Bldg 4.4.6.4	$ 12,422	$ 3,727	$ 7,453	$ 1,242	61.7 hrs
Bldg 4.4.6.4-O	$ 27,810	$ 8,343	$ 16,686	$ 2,781	138.1 hrs
Bldg 4.4.6.5	$ 198,852	$ 59,656	$ 119,311	$ 19,885	873.8 hrs
Bldg 4.4.6.6	$ 264,416	$ 217,967	$ 3,931	$ 42,519	6,020.9 hrs
Bldg 4.4.6.7	$ 28,602	$ 8,581	$ 17,161	$ 2,860	142.0 hrs
Bldg 4.4.7.1	$ 41,828	$ 11,666	$ 30,162	$ -	336.7 hrs
Bldg 4.4.8.1.3	$ 13,832	$ 13,832	$ -	$ -	342.5 hrs
Bldg 4.7.2.1	$ 117,182	$ 34,449	$ 55,764	$ 26,969	603.3 hrs
Bldg 4.7.2.3	$ 40,951	$ 12,285	$ 24,570	$ 4,095	182.7 hrs
Bldg 4.7.2.4	$ 96,600	$ -	$ 96,600	$ -	-
Bldg 4.7.2.5	$ 10,845	$ 2,532	$ 7,229	$ 1,085	40.2 hrs
PROC 4.2.1.1	$ 2,697,734	$ 2,502,172	$ -	$ 195,563	61,172.4 hrs
PROC 4.2.1.2	$ 159,202	$ 15,565	$ -	$ 143,637	381.2 hrs
PROC 4.2.1.3	$ 490,288	$ 177,992	$ -	$ 312,296	4,378.1 hrs
PROC 4.2.1.7	$ 280,574	$ 84,172	$ 168,344	$ 28,057	1,217.9 hrs
PROC 4.2.2.4	$ 73,182	$ 3,407	$ -	$ 69,775	83.3 hrs
PROC 4.2.5.4	$ 17,201,938	$ 1,168,757	$ 14,499,371	$ 1,533,810	17,005.0 hrs
PROC 4.2.2.6	$ 824,691	$ 247,407	$ 494,815	$ 82,469	3,659.0 hrs
PROC 4.3.5.1	$ 624,250	$ 187,275	$ 374,550	$ 62,425	2,709.7 hrs
SPRP 4.1.8.1	$ 6,810	$ 2,043	$ 3,405	$ 1,362	29.9 hrs
SPRP 4.2.12.1	$ 20,430	$ 6,129	$ 10,215	$ 4,086	91.1 hrs
SPRP 4.3.8.1	$ 3,405	$ 1,022	$ 1,703	$ 681	14.8 hrs
SPRP 4.4.7.1	$ 4,084,141	$ 1,545,505	$ 1,529,268	$ 1,009,367	38,450.0 hrs
SPRP 4.4.7.2	$ 139,787	$ 50,476	$ 55,690	$ 33,621	892.9 hrs
SPRP 4.4.7.4	$ 3,802,843	$ 2,116,207	$ 665,273	$ 1,021,363	49,046.4 hrs
SPRP 4.4.8.1	$ 15,116	$ 9,070	$ 1,512	$ 4,535	154.9 hrs
SPRP 4.7.1.2	$ 174,400	$ 34,880	$ 34,880	$ 104,640	595.8 hrs
SPRP 4.7.1.3	$ 193,620	$ 4,086	$ 8,172	$ 181,362	69.8 hrs
SRP 4.2.12.1	$ -	$ -	$ -	$ -	-
SRP 4.4.7.1	$ -	$ -	$ -	$ -	-
SRP 4.4.8.1	$ -	$ -	$ -	$ -	-
STIE 4.1.7.4	$ 13,350	$ 9,345	$ 2,002	$ 2,002	137.0 hrs
STIE 4.2.1.1	$ 12,348	$ 9,404	$ 460	$ 2,484	229.9 hrs
STIE 4.2.11.1	$ 532,906	$ 201,708	$ 64,098	$ 267,100	4,721.3 hrs
STIE 4.2.11.2	$ 5,841	$ 2,336	$ 2,336	$ 1,168	39.9 hrs
STIE 4.3.7.2	$ 13,350	$ 9,345	$ 2,002	$ 2,002	137.0 hrs
TOTAL	**$ 45,604,124**	**$ 15,017,646**	**$ 21,968,887**	**$ 8,617,592**	**343,230.9 hrs**

Subtotal (Office Costs Only)	**$ 803,682**	**$ 306,750**	**$ 399,154**	**$ 97,777**	**5,820.5 hrs**

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9 Appendix C – OPG Cost Summary

DNGS Heavy Water Management Building - OPG Costs

Total Project Estimate Costs **4,352,301**

Department	Hours	Rate	Cost
IT	446		74,117
Admin	202		11,880
CMO	3,017		277,908
Department Manager	737		98,257
Design Team Leader	1,994		176,470
Project Design	10,890		987,195
Field Engineer	5,332		445,346
Station support	3,852		330,771
Project Management Office	3,912		362,567
Design Project	16,274		1,520,391
Trades	0		0
Total	**46,656**		**4,284,901**

[From US Cost Export]

DNGS Heavy Water Management Building - OPG Costs

Project : D2O STORAGE FACILITY

Code	Description	Hours	Rate	Labor Cost
EM_DTSIN	DesignContract_Technical_Specialist_Intermediate	226	155.22	35,002
EM_DTSSR	DesignContract_Technical_Specialist_Senior	221	177.39	39,114
Design Contract Total		446	**Rate**	74,117
EM_OADAS	Administrative Assistant	202	58.93	11,880
Clerical Support		202	**Rate**	11,880
EM_OCMCA	Contract Administrator	1,803	100.26	180,729
EM_OCMCM	Contract Monitor	1,058	77.04	81,539
EM_OCMFM	FLM Modifications CMO	156	100.26	15,641
CMO Total		3,017	Rate	277,908
EM_ODPMR	Department Manager	737	133.32	98,257
Department Manager Total		737	**Rate**	98,257
EM_OEDTL	Design Team Leader	1,994	88.48	176,470
Design Team Leader Total		1,994	**Rate**	176,470
EM_OEELE	Electrical Engineer	309	88.48	27,362
EM_OEICE	Instrumentation and Control	330	88.48	29,236
EM_OSMTC	Section Manager - Technical	735	97.76	71,854
EM_OEMME	Mechanical Engineer	417	88.48	36,901
EM_OESRE	Engineer Others	7,881	88.48	697,311
EM_OESTE	Structural/Civil Engineer	386	88.48	34,114
EM_OESMR	Engineer ing Section Manager	832	108.68	90,417
Project Design Total		10,890	**Rate**	987,195
EM_OFECV	Field Engineering Civil	1,274	77.04	98,149
EM_OFEEL	Field Engineering Electrical	884	77.04	68,125
EM_OFEFM	FLM Modifications FE	1,489	100.26	149,258
EM_OFEME	Field Engineering Mechanical	1,685	77.04	129,814
Field Engineering Total		5,332	**Rate**	445,346
EM_OMTFM	FLM Maintenance	996	100.26	99,820
EM_OOPFM	FLM Operations	835	100.26	83,747
EM_ORADT	Radiation Technician	560	68.29	38,208
EM_OSTCM	Control Maintainer	677	78.72	53,300
EM_OSTMM	Mechanical Maintainer	53	79.03	4,189
EM_OSTNO	Nuclear Operator	403	76.87	30,979
EM_OSTCV	Civil Maintainer	328	62.51	20,528
Station Support Total		3,852	**Rate**	330,771

DNGS Heavy Water Management Building - OPG Costs

EM_OPCMST	Cost and Schedule Technician	362	77.37	28,011
EM_OPCSA	Cost and Schedule Analyst	3,550	94.24	334,556
Project Managemnet Office Total		3,912	**Rate**	362,567
EM_OPRL1	Project MP4	8,314	88.48	735,648
EM_OPRL2	Project MP5	4,712	88.48	416,874
EM_OPRMR	Design Projects Project Manager	3,248	113.26	367,868
Design Project Total		16,274	**Rate**	1,520,391
				0
Trades Total		0		0
LABOR TOTAL		**46,656**		**4,284,901**

EQUIPMENT		
ZEXPEN	General Expenses	60,900
ZTRAVL	Travel Expenses	6,500
ZCMO_DNG	CMO Allocation	
EQUIPMENT TOTAL		**67,400**

MATERIAL		
MATERIAL TOTAL		**0**

EPSCA		
EPSCA TOTAL		**0**

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10 Appendix D – Construction Cost Estimate

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
	[formulas >>>]							-						-	-		-	$ -		$ -		-	$ -
	EXTERNAL WORKS																						
	Remove existing surfaces							-						-	-		-	$ -		$ -		-	$ -
1	Clearing of Site / Site strip; 250mm deep	8.1.1.1	SPRP 4.4.7.1	56.00	30.50		1.00	1,708.00	m2		m2	PP-DMCDF	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
2	Remove existing Conc Curbs & Dispose	8.1.2.3	SPRP 4.4.7.1	150.00			1.00	150.00	m	0.02	m	CEpg364	Unzoned	1.70	5.10	Groundworks	58.54	$ 298.56	3.50	$ 524.70		-	$ -
3	Remove existing Asphalt pavement and dispose	8.1.2.3	SPRP 4.4.7.1	80.00	7.00		1.00	560.00	m2	0.03	m2	CEpg419	Unzoned	1.70	28.56	Groundworks	58.54	$ 1,671.96	10.43	$ 5,839.68		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Ground investigation							-						-	-		-	$ -		$ -		-	$ -
4	Trial trenches, 3m deep; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1				6.00	6.00	nr	3.18	nr	CEpg419	Unzoned	1.70	32.44	Groundworks	58.54	$ 1,898.87	42.27	$ 253.64		-	$ -
5	Trial trenches, 3m deep, commencing from 3m depth; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1				6.00	6.00	nr	3.18	nr	CEpg419	Unzoned	1.70	32.44	Groundworks	58.54	$ 1,898.87	42.27	$ 253.64		-	$ -
	Temporary services							-						-	-		-	$ -		$ -		-	$ -
6	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminaries		Bldg 4.7.2.5				4.00	4.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	External Lighting	64.38	$ -		$ -		-	$ -
7	Lunchroom Trailers and Washroom Trailers 22ft * 7ft 6" c.w Drying Racks, Lockers, Tables, Seating, heaters, Microwave, etc. Including transportation @$1200/mnth		Bldg 4.7.2.4				28.00	28.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
8	Temporary Offices - 3 - 20' office trailers for 28 months rental @ $750 ea per month including furniture, mobilisation and demobilisation		Bldg 4.7.2.4				28.00	28.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Site access road							-						-	-		-	$ -		$ -		-	$ -
9	Temporary road to new site	8.2.1.1	Bldg 4.7.2.1	120.00	7.00		1.00	840.00	m2		m2	ARpg429/430	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
	Temporary car parking							-						-	-		-	$ -		$ -		-	$ -
10	Car parking alternatives	8.2.1.3	Bldg 4.7.2.1	6.00	3.00		20.00	360.00	m2		m2	CEpg579	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
	Temporary Fencing, Railing and Walls							-						-	-		-	$ -		$ -		-	$ -
11	Fencing, OPG Standard Security height, 2.4m; Corner posts braced, intermediate posts at 3m centres, 1.2m set in ground, concrete surround.	8.4.1.1	Bldg 4.7.2.3	220.00			1.00	220.00	m		m	PP-DMCDF	Unzoned	1.70	-	Fencing	67.24	$ -		$ -		-	$ -
12	Pedestrian access around new site		Bldg 4.7.2.1	120.00	5.00		1.00	600.00	m2	0.02	m2	Cepg 289	Unzoned	1.70	20.40	Roadworks Crew	58.54	$ 1,194.26	0.67	$ 402.00	6.05	9.98	$ 5,989.50
13	Gates (3.6 Mx1.175 H)	8.4.1.3	Bldg 4.7.2.1				4.00	4.00	nr		nr	CE pg 336	Unzoned	1.70	-	Fencing	67.24	$ -		$ -		-	$ -
	Street Furniture							-						-	-		-	$ -		$ -		-	$ -
14	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminnaire	8.7.9.2	SPRP 4.4.7.2				5.00	5.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	External Lighting	64.38	$ -		$ -		-	$ -
15	Bollards; permanent bollard; non illuminated; galvanised steel removable and lockable pattern	8.4.4.3	SPRP 4.4.7.2				40.00	40.00	nr	0.80	nr	CEpg441	Unzoned	1.70	54.40	Concrete	62.13	$ 3,380.06	19.02	$ 760.98	131.26	216.58	$ 8,663.16
16	Turnstiles		SPRP 4.4.7.2				4.00	4.00	nr		nr	PP-WESB	Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
17	Directional signage		SPRP 4.4.7.2				10.00	10.00	nr	0.09	nr	ARpg401	Unzoned	1.70	1.53	Concrete	62.13	$ 95.06		$ -	250.00	412.50	$ 4,125.00
18	Removal of one Light post incld UG cable		SPRP 4.4.7.2				1.00	1.00	nr	0.61	nr	CEpg365	Unzoned	1.70	1.04	External Lighting	64.38	$ 66.76	68.24	$ 68.24		-	$ -
	External drainage							-						-	-		-	$ -		$ -		-	$ -
19	Sewer line connections to main line		STIE 4.2.11.2	40.00			1.00	40.00	m		m	PP-DMCDF	Zone 3	2.33	-	Groundworks	58.54	$ -		$ -		-	$ -
20	Storm water connections to main line		STIE 4.2.11.2	110.00			1.00	50.00	m		m	Rate Buildup	Zone 3	2.33	-	Groundworks	58.54	$ -		$ -		-	$ -
21	Manholes/Access chambers; 750 x 700 chamber 1500 depth to invert; includes excavation, support, backfilling and disposal, concrete base, brickwork chamber, concrete cover slab, concrete benching and channels, step irons, access cover and frames	8.6.1.5	SPRP 4.4.7.2				6.00	6.00	nr		nr	CEpg229	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
22	Valve Chambers; 1.2m diameter x 2.5m depth	8.6.1.5	SPRP 4.4.7.2				4.00	4.00	nr		nr	CEpg390	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
23	Weeper tiles (perforated pipe in drainage under slab on grade c/w Geotextile membrane and stone surround (600mm Dia)		SPRP 4.4.7.1				155.00	155.00	m					-	-	Groundworks	58.54	$ -		$ -		-	$ -
24	Excavation in rock for weeper tile (1mx1mx1m)		SPRP 4.4.7.1	155.00			1.00	155.00	m3	0.80	m3	CEpg169	Unzoned	1.70	210.80	Groundworks	58.54	$ 12,340.65	49.19	$ 7,623.91		-	$ -
	Connection to existing services							-						-	-		-	$ -		$ -		-	$ -
25	Main water line connections	8.7.1.1	Bldg 4.2.1.4	40.00			1.00	20.00	m		m	ARpg158	Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
26	Fire Hydrants		Bldg 4.2.10.2				2.00	2.00	nr	7.50	nr	MEpg253	Unzoned	1.70	25.50	Plumbers	66.47	$ 1,694.99		$ -	727.76	1,200.80	$ 2,401.61
27	CCTV cameras		Bldg 4.1.3.6-O				16.00	16.00	nr		nr	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
28	Buried Services - Appendix - F - Standby Generator Cable Duct		SPRP 4.1.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
29	Buried Services - Appendix - F - Service water - Low pressure		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
30	Buried Services - Appendix - F - Cables 500 below Ground		SPRP 4.1.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
31	Buried Services - Appendix - F- 12" Steam & 3" Condensate return		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
32	Buried Services - Appendix - F- 6" Air		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
33	Buried Services - Appendix - F- 8" Water		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
34	Buried Services - Appendix - F- Inactive Drainage		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
35	Buried Services - Appendix - F- Misc Fire Line		SPRP 4.3.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
36	Buried Services - Appendix - F-Fire Protection		SPRP 4.3.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
37	Buried Services - Appendix - F-Helium		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
38	Buried Services - Appendix - F- Oxygen		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
39	Buried Services - Appendix - F-Argon		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
40	Buried Services - Appendix - F-Nitrogen		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
41	Buried Services - Appendix - F-Box Drain Sump		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
42	Buried Services - Appendix - F-600 mm Dia Corrugated Steel Pipe CSP Yard Drainage		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
43	Relocate Existing Cable Duct from Standby Generators OIL Tanks # 1 & 2		SPRP 4.2.12.1	50.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
44	Relocate existing Low Pressure Service Water open system piping.		SPRP 4.2.12.1	30.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
	Demolition/removal of existing structures							-						-	-		-	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour									Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
45	Demolition of existing building (Offices)	9.2.1.1	SPRP 4.4.8.1	7.00	3.00	2.50	3.00	157.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
46	Demolition of existing underground services (Offices)	9.2.1.2	SPRP 4.4.8.1	7.00	3.00	0.50	3.00	31.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
47	Temporary Terminating of services	9.4.1.2	Bldg 4.7.2.5				4.00	4.00	nr		nr	MEpg226	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Asphalt road							-						-	-		-	$ -		$ -		-	$ -
48	Reinstatement of Asphalt road (incld roadbase)		SPRP 4.4.7.2	40.00	4.00		1.00	160.00	m2		m2	ARpg429/430	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
49	New Kerbs at roads (reinstated road portions)		SPRP 4.4.7.2	64.00			1.00	64.00	m		m	CE pg 80	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
50	Line painting;Continuous line in reflectorised white 200mm wide		SPRP 4.4.7.2	160.00			1.00	160.00	m		m	CEpg439	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
51	Road signs		SPRP 4.4.7.2				4.00	4.00	nr		nr	ARpg155	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 24,540.05**		**$ 15,726.79**			**$ 21,179.27**
	SITE INVESTIGATION																						
52	CAT scan of existing buried services and other obstacles	9.5.3.1	SPRP 4.4.7.1				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	WORKS TO EXISTING STRUCTURES																						
53	Remove existing Loading bay and Dock	7.1.1.1	SPRP 4.4.8.1	6.00	5.50	2.50	1.00	82.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
54	Cut and patch at new openings for pipes	7.1.1.2	SPRP 4.4.7.2				50.00	50.00	nr		nr		Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
55	New door for Access to new building	7.1.1.2	Bldg 4.4.6.1				1.00	1.00	nr		nr	ARp141	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Minor building works							-						-	-		-	$ -		$ -		-	$ -
56	Repairs to existing building after Ramp removal	8.8.1.1	SPRP 4.4.7.2	25.00	5.00		1.00	125.00	m2		m2	ARp489	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
57	Repairs to existing building after Loading dock removal	8.8.1.3	SPRP 4.4.7.2	5.00	5.00		1.00	25.00	m2		m2	ARp489	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	SUBSTRUCTURE																						
	EXCAVATION							-						-	-		-	$ -		$ -		-	$ -
	Bulk excavation							-						-	-		-	$ -		$ -		-	$ -
58	Vacuum Excavation (uptp 2.5 M) at buried services (4 weeks@$40,000/week		SPRP 4.7.1.2				4.00	4.00	wks					-	-	Groundworks	58.54	$ -		$ -		-	$ -
59	Hand Excavation around buried services		SPRP 4.4.7.1	25.00	0.30	0.30	4.00	9.00	m3	3.15	m3	CE pg 183	Unzoned	1.70	48.20	Groundworks	58.54	$ 2,821.43		$ -		-	$ -
60	Bulk excavation for tank farm; 10-15m max depth		SPRP 4.4.7.1	24.50	50.00	12.50		15,312.50	m3	0.29	m3	CEpg169	Unzoned	1.70	7,549.06	Groundworks	58.54	$ 441,937.22	17.79	$ 272,363.44		-	$ -
61	Extra over for excavation in rock; 1.0-2.0m maximum depth		SPRP 4.4.7.1	24.50	50.00	1.00		1,225.00	m3	0.80	m3	CEpg168	Unzoned	1.70	1,666.00	Groundworks	58.54	$ 97,530.97	49.19	$ 60,253.46		-	$ -
62	Disposal of excavated material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4	15,312.50				15,312.50	m3	0.05	m3	CEpg171	Unzoned	1.70	1,301.56	Groundworks	58.54	$ 76,196.07	4.22	$ 64,680.00		-	$ -
63	Disposal of excavated rock material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.06	m3	CEpg171	Unzoned	1.70	124.95	Groundworks	58.54	$ 7,314.82	5.08	$ 6,225.45		-	$ -
64	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.23	m3	CEpg171	Unzoned	1.70	478.98	Groundworks	58.54	$ 28,040.15	22.23	$ 27,226.24		-	$ -
65	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	7,656.25				7,656.25	m3	0.22	m3	CEpg171	Unzoned	1.70	2,863.44	Groundworks	58.54	$ 167,631.36	21.25	$ 162,710.63		-	$ -
66	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper; ADDITIONAL for contaminated sludge		SPRP 4.4.7.4	7,656.25				7,656.25	m3		m3	CEpg171	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
67	Disposal of excavated material from temporary spoil heap to licensed tip; Un-contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	7,656.25				7,656.25	m3	0.22	m3	CEpg171	Unzoned	1.70	2,863.44	Groundworks	58.54	$ 167,631.36	21.25	$ 162,710.63		-	$ -
68	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	15,312.50				15,312.50	m3	0.12	m3	CEpg171	Unzoned	1.70	3,123.75	Groundworks	58.54	$ 182,870.57	8.81	$ 134,918.44		-	$ -
69	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.20	m3	CEpg171	Unzoned	1.70	416.50	Groundworks	58.54	$ 24,382.74	14.70	$ 18,009.34		-	$ -
70	Contaminated waste disposal fees (766 loads x 10 = 7660 M3)		SPRP 4.4.7.4	765.63				765.63	loads			not included	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Detailed excavation							-						-	-		-	$ -		$ -		-	$ -
71	Detailed excavation for 100Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	3.14	9.00	1.50	19.00	805.82	m3	0.80	m3	CEpg169	Unzoned	1.70	1,095.91	Groundworks	58.54	$ 64,156.95	49.19	$ 39,635.39		-	$ -
72	Detailed excavation for 50Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	3.14	6.25	1.50	2.00	58.90	m3	0.80	m3	CEpg169	Unzoned	1.70	80.11	Groundworks	58.54	$ 4,689.84	49.19	$ 2,897.32		-	$ -
73	Detailed excavation for 25Mg tanks; in rock	1.1.1.1	SPRP 4.4.7.1	3.14	5.06	1.50	4.00	95.43	m3	0.80	m3	CEpg169	Unzoned	1.70	129.78	Groundworks	58.54	$ 7,597.53	49.19	$ 4,693.66		-	$ -
74	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	24.50	1.70	1.00	2.00	83.30	m3	0.80	m3	CEpg169	Unzoned	1.70	113.29	Groundworks	58.54	$ 6,632.11	49.19	$ 4,097.24		-	$ -
75	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	50.00	1.70	1.00	2.00	170.00	m3	0.80	m3	CEpg169	Unzoned	1.70	231.20	Groundworks	58.54	$ 13,534.91	49.19	$ 8,361.71		-	$ -
76	Excavation for Inspection pit	1.1.1.1	SPRP 4.4.7.1	5.50	5.50	13.00	1.00	393.25	m3	0.29	m3	CEpg169	Unzoned	1.70	193.87	Groundworks	58.54	$ 11,349.67	17.79	$ 6,994.74		-	$ -
77	Excavation for Inspection pit ; in rock	1.1.1.1	SPRP 4.4.7.1	5.50	5.50	3.00	1.00	90.75	m3	0.80	m3	CEpg169	Unzoned	1.70	123.42	Groundworks	58.54	$ 7,225.25	49.19	$ 4,463.67		-	$ -
78	Detail Excavation for Weeper Tiles in Rock	1.1.1.1	SPRP 4.4.7.1	172.00	0.40	0.35	1.00	24.08	m3	0.80	m3	CEpg169	Unzoned	1.70	32.75	Groundworks	58.54	$ 1,917.18	49.19	$ 1,184.41		-	$ -
79	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4	25.50	0.40	15.00	2.00	306.00	m3	0.22	m3	CEpg171	Unzoned	1.70	114.44	Groundworks	58.54	$ 6,699.78	21.25	$ 6,503.11		-	$ -
80	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4	51.00	0.40	15.00	2.00	612.00	m3	0.22	m3	CEpg171	Unzoned	1.70	228.89	Groundworks	58.54	$ 13,399.56	21.25	$ 13,006.22		-	$ -
81	Disposal of excavated rock material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.06	m3	CEpg171	Unzoned	1.70	135.48	Groundworks	58.54	$ 7,931.53	5.08	$ 6,750.32		-	$ -
82	Disposal of excavated material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4	393.25				393.25	m3	0.05	m3	CEpg171	Unzoned	1.70	33.43	Groundworks	58.54	$ 1,956.84	4.22	$ 1,661.09		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour									Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
83	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.23	m3	CEpg171	Unzoned	1.70	519.36	Groundworks	58.54	$ 30,404.21	22.23	$ 29,521.67		-	$ -
84	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	393.25				393.25	m3	0.22	m3	CEpg171	Unzoned	1.70	147.08	Groundworks	58.54	$ 8,610.09	21.25	$ 8,357.35		-	$ -
85	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	393.25				393.25	m3	0.12	m3	CEpg171	Unzoned	1.70	80.22	Groundworks	58.54	$ 4,696.41	8.81	$ 3,464.93		-	$ -
86	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.20	m3	CEpg171	Unzoned	1.70	451.61	Groundworks	58.54	$ 26,438.44	14.70	$ 19,527.70		-	$ -
87	Contaminated waste disposal fees	1.2.1.2	SPRP 4.4.7.4	39.33				39.33	loads	0.22		CEpg171	Unzoned	1.70	14.71	Groundworks	58.54	$ 861.01		$ -		-	$ -
	Earthwork support							-						-	-		-	$ -		$ -		-	$ -
88	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter cast-in-place piles; 20N/mm2 concrete; nominal reinforcement	8.8.3.1	SPRP 4.4.7.1			14.00	504.00	7,056.00	m		m	CEpg453	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
89	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter empty bores	8.8.3.1	SPRP 4.4.7.1			14.00	504.00	7,056.00	m		m	CEpg453	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
90	Trimming material other than topsoil, rock or artificial hard material; using D4H dozer, tractor loader or motor grader average rate to sides of caisson walls; 45-90° to horizontal	8.8.3.1	SPRP 4.4.7.1	149.00		12.50	1.00	1,862.50	m2	0.06	m2	CEpg170	Unzoned	1.70	189.98	Groundworks	58.54	$ 11,121.52	2.06	$ 3,841.41		-	$ -
91	Trimming rock; using D6E dozer; vertical to sides of caisson walls	8.8.3.1	SPRP 4.4.7.1	149.00			1.00	149.00	m2	1.06	m2	CEpg170	Unzoned	1.70	268.50	Groundworks	58.54	$ 15,718.41	39.55	$ 5,893.02		-	$ -
92	Steel in Caissons (Soldier Piles) IPN 280 @ 54Kgs/LM; 203 x 203 mm; length 15m		SPRP 4.4.7.1				30.00	30.00	nr		nr	CEpg267	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
93	Waterproofing to sides of wall (inside face); Bituthene 4000; lapped joints; at any inclination	1.3.1.1	SPRP 4.4.7.1	149.00		15.00	1.00	2,235.00	m2	0.08	m2	CEpg479	Unzoned	1.70	303.96	Groundworks	58.54	$ 17,794.43	2.16	$ 4,830.95	12.84	21.19	$ 47,350.71
94	Shoring for inspection pit	8.8.3.1	SPRP 4.4.7.1	28.00		16.00	1.00	448.00	m2				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Dewatering							-						-	-		-	$ -		$ -		-	$ -
95	Dewatering equipment (rental 3months)	9.3.1.1	SPRP 4.7.1.3				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
96	Holding tanks and filter bags(rental 3months)	9.3.1.1	SPRP 4.7.1.3				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
97	75mm pipes for temp dewatering - 2 lines for 300m length discharge to Intake		SPRP 4.7.1.3	600.00			1.00	600.00	m				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
98	Pumps rental (3 months) 600 V - 2 ea		SPRP 4.7.1.3				6.00	6.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
99	Diesel Genset for Pumps rental (3 months)		SPRP 4.7.1.3				6.00	6.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
100	Diesel fuel (50 liters daily for 60 daysx2 ea)		SPRP 4.7.1.3	1.00	1.00	1.00	6,000.00	6,000.00	litres				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	BELOW GROUND CONSTRUCTION							-						-	-		-	$ -		$ -		-	$ -
	Slab on grade							-						-	-		-	$ -		$ -		-	$ -
101	Level and compact bottoms of excavations	1.4.1.1	Bldg 4.4.7.1	21.50	47.00		1.00	1,010.50	m2	0.08	m2	CEpg170	Unzoned	1.70	137.43	Groundworks	58.54	$ 8,045.31	29.85	$ 30,161.91		-	$ -
102	Formwork to sides of slab on grade; plane vertical; width 0.3m	1.4.1.1	Bldg 4.4.1.1	137.00		0.30	1.00	41.10	m2	0.70	m2	CEpg 192	Unzoned	1.70	48.91	Concrete	62.13	$ 3,038.89	13.41	$ 551.34	9.47	15.63	$ 642.21
103	Reinforcement to insitu concrete slab; 100kg/m3; deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.4.1.1	Bldg 4.4.1.2				30.50	30.50	MT	6.15	Tonne	CEpg196	Unzoned	1.70	318.88	Concrete	62.13	$ 19,812.98	149.94	$ 4,573.03	682.96	1,126.88	$ 34,369.76
104	Insitu concrete slab on grade; Grade C40 cement; 300mm thick	1.4.1.1	Bldg 4.4.1.1	21.50	47.00	0.30	1.00	303.15	m3	0.18	m3	CEpg190/187	Unzoned	1.70	92.76	Concrete	62.13	$ 5,763.75	19.06	$ 5,777.28		225.00	$ 68,208.75
105	Less: Pad foundations for tanks	1.4.1.1	Bldg 4.4.1.1				(80.00)	(80.00)	m3	0.18	m3	CEpg190/187	Unzoned	1.70	(24.48)	Concrete	62.13	$ (1,521.03)	19.06	$ (1,524.60)		225.00	$ (18,000.00)
106	Surface finish to insitu concrete slab on grade; Float finish		Bldg 4.4.1.1	21.50	47.00		1.00	1,010.50	m2	0.02	m2	CEpg 202	Unzoned	1.70	34.36	Concrete	62.13	$ 2,134.72		$ -		-	$ -
107	Weeping tiles below slab on grade; 225mm pipes unplasticized pvc pipes	1.4.1.8	Bldg 4.4.1.1	172.00			1.00	172.00	m	0.07	m	CEpg222	Unzoned	1.70	20.47	Groundworks	58.54	$ 1,198.24	0.74	$ 127.71	72.06	118.90	$ 20,450.63
	Pad foundations for tanks							-						-	-		-	$ -		$ -		-	$ -
108	Formwork for 19 - 100 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	3.50	2.00	19.00	835.66	m2	0.52	m2	CEpg192	Unzoned	1.70	738.73	Concrete	62.13	$ 45,899.67	9.97	$ 8,328.22	10.79	17.80	$ 14,877.74
109	Formwork for 2 - 50 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	2.75	1.75	2.00	60.48	m2	0.52	m2	CEpg192	Unzoned	1.70	53.46	Concrete	62.13	$ 3,321.69	9.97	$ 602.70	10.79	17.80	$ 1,076.68
110	Formwork for 4 - 25 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	2.50	1.50	4.00	94.25	m2	0.52	m2	CEpg192	Unzoned	1.70	83.32	Concrete	62.13	$ 5,176.65	9.97	$ 939.27	10.79	17.80	$ 1,677.94
111	Reinforcement in Tank Foundations (150 Kgs/M3); deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.1.1.1	Bldg 4.4.1.2				249.38	249.38	MT	6.15	Tonne	CEpg196	Unzoned	1.70	2,607.22	Concrete	62.13	$ 161,995.43	149.94	$ 37,390.17	682.96	1,126.88	$ 281,015.05
112	Concrete for 19 - 100 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	12.25	2.00	19.00	1,462.41	m3	0.15	m3	CEpg190/187	Unzoned	1.70	372.91	Concrete	62.13	$ 23,170.51	15.97	$ 23,357.63		225.00	$ 329,042.56
113	Concrete for 2- 50 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	7.56	1.75	2.00	83.15	m3	0.15	m3	CEpg190/187	Unzoned	1.70	21.20	Concrete	62.13	$ 1,317.50	15.97	$ 1,328.14		225.00	$ 18,709.66
114	Concrete for 4 - 25 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	6.25	1.50	4.00	117.81	m3	0.15	m3	CEpg190/187	Unzoned	1.70	30.04	Concrete	62.13	$ 1,866.58	15.97	$ 1,881.66		225.00	$ 26,507.19
115	Connection to main inspection pit (600 dia PVC)	1.4.1.8	Bldg 4.4.1.1	50.00				50.00	m				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Inspection chamber							-						-	-		-	$ -		$ -		-	$ -
116	Formwork in Inspection Chamber -Base slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	10.50		0.30	1.00	3.15	m2	0.38	m2	CEpg193	Unzoned	1.70	2.03	Concrete	62.13	$ 126.44	7.28	$ 22.92	12.86	21.22	$ 66.84
117	Formwork in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	10.00		15.00	1.00	150.00	m2	0.48	m2	CEpg193	Unzoned	1.70	122.40	Concrete	62.13	$ 7,605.14	9.21	$ 1,381.05	21.08	34.78	$ 5,217.30
118	Formwork in Inspection Chamber -Walls	1.4.1.8	Bldg 4.4.1.1	11.60		15.00	1.00	174.00	m2	0.48	m2	CEpg193	Unzoned	1.70	141.98	Concrete	62.13	$ 8,821.96	9.21	$ 1,602.02	21.08	34.78	$ 6,052.07
119	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	2.50	2.50		1.00	6.25	m2	0.38	m2	CEpg193	Unzoned	1.70	4.04	Concrete	62.13	$ 250.86	7.28	$ 45.48	12.86	21.22	$ 132.62
120	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	11.60		0.30	1.00	3.48	m2	0.38	m2	CEpg193	Unzoned	1.70	2.25	Concrete	62.13	$ 139.68	7.28	$ 25.32	12.86	21.22	$ 73.84
121	Reinforcement in Inspection Chamber (150kgs/m3)	1.4.1.8	Bldg 4.4.1.2				1.00	1.00	MT	6.15	Tonne	CEpg196	Unzoned	1.70	10.46	Concrete	62.13	$ 649.61	149.94	$ 149.94	682.96	1,126.88	$ 1,126.88
122	Concrete in Inspection Chamber - Blinding; 150-300mm thick	1.4.1.8	Bldg 4.4.1.1	2.60	2.60	0.20	1.00	1.35	m3	0.16	m3	CEpg189/187	Unzoned	1.70	0.37	Concrete	62.13	$ 22.85	3.27	$ 4.42		225.00	$ 304.20
123	Concrete in Inspection Chamber - Base Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	2.60	2.60	0.25	1.00	1.69	m3	0.18	m3	CEpg190/187	Unzoned	1.70	0.52	Concrete	62.13	$ 32.13	19.06	$ 32.21		225.00	$ 380.25
124	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	2.90	0.25	15.00	2.00	21.75	m3	0.22	m3	CEpg190/187	Unzoned	1.70	8.13	Concrete	62.13	$ 505.42	23.30	$ 506.73		225.00	$ 4,893.75
125	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	2.50	0.25	15.00	2.00	18.75	m3	0.22	m3	CEpg190/187	Unzoned	1.70	7.01	Concrete	62.13	$ 435.71	23.30	$ 436.84		225.00	$ 4,218.75
126	Concrete in Inspection Chamber - Top Slab	1.4.1.8	Bldg 4.4.1.1	2.90	2.90	0.25	1.00	2.10	m3	0.18	m3	CEpg190/187	Unzoned	1.70	0.64	Concrete	62.13	$ 39.97	19.06	$ 40.07		225.00	$ 473.06

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour									Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
	Basement Walls							-							-		-	$ -		$ -		-	$ -
127	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1	21.50	1.50	2.00	1.00	64.50	m2	0.47	m2	CEpg192	Unzoned	1.70	51.54	Concrete	62.13	$ 3,202.08	9.14	$ 589.59	9.47	15.63	$ 1,007.84
128	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1	47.00	1.50	2.00	1.00	141.00	m2	0.47	m2	CEpg192	Unzoned	1.70	112.66	Concrete	62.13	$ 6,999.90	9.14	$ 1,288.88	9.47	15.63	$ 2,203.20
129	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1	24.50	2.00	1.50	2.00	147.00	m3	0.15	m3	CEpg190/187	Unzoned	1.70	37.49	Concrete	62.13	$ 2,329.07	15.97	$ 2,347.88		225.00	$ 33,075.00
130	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1	47.00	2.00	1.50	2.00	282.00	m3	0.15	m3	CEpg190/187	Unzoned	1.70	71.91	Concrete	62.13	$ 4,468.02	15.97	$ 4,504.10		225.00	$ 63,450.00
131	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1	21.50	2.00	13.00	1.00	559.00	m2	0.48	m2	CEpg193	Unzoned	1.70	456.14	Concrete	62.13	$ 28,341.82	9.21	$ 5,146.71	21.08	34.78	$ 19,443.14
132	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1	47.00	2.00	13.00	1.00	1,222.00	m2	0.48	m2	CEpg193	Unzoned	1.70	997.15	Concrete	62.13	$ 61,956.54	9.21	$ 11,250.95	21.08	34.78	$ 42,503.60
133	Reinforcement in Walls/Dikes (@120kgs/M3)	1.3.1.1	Bldg 4.4.1.2				1.00	420.00	MT	6.15	Tonne	CEpg196	Unzoned	1.70	4,391.10	Concrete	62.13	$ 272,834.41	149.94	$ 62,972.91	682.96	1,126.88	$ 473,288.51
134	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1	24.50	1.50	13.00	2.00	955.50	m3	0.22	m3	CEpg190/187	Unzoned	1.70	357.36	Concrete	62.13	$ 22,203.84	23.30	$ 22,261.24		225.00	$ 214,987.50
135	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1	47.00	1.50	13.00	2.00	1,833.00	m3	0.22	m3	CEpg190/187	Unzoned	1.70	685.54	Concrete	62.13	$ 42,595.12	23.30	$ 42,705.23		225.00	$ 412,425.00
	Concrete Ancillaries							-							-		-	$ -		$ -		-	$ -
136	Step ladders inside Inspection Chamber	1.4.1.8	Bldg 4.4.3.3				50.00	50.00	nr		nr	CEpg228	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
137	Manhole cover to inspection chamber; Complete with frame; Bed and set in concrete; access cover and frame	1.4.1.8	Bldg 4.4.3.3				1.00	1.00	nr		nr	CEpg228	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
138	Rock anchors; 25mm diameter; 2m length; including drilling, steel and grout	1.4.1.9	Bldg 4.4.1.2				12.00	12.00	nr		nr	CEpg154/MEpg652	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
139	Rock Anchors 25mm - 2M Deep; including drilling, steel and grout	1.1.1.1	Bldg 4.4.1.2				421.00	421.00	nr		nr	CEpg154/MEpg652	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
140	Rock anchors 25mm 2M length for Dike wall		Bldg 4.4.1.2				145.00	145.00	nr					-	-	Groundworks	58.54	$ -		$ -		-	$ -
141	Insulation at Basement upto 1.5 M; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1	149.00		2.00	1.00	298.00	m2	0.08	m2	CEpg344	Unzoned	1.70	40.53	Groundworks	58.54	$ 2,372.59		$ -	5.68	9.37	$ 2,792.86
142	Insulation at Loading bay walls; boards; polystherene standard grade; fixing with adhesive; to floors; 40mm thick		Bldg 4.4.5.1	5.50	5.00		1.00	27.50	m2	0.08	m2	CEpg344	Unzoned	1.70	3.74	Groundworks	58.54	$ 218.95		$ -	5.68	9.37	$ 257.73
143	Insulation at Loading bay slab; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1	5.50	1.50		1.00	8.25	m2	0.06	m2	CEpg344	Unzoned	1.70	0.84	Groundworks	58.54	$ 49.26		$ -	7.13	11.76	$ 97.06
144	Trace heating to Loading bay Ramp & slab		Bldg 4.4.5.1	16.00	5.50		1.00	88.00	m2		m2	PP-Ext Str	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 2,206,514.66**		**$ 1,355,592.48**			**$ 2,114,399.86**
	SUPERSTRUCTURE																						
	Insitu concrete walls to first floor							-						-	-		-	$ -		$ -		-	$ -
145	Formwork - wall above Lvl 100.00 - 5 M high external; basic finish; height 3m above floor level	2.5.1.1	Bldg 4.4.1.1	137.00		5.00	2.00	1,370.00	m2	2.04	m2	ARp203	Unzoned	1.70	4,751.16	Concrete	62.13	$ 295,206.20		$ -	9.55	15.76	$ 21,587.78
146	Reinforcement in concrete walls; 120kgs/m3; 12 mm diameter; bent		Bldg 4.4.1.2				20.55	20.55	MT	24.00	tonne	ARp206	Unzoned	1.70	838.44	Concrete	62.13	$ 52,095.21		$ -	504.01	831.62	$ 17,089.72
147	Concrete wall above Lvl 100.00 - 5 M high external; grade C40	2.5.1.1	Bldg 4.4.1.1	137.00	0.25	5.00	1.00	171.25	m3	2.73	m3	ARp199	Unzoned	1.70	794.77	Concrete	62.13	$ 49,381.92		$ -		225.00	$ 38,531.25
148	Formwork Columns (400x400) - wall above Lvl 100.00 -7.8 M high	2.5.1.1	Bldg 4.4.1.1	4.00	0.40	7.80	12.00	149.76	m2	5.10	m2	ARp204	Unzoned	1.70	1,298.42	Concrete	62.13	$ 80,675.33		$ -	7.53	12.42	$ 1,860.69
149	Reinforcement for Columns (400x400) @ 150 kgs/m3; 12mm diameter; bent		Bldg 4.4.1.2				2.25	2.25	MT	24.00	tonne	ARp206	Unzoned	1.70	91.65	Concrete	62.13	$ 5,694.73		$ -	504.01	831.62	$ 1,868.14
150	Columns (400x400) - Concrete wall above Lvl 100.00 - 7.8 M high	2.5.1.1	Bldg 4.4.1.1	0.40	0.40	7.80	12.00	14.98	m3	4.44	m3	ARp199	Unzoned	1.70	113.04	Concrete	62.13	$ 7,023.50		$ -		225.00	$ 3,369.60
151	Concrete topping finishes - Hardeners; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.1.1	Bldg 4.4.1.1	48.50	21.50		1.00	1,042.75	m2	0.25	m2	ARp383	Unzoned	1.70	443.17	Concrete	62.13	$ 27,535.63		$ -	11.54	19.04	$ 19,855.00
	Insitu concrete upper floors - Beams							-						-	-		-	$ -		$ -		-	$ -
152	Formwork for Beams (300x750)	2.2.1.1	Bldg 4.4.1.1	75.00	1.80		1.00	135.00	m2	2.41	m2	ARp204	Unzoned	1.70	553.10	Concrete	62.13	$ 34,365.73		$ -	9.55	15.76	$ 2,127.26
153	Reinforcement in Beams (300x750) @ 200kg/m3	2.2.1.1	Bldg 4.4.1.2	1.00	17.00	0.20	1.00	3.40	MT	24.00	tonne	ARp206	Unzoned	1.70	138.72	Concrete	62.13	$ 8,619.16		$ -	504.01	831.62	$ 2,827.50
154	Concrete in Beams (300x750)	2.2.1.1	Bldg 4.4.1.1	75.00	0.30	0.75	1.00	16.88	m3	4.44	m3	ARp199	Unzoned	1.70	127.37	Concrete	62.13	$ 7,914.10		$ -		225.00	$ 3,796.88
155	35mpa Concrete in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	660.00	1.00	0.30	1.00	198.00	m3	2.59	m3	ARp199	Unzoned	1.70	871.79	Concrete	62.13	$ 54,167.61		$ -		225.00	$ 44,550.00
156	Formwork in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	660.00			1.00	660.00	m2	3.34	m2	ARpg202	Unzoned	1.70	3,747.48	Concrete	62.13	$ 232,844.05		$ -	9.34	15.41	$ 10,171.26
157	Formwork (sides) in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	103.00		0.30	1.00	30.90	m2	3.34	m2	ARpg202	Unzoned	1.70	175.45	Concrete	62.13	$ 10,901.34		$ -	9.34	15.41	$ 476.20
158	Reinforcement in Suspended slab at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				29.70	29.70	MT	24.00	tonne	ARp206	Unzoned	1.70	1,211.76	Concrete	62.13	$ 75,290.89		$ -	504.01	831.62	$ 24,699.01
159	35 mpa Concrete in Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	103.00	0.35	0.40	1.00	14.42	m3	4.44	m3	ARp199	Unzoned	1.70	108.84	Concrete	62.13	$ 6,762.74		$ -		225.00	$ 3,244.50
160	35 mpa Concrete in Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	73.50	0.35	0.40	1.00	10.29	m3	4.44	m3	ARp199	Unzoned	1.70	77.67	Concrete	62.13	$ 4,825.84		$ -		225.00	$ 2,315.25
161	Formwork for Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	103.50		0.40	2.00	82.80	m2	2.41	m2	ARp204	Unzoned	1.70	339.23	Concrete	62.13	$ 21,077.65		$ -	9.55	15.76	$ 1,304.72
162	Formwork for Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	73.50		0.40	2.00	58.80	m2	2.41	m2	ARp204	Unzoned	1.70	240.90	Concrete	62.13	$ 14,968.18		$ -	9.55	15.76	$ 926.54
163	Reinforcement in Beams at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				6.49	6.49	MT	24.00	tonne	ARp206	Unzoned	1.70	264.63	Concrete	62.13	$ 16,442.31		$ -	504.01	831.62	$ 5,393.86
164	35 mpa Concrete in Column footing (1.2x1.2x1.5) 6 ea	2.2.1.1	Bldg 4.4.1.1	1.20	1.20	1.50	6.00	12.96	m3	0.18	m3	CEpg190/187	Unzoned	1.70	3.97	Concrete	62.13	$ 246.41	19.06	$ 246.99		225.00	$ 2,916.00
165	Rock anchors 25mm 2M length for Col footing 9ea/6ftgs	2.2.1.1	Bldg 4.4.1.2				54.00	54.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
166	Reinforcement in Col footing at 120kgs/m3	2.2.1.1	Bldg 4.4.1.2				1.56	1.56	MT	24.00	tonne	ARp206	Unzoned	1.70	63.45	Concrete	62.13	$ 3,942.50		$ -	504.01	831.62	$ 1,293.33
167	35 mpa Concrete in Columns (600x600) lvl 87.00 to lvl100.00	2.2.1.1	Bldg 4.4.1.1	0.60	0.60	12.60	6.00	27.22	m3	4.44	m3	ARp199	Unzoned	1.70	205.43	Concrete	62.13	$ 12,763.86		$ -		225.00	$ 6,123.60
168	Formwork for Columns (600x600)	2.2.1.1	Bldg 4.4.1.1	4.00	0.60	12.60	6.00	181.44	m2	5.10	m2	ARp204	Unzoned	1.70	1,573.08	Concrete	62.13	$ 97,741.26		$ -	7.53	12.42	$ 2,254.30
169	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				4.08	4.08	MT	24.00	tonne	ARp206	Unzoned	1.70	166.56	Concrete	62.13	$ 10,349.08		$ -	504.01	831.62	$ 3,394.99
170	35 mpa Concrete in Columns (450x450) at Lvl 100.00 to Lvl 107.80	2.2.1.1	Bldg 4.4.1.1	0.45	0.45	7.30	6.00	8.87	m3	4.44	m3	ARp199	Unzoned	1.70	66.95	Concrete	62.13	$ 4,159.65		$ -		225.00	$ 1,995.64
171	Formwork for Columns (450x450)	2.2.1.1	Bldg 4.4.1.1	4.00	0.45	7.30	6.00	78.84	m2	5.10	m2	ARp204	Unzoned	1.70	683.54	Concrete	62.13	$ 42,470.91		$ -	7.53	12.42	$ 979.55
172	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				1.33	1.33	MT	24.00	tonne	ARp206	Unzoned	1.70	54.28	Concrete	62.13	$ 3,372.69		$ -	504.01	831.62	$ 1,106.40
173	Reinforcement at Column locations in Dike walls (ext) @150kgs/m3	2.2.1.1	Bldg 4.4.1.2				4.80	4.80	MT	24.00	tonne	ARp206	Unzoned	1.70	195.84	Concrete	62.13	$ 12,168.22		$ -	504.01	831.62	$ 3,991.76
	Insitu concrete upper floor - Ground floor slab							-						-	-		-	$ -		$ -		-	$ -
174	Formwork for Suspended slab at 100.00	2.2.1.1	Bldg 4.4.1.1	48.50	21.50		1.00	1,042.75	m2	3.34	m2	ARpg202	Unzoned	1.70	5,920.73	Concrete	62.13	$ 367,875.96		$ -	9.34	15.41	$ 16,069.82
175	Reinforcement at Suspended slab at 100.00 (120Kg/m3)	2.2.1.1	Bldg 4.4.1.2	1.00	1.00		44.10	44.10	m2	24.00	tonne	ARp206	Unzoned	1.70	1,799.28	Concrete	62.13	$ 111,795.56		$ -	504.01	831.62	$ 36,674.29

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
176	Concrete in Suspended slab at LVL-100.00; thickness 150-450mm	2.2.1.1	Bldg 4.4.1.1	50.00	24.50	0.30	1.00	367.50	m3	2.59	m3	ARp199	Unzoned	1.70	1,618.10	Concrete	62.13	$ 100,538.37		$ -		225.00	$ 82,687.50
177	Less Concrete at Openings in slab - Elevators/Staircase	2.2.1.1	Bldg 4.4.1.1	1.00	1.00	1.00	1.00	1.00	m3	2.59	m3	ARp199	Unzoned	1.70	4.40	Concrete	62.13	$ 273.57		$ -		225.00	$ 225.00
	Insitu concrete loading bay							-						-	-		-	$ -		$ -		-	$ -
178	Formwork for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		13.00	13.00	m2	3.72	m2	ARpg202	Unzoned	1.70	82.21	Concrete	62.13	$ 5,108.12		$ -	9.55	15.76	$ 204.85
179	Formwork for Walls & Fdn to Loading Bay	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		34.00	34.00	m2	2.04	m2	ARp203	Unzoned	1.70	117.91	Concrete	62.13	$ 7,326.29		$ -	9.55	15.76	$ 535.76
180	Formwork for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		120.00	120.00	m2	2.04	m2	ARp203	Unzoned	1.70	416.16	Concrete	62.13	$ 25,857.48		$ -	9.55	15.76	$ 1,890.90
181	Reinforcement for Loading Bay Walls/Pit/Ramp (120kgs/m3)	5.10.7.1	Bldg 4.4.1.2				120.00	120.00	MT	24.00	tonne	ARp206	Unzoned	1.70	4,896.00	Concrete	62.13	$ 304,205.62		$ -	504.01	831.62	$ 99,793.98
182	Concrete for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1				43.00	43.00	m3	2.82	m3	ARp199	Unzoned	1.70	206.14	Concrete	62.13	$ 12,808.32		$ -		225.00	$ 9,675.00
183	Concrete for Walls at Loading Bay	5.10.7.1	Bldg 4.4.1.1				8.00	8.00	m3	2.73	m3	ARp199	Unzoned	1.70	37.13	Concrete	62.13	$ 2,306.89		$ -		225.00	$ 1,800.00
184	Concrete for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1				31.00	31.00	m3	2.73	m3	ARp199	Unzoned	1.70	143.87	Concrete	62.13	$ 8,939.21		$ -		225.00	$ 6,975.00
	Miscellaneous concrete works							-						-	-		-	$ -		$ -		-	$ -
185	Formwork for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1	80.00		0.15	2.00	24.00	m2	2.04	m2	ARp203	Unzoned	1.70	83.23	Concrete	62.13	$ 5,171.50		$ -	9.55	15.76	$ 378.18
186	Rebar for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.2				0.29	0.29	MT	24.00	tonne	ARp206	Unzoned	1.70	11.75	Concrete	62.13	$ 730.09		$ -	504.01	831.62	$ 239.51
187	Concrete at Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1	80.00	0.30	0.15	1.00	3.60	m3	2.73	m3	ARp199	Unzoned	1.70	16.71	Concrete	62.13	$ 1,038.10		$ -		225.00	$ 810.00
188	Nosing angle SS at Kerb walls at Cleaning at Drum Cleaning areas; angle section bearers; 90 x 90 x 6mm		Bldg 4.4.3.1	80.00			2.00	160.00	m	0.31	m	ARp412	Unzoned	1.70	84.32	Concrete	62.13	$ 5,239.10		$ -	42.43	70.01	$ 11,201.52
189	Precast concrete at mid landing slab inside Inspection chamber		Bldg 4.4.1.1	3.00	0.75	0.20	8.00	3.60	m2		m2		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
190	Precast concrete cover slab to inspection chamber		Bldg 4.4.1.1				1.00	1.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
191	Precast concrete inspection pit; 15m x 2.5m x 2.5m		Bldg 4.4.1.1				15.00	15.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
	Structural steel frame							-						-	-		-	$ -		$ -		-	$ -
192	Base plates for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.3.3				18.00	18.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
193	Foundation Bolts 20mm for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.1.2				72.00	72.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
194	Grouting of Base plates (300x300)	2.1.1.1	Bldg 4.4.1.3				18.00	18.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
195	Intumescent painting to Steel Columns; paint fire protection (60 minutes); spray applied	2.1.1.2	Bldg 4.4.5.3	11.00	1.10		12.00	145.20	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Structural Steel frame work Lvl 107.80 to roof (7.2M Height)							-						-	-		-	$ -		$ -			$ -
196	Steel members in frame work (15kgs/sqft)		Bldg 4.4.3.1				110.00	110.00	MT		tonne	ARp134	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
197	Roof trusses at 115.00m level; Steel roof trusses and beams; thermal and acoustic insulation;aluminum profiled composite cladding	2.3.1.1	Bldg 4.4.3.1				610.00	610.00	m2		m2	ARp135	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Fire protection to structural steelwork							-						-	-		-	$ -		$ -		-	$ -
198	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3				880.00	880.00	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
199	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3				660.00	660.00	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Hoist gantries							-						-	-		-	$ -		$ -		-	$ -
200	Structural Steel Gantry for Hoists 1 T & 5 T	2.1.1.1	Bldg 4.4.3.2	44.00	220.00		1.00	9,680.00	kg		kg	ARp134	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Insitu concrete upper floors							-						-	-		-	$ -		$ -		-	$ -
201	Surface finish to insitu concrete; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.2.1	Bldg 4.4.1.1	880.00			1.00	880.00	m2	0.25	m2	ARp383	Unzoned	1.70	374.00	Concrete	62.13	$ 23,237.93		$ -	11.54	19.04	$ 16,756.08
	Tank inspection platforms							-						-	-		-	$ -		$ -		-	$ -
202	Open grid flooring for inspection around tanks on 94.00m level	2.1.1.1	Bldg 4.4.3.1				590.00	590.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Roof structure							-						-	-		-	$ -		$ -		-	$ -
203	Built up Roof at Lvl 115.00m; steel roof trusses and beams; thermal and acoustic insulation; aluminum profiled composite cladding	2.3.1.3	Bldg 4.4.5.1				600.00	600.00	m2		m2	ARp135	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
204	Waterproofing to Roof	2.3.2.1	Bldg 4.4.5.1				720.00	720.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
205	Waterproofing to openings	2.3.2.1	Bldg 4.4.5.1	16.00			1.00	16.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
206	Metal Flashings	2.3.2.1	Bldg 4.4.3.1	146.00	1.50		1.00	219.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
207	Roof anchors SS on roof (6 nrs)		Bldg 4.4.3.1				6.00	6.00	nr		nr			-	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
208	600 x 600 x 2mm plain Cement tiles on roof at pathways c/w spacers & underpads		Bldg 4.4.6.6	0.60	0.60		380.00	136.80	m2		m2	CEpg81	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
	Rainwater goods							-						-	-		-	$ -		$ -		-	$ -
209	Rainwater down take pipes; fixed to backgrounds; including offsets and shoes; 110mm diameter uPVC	2.3.4.2	Bldg 4.4.5.1	15.00			6.00	90.00	m		m	ARp135	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
	Cladding							-						-	-		-	$ -		$ -		-	$ -
210	Metal cladding External walls at Lvl 105.00 to 107.80; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	137.00		3.80	1.00	520.60	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
211	Metal cladding External walls at Lvl 107.80 to 115.00; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	146.00		7.70	1.00	1,124.20	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
212	Metal cladding external walls to staircase above 115.00m level; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.1.1	18.00		2.80	1.00	50.40	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 2,175,458.80**		**$ 246.99**			**$ 515,968.11**
	STAIRCASES																						
213	Light duty metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide	2.44.1	Bldg 4.4.3.3				8.00	8.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
214	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3				14.00	14.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
215	Light duty spiral metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide - Lvl 87.00 to Lvl 94.00 at Platform -Emergency	2.44.1	Bldg 4.4.3.3				2.00	2.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
216	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3				3.00	3.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
217	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	2.00	2.00		8.00	32.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
218	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	2.00	4.00		4.00	32.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	WINDOWS AND EXTERNAL DOORS																						
219	Aluminium Windows (Offices); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2-O	1.50		1.50	10.00	22.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
220	Aluminium Windows (Drum Handling); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	6.00	13.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
221	Aluminium Windows (HVAC Rm); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	6.00	13.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
222	Aluminium Windows (Roof); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	2.00	4.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
223	Exterior Doors c/w Frame door; single external steel door, including frame, ironmongery, powder coated finish	2.6.2.1	Bldg 4.4.6.1				6.00	6.00	nr		nr	ARp141	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
224	Rolling Shutters and collapsible gtes; galvanised steel; 1 hr fire resisting; self coiling; activated by fusible link; fixing with bolts; 2400 mm x 2750 mm	2.6.1.3	Bldg 4.4.6.1				2.00	2.00	nr		nr	ARp346	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	INTERNAL WALLS AND PARTITIONS																						
	Internal walls and partitions							-						-	-		-	$ -		$ -		-	$ -
225	Concrete filled Hollow Block Masonry 200mm(Offices)	2.7.1.1	Bldg 4.4.2.2-O	46.50		7.80	1.00	362.70	m2	0.56	m2	ARp230	Unzoned	1.70	345.29	Masonry	61.49	$ 21,231.91		$ -	20.56	33.92	$ 12,304.23
226	Concrete filled Hollow Block Masonry 200mm(Clean up Rm)	2.7.1.1	Bldg 4.4.2.2	23.00		7.80	1.00	179.40	m2	0.56	m2	ARp230	Unzoned	1.70	170.79	Masonry	61.49	$ 10,501.80		$ -	20.56	33.92	$ 6,085.97
227	Hollow Block Masonry 150 mm(HVAC/Elec))	2.7.1.1	Bldg 4.4.2.2	43.00		7.20	1.00	309.60	m2	0.20	m2	CEpg488	Unzoned	1.70	105.26	Masonry	61.49	$ 6,472.68	2.64	$ 817.34	14.96	24.68	$ 7,642.17
228	GWB on side of Block Masonry inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	52.50		3.30	1.00	173.25	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
229	GWB (Acoustic) wall inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	46.50		3.50	1.00	162.75	m2		m2	ARp143	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
230	Metal Stud Cement Board walls (Washroom)	2.7.1.1	Bldg 4.4.3.3-O	23.50		3.30	1.00	77.55	m2		m2	ARp143	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
231	Hollow Block Masonry 150mm in Battery room (UPS system)	2.7.1.1	Bldg 4.4.2.2	14.00		3.50	1.00	49.00	m2	0.20	m2	CEpg488	Unzoned	1.70	16.66	Masonry	61.49	$ 1,024.42	2.64	$ 129.36	14.96	24.68	$ 1,209.52
	Surface finishes to internal walls and partitions							-						-	-		-	$ -		$ -		-	$ -
232	Masonry wall Finishes; Two coats emulsion paint finish	3.1.1.1	Bldg 4.4.6.6				1,439.00	1,439.00	m2	0.21	m2	ARp380	Unzoned	1.70	513.72	Building works	60.43	$ 31,044.64		$ -	1.02	1.68	$ 2,421.84
233	GWB Wall Finishes	3.1.1.1	Bldg 4.4.6.15-O				654.00	654.00	m2	0.40	m2	ARp380	Unzoned	1.70	444.72	Building works	60.43	$ 26,874.74		$ -	3.19	5.26	$ 3,442.33
234	Finishes to Concrete walls	3.1.1.1	Bldg 4.4.6.6				3,286.00	3,286.00	m2	0.21	m2	ARp380	Unzoned	1.70	1,173.10	Building works	60.43	$ 70,891.38		$ -	1.02	1.68	$ 5,530.34
235	Epoxy painting to walls at Storage area		Bldg 4.4.6.6	137.00		13.00	1.00	1,781.00	m2	0.25	m2	ARp383	Unzoned	1.70	756.93	Concrete	62.13	$ 47,030.40		$ -	11.54	19.04	$ 33,912.02
236	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	18.00		2.20	1.00	39.60	m2	0.56	m2	ARp371	Unzoned	1.70	37.70	Building Works	60.43	$ 2,278.19		$ -	13.85	22.85	$ 904.96
237	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	5.00		2.20	1.00	11.00	m2	0.56	m2	ARp371	Unzoned	1.70	10.47	Building Works	60.43	$ 632.83		$ -	13.85	22.85	$ 251.38
238	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	1.00		2.20	1.00	2.20	m2	0.56	m2	ARp371	Unzoned	1.70	2.09	Building Works	60.43	$ 126.57		$ -	13.85	22.85	$ 50.28
								-						-	-		-	$ -		$ -			$ -
	2.8 INTERNAL DOORS							-						-	-		-	$ -		$ -			$ -
239	Internal Doors c/w Frames (Offices); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; hardwood faced	2.8.1.2	Bldg 4.4.6.1-O				5.00	5.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
240	Internal Doors c/w Frames (Washroom); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; single leaf	2.8.1.1	Bldg 4.4.6.1-O				2.00	2.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
241	Internal Doors c/w Frames (HVAC); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1				4.00	4.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
242	Fire Resistant doors c/w Frames; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1				4.00	4.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
243	Internal Doors c/w Frames (Clean up room); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1				2.00	2.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
244	New door for Access to new building from Exstg Bldg; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1				3.00	3.00	nr		nr	ARp142	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
245	Automatic door; magnetic locks	2.8.1.2	Bldg 4.4.6.1				18.00	18.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Internal floor finishes							-						-	-		-	$ -		$ -		-	$ -
246	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				100.00	100.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
247	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				100.00	100.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
248	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				530.00	530.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
249	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				530.00	530.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
250	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O				200.00	200.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
251	Heavy duty carpet tiles; to cement and sand base - (Offices)		Bldg 4.4.6.3-O				200.00	200.00	m2	0.28	m2	ARp377	Unzoned	1.70	95.20	Flooring	63.61	$ 6,055.96		$ -	19.22	31.71	$ 6,342.60
252	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O				50.00	50.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
253	Glazed ceramic floor tile; anti-slip tiles		Bldg 4.4.6.3-O				50.00	50.00	m2		m2	ARp146	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
254	Line painting to Floors	3.2.1.6	Bldg 4.4.6.3	300.00			1.00	300.00	m	0.04	m2	ARp434	Unzoned	1.70	20.40	Building works	60.43	$ 1,232.79		$ -	0.19	0.31	$ 94.05
255	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				600.00	600.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
256	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				600.00	600.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
257	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				1,010.00	1,010.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
258	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				1,010.00	1,010.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Ceiling finishes							-						-	-		-	$ -		$ -		-	$ -
259	Paints to ceilings (Storage); two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4				1,010.00	1,010.00	m2		m2	ARp146	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
260	Paints to ceilings; two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4				600.00	600.00	m2		m2	ARp147	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
261	Acoustic ceilings to Offices on anti vibration mounting	3.3.3.1	Bldg 4.4.6.4-O				250.00	250.00	m2		m2	ARp147	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 225,398.30**		**$ 946.70**			**$ 80,191.67**
	ELEVATORS, LIFTS AND HOISTS																						
262	Dock Levellers (Elec Operated)	5.10.7.1	Bldg 4.4.6.7				2.00	2.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
263	Rubber Bumpers on Wall at Loading Bay	5.10.7.1	Bldg 4.4.6.7				8.00	8.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
264	Temporary prefabricated Loading dock (use during construction)		Bldg 4.4.6.7				1.00	1.00	Item				Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	BUILDING SERVICES																						
	Sanitary appliances							-						-	-		-	$ -		$ -		-	$ -
265	Washroom Accessories (complete Male/Fe/HC)	5.1.1.1	Bldg 4.4.6.14-O				1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
	Disposal equipment							-						-	-		-	$ -		$ -		-	$ -
266	Garbage/Recycling Equipment	5.3.3.1	Bldg 4.4.6.14-O				1.00	1.00	nr		nr	ARp155	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Water installations							-						-	-		-	$ -		$ -		-	$ -
267	Hot and cold water installations; complete installation		Bldg 4.2.1.4				250.00	250.00	m2		m2	ARp149	Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
268	Stand alone Demineralized water tank on Metal stand (1000 gallons Cap)		Bldg 4.2.6.2				1.00	1.00	item				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Water installations							-						-	-		-	$ -		$ -			$ -
269	Water Heater 100 litres		Bldg 4.2.6.2	1.00			2.00	2.00	nr	2.00	nr	MEpg238	Unzoned	1.70	6.80	Plumbers	66.47	$ 452.00		$ -	957.44	1,579.78	$ 3,159.55
	Uninterruptible Power Supply							-						-	-		-	$ -		$ -			$ -
270	Static UPS including Control panel & Batteries for 500 KVA @ $495/KVA		Bldg 4.1.1.5				500.00	500.00	kVA		KVA		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
271	Inverter Panels		Bldg 4.1.1.5				2.00	2.00	nr		nr		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
272	Battery Racks		Bldg 4.1.1.5				2.00	2.00	nr		nr		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	ELECTRICAL							-						-	-		-	$ -		$ -			$ -
273	Sub Station (prefabricated) @ $45,000		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
274	Transformer - 1000 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
275	Transformer - 1500 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
276	Transformer - 2000 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
277	Standby Generator (Diesel powered) 1000 KVA @ $350,000		Bldg 4.1.2.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
278	Ring Main Unit 11 kv including Electrical terminations @ $29,700		Bldg 4.1.1.1				3.00	3.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
279	Lighting and power installation - Offices 250m2 -		Bldg 4.1.5.3-O				250.00	250.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
280	Electrical Installation - Storage Area - 1010 m2 - Lighting Installation		Bldg 4.1.5.2				1,010.00	1,010.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
281	Electrical Installation - Facility/Clean up/Drum Handling-630 m2		Bldg 4.1.5.2				630.00	630.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
282	Electrical Installation -HVAC /Electrical Rm - 600 m2 - Lighting Installation		Bldg 4.1.5.2				600.00	600.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
283	Lightening Arrestor (c/w earthing wire, copper rods)		Bldg 4.1.5.2				1.00	1.00	item		item		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Space Heating & Air Treatment							-						-	-		-	$ -		$ -			$ -
284	Heating - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
285	Cooling - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
286	Ductwork - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
287	Heating - Storage Area - 1010 m2		PROC 4.2.1.7				1,010.00	1,010.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
288	BMS System Installation		PROC 4.2.1.7				1,010.00	1,010.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
289	Heating - Facility/Clean up/Drum Handling - 630 m2		PROC 4.2.1.7				630.00	630.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
290	BMS System Installation		PROC 4.2.1.7				630.00	630.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
291	Heating - HVAC/Elec Rm - 600 m2		PROC 4.2.1.7				600.00	600.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
292	BMS System Installation		PROC 4.2.1.7				600.00	600.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	SPRINKLER INSTALLATION							-						-	-		-	$ -		$ -			$ -
293	Offices - 250 m2		Bldg 4.2.10.3-O				250.00	250.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
294	Storage Area - 1010 m2		Bldg 4.2.10.1				1,010.00	1,010.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
295	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.2.10.1				630.00	630.00	m2		m2	MEpg106	Unzoned	-	-	Pipefitters	69.11	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
296	HVAC/Elec Rm - 600 m2		Bldg 4.2.10.1				600.00	600.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	COMMUNICATION INSTALLATION - Fire/Voice Alarm							-						-	-		-	$ -		$ -			$ -
297	Offices - 250 m2		Bldg 4.1.3.8-O				250.00	250.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
298	Storage Area - 1010 m2		Bldg 4.1.3.4				1,010.00	1,010.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
299	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.1.3.4				630.00	630.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
300	HVAC/Elec Rm - 600 m2		Bldg 4.1.3.4				600.00	600.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Natural Gas Installation							-						-	-		-	$ -		$ -			$ -
	Not Required							-						-	-		-	$ -		$ -		-	$ -
	Heating, Ventilation and Air Conditioning							-						-	-		-	$ -		$ -		-	$ -
301	Building Management system tie ins for Office building Heating & Cooling system	5.6.1.1	Bldg 4.2.2.7-O				250.00	250.00	m2		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
302	Main Steam line tie ins from Main Source	5.6.1.1	Bldg 4.2.2.7-O				1.00	1.00	item		item	ARp150	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
303	Local ventilation to WC	5.6.1.1	Bldg 4.2.2.7-O				4.00	4.00	nr		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
304	Ventilation system to toilet areas	5.6.1.1	Bldg 4.2.2.7-O				50.00	50.00	m2		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
305	Electrical Space Heaters at Storage Area - 1010 M2	5.6.2.1	Bldg 4.2.6.2				4.00	4.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
306	Clean Breathing Air System Plant	5.7.1.1	PROC 4.2.1.7				2.00	2.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
307	Service Air System Plant	5.7.1.1	PROC 4.2.1.7				1.00	1.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
308	Instrument System Plant (with dessicant air dryer)	5.7.1.1	PROC 4.2.1.7				1.00	1.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
307	Exhaust Fan with Mech operated Louvers c/w control system	5.7.3.1	Bldg 4.4.6.5				6.00	6.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
309	Pre fab Mech Operated Metal Louvres (prefinished)2x3M	5.7.3.1	Bldg 4.4.6.5				6.00	6.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Electrical installations							-						-	-		-	$ -		$ -		-	$ -
310	Electrical Main Junction & Distribution Box	5.8.1.1	Bldg 4.1.1.2				1.00	1.00	item	3.50			Unzoned	1.70	5.95	Electrical Workers	68.23	$ 405.99		$ -	10,234.18	16,886.40	$ 16,886.40
311	Internal LV wiring	5.8.1.1	Bldg 4.1.1.2				490.00	490.00	m	0.20			Unzoned	1.70	166.60	Electrical Workers	68.23	$ 11,367.62		$ -	9.27	15.30	$ 7,494.80
312	Lighting & Fixtures (Office)	5.8.3.1	Bldg 4.1.5.2-O				12.00	12.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
313	Lighting & Fixtures (Storage)	5.8.3.1	Bldg 4.1.5.2				20.00	20.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
314	Lighting & Fixtures (HVAC room)	5.8.3.1	Bldg 4.1.5.2				8.00	8.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
315	Lighting & Fixtures (External)	5.8.3.1	Bldg 4.1.5.2				18.00	18.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
316	Special Lighting systems	5.8.4.1	Bldg 4.1.5.2				4.00	4.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
317	Way finding Signs (Illuminated)	5.8.4.1	Bldg 4.1.5.2				16.00	16.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Fire and lightening protection							-						-	-		-	$ -		$ -		-	$ -
318	Fire alarms/appliances		Bldg 4.1.6.1	1.00	1.00	1.00	2,500.00	2,500.00	m2				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
319	Lightening protection system	5.11.2.1	Bldg 4.1.6.1	1.00	1.00	1.00	2,500.00	2,500.00	m2				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
320	Fire and Smoke Detectors		Bldg 4.1.6.1				16.00	16.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
	Communication, security and control systems							-						-	-		-	$ -		$ -		-	$ -
321	LAN	5.12.1.2	Bldg 4.1.3.5-O				12.00	12.00	nr		nr	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
322	Internal Communication system; Telecommunication System	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
323	Public address system	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
324	Central security control devices; Security Systems; Security Lights and lighting system,	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
325	TV monitors	5.12.1.14	Bldg 4.1.3.6-O				8.00	8.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
326	Surveillance equipment; detectors and alarms	5.12.1.1	Bldg 4.1.3.2				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
	Builders work in connection with building services							-						-	-		-	$ -		$ -		-	$ -
327	Cutting and Patching	5.14.1.1	STIE 4.2.11.1				100.00	100.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
328	Fire & smoke stopping	5.14.1.1	Bldg 4.1.6.1				2,490.00	2,490.00	m2				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
329	Ducts/Pipe sleeves/Openings	5.14.1.1	STIE 4.2.11.1				150.00	150.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
330	Housekeeping pads; 150mm thick	5.14.1.1	Bldg 4.4.1.1	3.00	6.00		15.00	270.00	m2				Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
331	Housekeeping pads; 100mm thick	5.14.1.1	Bldg 4.4.1.1	1.50	2.50		10.00	37.50	m2				Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
	Ducts for incoming services							-						-	-		-	$ -		$ -		-	$ -
332	Excavation for Duct bank for services (incoming)		SPRP 4.4.7.1	30.00	1.50	1.50	1.00	67.50	m3	0.29	m3	CEpg169	Unzoned	1.70	33.28	Groundworks	58.54	$ 1,948.13	17.79	$ 1,200.62		-	$ -
333	Concrete in blinding for Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	1.00	0.10	1.00	3.00	m3	0.16	m3	CEpg189/187	Unzoned	1.70	0.82	Concrete	62.13	$ 50.70	3.27	$ 9.80	92.91	153.30	$ 459.90
334	Concrete in base slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.90	0.15	1.00	4.05	m3	0.18	m3	CEpg190/187	Unzoned	1.70	1.24	Concrete	62.13	$ 77.00	19.06	$ 77.18	92.91	153.30	$ 620.87
335	Concrete in walls Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.15	1.05	2.00	9.45	m3	0.22	m3	CEpg190/187	Unzoned	1.70	3.53	Concrete	62.13	$ 219.60	23.30	$ 220.17	92.91	153.30	$ 1,448.70
336	Concrete in roof slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.90	0.15	1.00	4.05	m3	0.18	m3	CEpg190/187	Unzoned	1.70	1.24	Concrete	62.13	$ 77.00	19.06	$ 77.18	92.91	153.30	$ 620.87
337	Formwork in walls Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		1.05	2.00	63.00	m2	2.04	m2	ARp203	Unzoned	1.70	218.48	Concrete	62.13	$ 13,575.18		$ -	9.55	15.76	$ 992.72
338	Formwork for Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		0.75	2.00	45.00	m2	3.34	m2	ARpg202	Unzoned	1.70	255.51	Concrete	62.13	$ 15,875.73		$ -	9.34	15.41	$ 693.50
339	Formwork for roof slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		0.75	1.00	22.50	m2	3.34	m2	ARpg202	Unzoned	1.70	127.76	Concrete	62.13	$ 7,937.87		$ -	9.34	15.41	$ 346.75
340	Reinforcement for Duct bank for services (incoming)		Bldg 4.4.1.2				1.00	1.00	MT	24.00	tonne	ARp206	Unzoned	1.70	40.80	Concrete	62.13	$ 2,535.05		$ -	504.01	831.62	$ 831.62
	Tie-ins to existing services							-						-	-		-	$ -		$ -		-	$ -
	Testing and commissioning building services							-						-	-		-	$ -		$ -		-	$ -
341	Testing Telecommunication System;		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
342	Testing Public Address System;		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
343	Testing Fire Detection and Alarm Systems		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
344	Testing Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
345	Testing Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
346	Testing Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
347	Commissioning Telecommunication System;		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
348	Commissioning Public Address System;		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
349	Commissioning Fire Detection and Alarm Systems		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
350	Commissioning Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
351	Commissioning Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
352	Commissioning Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
353	Specialist Training and Information sharing	5.15.1.1	Bldg 4.4.8.1.3				60.00	60.00	hours	1.00	hrs		Zone 3	2.33	139.80	Electrical Workers	68.23	$ 9,538.97		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 64,060.83**		**$ 1,584.96**			**$ 33,555.67**
	MISCELLANEOUS METALWORK																						
354	Railings at Roof top; mild steel balustrade and steel handrail; 1100mm high		Bldg 4.4.3.3	146.00			1.00	146.00	m		m	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
355	Miscellaneous metals (Offices)		Bldg 4.4.3.5-O				1.00	1.00	LS		LS		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
356	Miscellaneous Mmetals (Building)		Bldg 4.4.3.1				1.00	1.00	LS		LS		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT																						
	General fixtures and fittings							-						-	-		-	$ -		$ -		-	$ -
357	Furniture to Offices (18 personnel)		Bldg 4.4.6.13-O				18.00	18.00	people		nr	PP	Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
358	Furniture to Conference room and Admin area		Bldg 4.4.6.13-O				1.00	1.00	item				Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
359	Window Blinds; 2.0m wide		Bldg 4.4.6.13-O				10.00	10.00	nr	1.45	nr	ARp395	Unzoned	1.70	24.65	Building works	60.43	$ 14,896.17		$ -	109.78	181.14	$ 1,811.37
360	Eye wash Station		Bldg 4.4.6.14-O				2.00	2.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
361	Emergency Shower		Bldg 4.4.6.14-O				2.00	2.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
362	Laboratory Shelving		Bldg 4.4.6.14-O				1.00	1.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
363	Change room station		Bldg 4.4.6.14-O				1.00	1.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
364	Fume hoods - cover at all tanks		Bldg 4.2.2.5				25.00	25.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
365	Fume hoods @ Drum Cleaning Area		Bldg 4.2.2.5				2.00	2.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
365	Radiation monitors (Storage area)		Bldg 4.1.9.1				1.00	1.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
366	SAM - Small Article Monitor		Bldg 4.1.9.1				1.00	1.00	nr			PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
367	Motion detector		Bldg 4.1.9.1				8.00	8.00	nr			PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 14,896.17**		**$ -**			**$ 1,811.37**
	PROCESS EQUIPMENT																						
	PHT D2O Supply Tanks (8 ea)							-						-	-		-	$ -		$ -		-	$ -
368	Tanks 100 Mg 38110 - SS 304 Class 6		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
369	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
370	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
371	Pressure sensors		PROC 4.2.1.3				8.00	8.00	nr	6.00			Unzoned	1.70	81.60	Pipefitters	69.11	$ 5,639.62		$ -		517.00	$ 4,136.00
372	Level sensors		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Pipefitters	69.11	$ 7,519.49		$ -		2,269.00	$ 36,304.00
373	Pressure Gauges		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Pipefitters	69.11	$ 7,519.49		$ -		1,493.00	$ 23,888.00
374	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			8.00	600.00	m	0.58			Unzoned	1.70	586.50	Pipefitters	69.11	$ 40,534.77		$ -		52.15	$ 31,290.00
375	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			8.00	600.00	m	0.58			Unzoned	1.70	586.50	Pipefitters	69.11	$ 40,534.77		$ -		52.15	$ 31,290.00
376	Switches - 2 level		PROC 4.2.1.3				16.00	16.00	nr	3.50			Unzoned	1.70	95.20	Electrical Workers	68.23	$ 6,495.78		$ -		1,011.00	$ 16,176.00
377	Transmitters - 2 ea		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Electrical Workers	68.23	$ 7,423.75		$ -		554.00	$ 8,864.00
378	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				8.00	8.00	nr	4.00			Unzoned	1.70	54.40	Electrical Workers	68.23	$ 3,711.88		$ -		758.00	$ 6,064.00
379	Isolation Valve		PROC 4.2.1.2				8.00	8.00	nr	0.39			Unzoned	1.70	5.30	Pipefitters	69.11	$ 366.58		$ -		2,577.00	$ 20,616.00
380	Data Cables to Control room		Bldg 4.1.3.1	90.00			8.00	720.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
381	Item-6- Cover gas Vent Control Valve pnuematic control Valve and Accessories		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
382	Item - 8 - Cover Gas Relief Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
383	Item - 9 - Main Outlet Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
384	Item - 11 & 12 - Outlet Isolation Valves		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
385	Item - 15 - Main Inlet Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
386	Item 24 & 25 - Inlet Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
387	Item - 26 - Cover Gas Supply Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
388	Item - 28 - Supply Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
389	Item - 29 - Vacuum Relief Valve		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
390	Item - 32 - Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -		517.00	$ 517.00
391	Item 33 & 34 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	3.50			Unzoned	1.70	11.90	Electrical Workers	68.23	$ 811.97		$ -		2,269.00	$ 4,538.00
392	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.5.4				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		-	$ -
393	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Moderator D2O Supply Tanks(7 ea)							-						-	-		-	$ -		$ -			$ -
394	Tanks 100 Mg 38110; SS 304 Class 3		PROC 4.2.5.4				7.00	7.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
395	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				7.00	7.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
396	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
397	Valves		PROC 4.2.1.2				14.00	14.00	nr	0.39			Unzoned	1.70	9.28	Pipefitters	69.11	$ 641.51		$ -		-	$ -
398	Pressure sensors		PROC 4.2.1.3				7.00	7.00	nr	6.00			Unzoned	1.70	71.40	Pipefitters	69.11	$ 4,934.67		$ -		517.00	$ 3,619.00
399	Level sensors		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Pipefitters	69.11	$ 6,579.56		$ -		2,269.00	$ 31,766.00
400	Pressure Gauges		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Pipefitters	69.11	$ 6,579.56		$ -		1,493.00	$ 20,902.00
401	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			7.00	525.00	m	8.00			Unzoned	1.70	7,140.00	Pipefitters	69.11	$ 493,466.82		$ -		52.15	$ 27,378.75
402	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			7.00	525.00	m	6.00			Unzoned	1.70	5,355.00	Pipefitters	69.11	$ 370,100.12		$ -		52.15	$ 27,378.75
403	Switches - 2 level		PROC 4.2.1.3				14.00	14.00	nr	3.50			Unzoned	1.70	83.30	Electrical Workers	68.23	$ 5,683.81		$ -		1,011.00	$ 14,154.00
404	Transmitters - 2 ea		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Electrical Workers	68.23	$ 6,495.78		$ -		554.00	$ 7,756.00
405	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				7.00	7.00	nr	4.00			Unzoned	1.70	47.60	Electrical Workers	68.23	$ 3,247.89		$ -		758.00	$ 5,306.00
406	Isolation Valve		PROC 4.2.1.2				7.00	7.00	nr	0.39			Unzoned	1.70	4.64	Pipefitters	69.11	$ 320.75		$ -		2,577.00	$ 18,039.00
407	Data Cables to Control room		Bldg 4.1.3.1	90.00			7.00	630.00	m	0.39			Zone 3	2.33	572.48	Electrical Workers	68.23	$ 39,062.10		$ -		12.10	$ 7,623.00

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
408	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.1.3				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		-	$ -
409	Item-5-Cover Gas Vent Control Pnuematic Valve & Accessories- 2 "		PROC 4.2.1.2				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		790.00	$ 790.00
410	Item-7-Cover Gas Relief Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
411	item-10-Main Outlet Header Isolation Valve 3 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
412	Item-13&14- Outlet Isolation Valve - 3 "		PROC 4.2.1.2				2.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
413	Item - 18 & 19- Inlet Isolation Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		460.00	$ 920.00
414	Item - 27 - Cover Gas Supply Isolation Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
415	Item - 30 - Vacuum Relief Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	4.50			Unzoned	1.70	15.30	Pipefitters	69.11	$ 1,057.43		$ -		1,170.00	$ 2,340.00
416	Item - 31- Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	6.00			Unzoned	1.70	10.20	Electrical Workers	68.23	$ 695.98		$ -		517.00	$ 517.00
417	Item- 35 & 36 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		2,269.00	$ 4,538.00
418	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TRF/SUP Feed Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
419	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
420	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
421	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
422	Valves		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		-	$ -
423	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
424	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
425	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
426	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
427	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
428	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
429	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
430	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
431	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
432	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
433	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TRF/SUP Product Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
434	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
435	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
436	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
437	Valves		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		-	$ -
438	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
439	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
440	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
441	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
442	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
443	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
444	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
445	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
446	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
447	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
448	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Downgraded D2O Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
449	Tanks 50 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
450	Tanks 50 Mg 38500 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
451	Tanks 50 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
452	Valves; 3"		PROC 4.2.1.2				4.00	4.00	nr	0.39	nr		Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		790.00	$ 3,160.00
453	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
454	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
455	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
456	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
457	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
458	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
459	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
460	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
461	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
462	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
463	Item - 38 & 39 - Transfer Pump; including Item 40 & 41 24 HP motor		PROC 4.2.2.4				2.00	2.00	nr	4.00	nr		Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		13,955.00	$ 27,910.00
464	Item - 42 & 43 - Check Valve 1 1/2 "		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		1,039.00	$ 2,078.00
465	Item - 44 - Main Inlet Header Check valve 1 1/2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
466	Item - 45 - Cover Gas Vent Control Valve pnuematic Control Valve and Accessories 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
467	Item - 46 & 47 - Outlet Control Valve and Accessories 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
468	Item 48 & 49 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
469	Item - 50 - Cover Gas Relief Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
470	Item 51 & 52 - Relief Valve - 1 1/2 "		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		620.00	$ 1,240.00
471	Item 53 & 54 - Inlet Isolation Valve 2 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		770.00	$ 1,540.00
472	Item 55 - Cover Gas Supply Isolation Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
473	Item 56 - Cover Gas Drain Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
474	Item 57 - Vent Isolation Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
475	Item - 58 - Recirculation Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
476	Item - 59 - Clean up system Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
477	Item - 60 & 61 - Outlet Isolation Valve 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
478	Item - 62 - Transfer System Supply Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
479	Item - 63 - Main Discharge Header Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
480	Item - 64 & 65 - Main Inlet Header Spare Connection Isolation Valve 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
481	Item - 66 - Main Inlet Header Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		460.00	$ 460.00
482	Item - 67 - Vacuum Relief Valve - 2"		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
483	Item - 68 - Recirculation Flow Orifice 1 1/2"		PROC 4.2.1.3				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
484	Item 69 & 70 - Commissioning Strainer 2 1/2"		PROC 4.2.1.3				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		300.00	$ 600.00
485	Item 71 & 72 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		2,269.00	$ 4,538.00
486	Item 73 - Cover Gas Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	6.00			Unzoned	1.70	10.20	Electrical Workers	68.23	$ 695.98		$ -		517.00	$ 517.00
487	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Downgraded D2O Tank (1 ea)							-						-	-		-	$ -		$ -			$ -
488	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
489	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
490	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
491	Valves; 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		620.00	$ 1,240.00
492	Pressure sensors		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Pipefitters	69.11	$ 469.97		$ -		517.00	$ 517.00
493	Level sensors		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		2,269.00	$ 4,538.00
494	Pressure Gauges		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		1,493.00	$ 2,986.00
495	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			1.00	75.00	m	0.58			Unzoned	1.70	73.31	Pipefitters	69.11	$ 5,066.85		$ -		52.15	$ 3,911.25
496	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			1.00	75.00	m	0.58			Unzoned	1.70	73.31	Pipefitters	69.11	$ 5,066.85		$ -		52.15	$ 3,911.25
497	Switches - 2 level		PROC 4.2.1.3				2.00	2.00	nr	3.50			Unzoned	1.70	11.90	Electrical Workers	68.23	$ 811.97		$ -		1,011.00	$ 2,022.00
498	Transmitters - 2 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		554.00	$ 1,108.00
499	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -		758.00	$ 758.00
500	Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
501	Data Cables to Control room		Bldg 4.1.3.1	90.00			1.00	90.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
502	Item - 100 - Transfer System Feed Isolation Valve - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
503	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	CLEAN Up D2O Tank (3 ea)							-						-	-		-	$ -		$ -			$ -
504	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				3.00	3.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
505	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4				3.00	3.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
506	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
507	Valves; 2"		PROC 4.2.1.2				6.00	6.00	nr	0.39			Unzoned	1.70	3.98	Pipefitters	69.11	$ 274.93		$ -		620.00	$ 3,720.00
508	Pressure sensors		PROC 4.2.1.3				3.00	3.00	nr	4.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,551.00
509	Level sensors		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Pipefitters	69.11	$ 2,819.81		$ -		2,269.00	$ 13,614.00
510	Pressure Gauges		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Pipefitters	69.11	$ 2,819.81		$ -		1,493.00	$ 8,958.00
511	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			3.00	225.00	m	0.58			Unzoned	1.70	221.85	Pipefitters	69.11	$ 15,332.72		$ -		52.15	$ 11,733.75
512	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			3.00	225.00	m	0.58			Unzoned	1.70	221.85	Pipefitters	69.11	$ 15,332.72		$ -		52.15	$ 11,733.75
513	Switches - 2 level		PROC 4.2.1.3				6.00	6.00	nr	3.50			Unzoned	1.70	35.70	Electrical Workers	68.23	$ 2,435.92		$ -		1,011.00	$ 6,066.00
514	Transmitters - 2 ea		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Electrical Workers	68.23	$ 2,783.91		$ -		554.00	$ 3,324.00
515	Beetle - Leak Detection - 1 ea		PROC 4.2.1.2				3.00	3.00	nr	4.00			Unzoned	1.70	20.40	Electrical Workers	68.23	$ 1,391.95		$ -		758.00	$ 2,274.00
516	Isolation Valve		PROC 4.2.1.2				3.00	3.00	nr	0.39			Unzoned	1.70	1.99	Pipefitters	69.11	$ 137.47		$ -		2,577.00	$ 7,731.00
517	Data Cables to Control room		Bldg 4.1.3.1	90.00			3.00	270.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
518	Item - 75 & 76 - Clean up Product Transfer Pump Suction 1 1/2" Discharge 1 1/2" including Item 78 & 79 Pump motor 4 HP		PROC 4.2.2.4				2.00	2.00	nr	4.00	nr		Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		13,955.00	$ 27,910.00
519	Item - 77 - Oxidation unit Feed Pump Suction 1" Discharge 1/2" including Item 80 Oxidation Pump Motor 1 HP		PROC 4.2.2.4				1.00	1.00	nr	4.00	nr		Unzoned	1.70	6.80	Pipefitters	69.11	$ 469.97		$ -		13,955.00	$ 13,955.00
520	Item - 81 - Cover Gas Vent Control Valve Pnuematic Valve & Accessories 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
521	Item - 82 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
522	Item - 83 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
523	Item - 84 & 85- Outlet Control Valve Pnuematic Control Valve & Accessories 1"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
524	Item - 86 - Cover Gas Relief Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
525	Item - 87, 88,& 89 - Relief Valve 3/4"		PROC 4.2.1.2				3.00	3.00	nr	0.39			Unzoned	1.70	1.99	Pipefitters	69.11	$ 137.47		$ -		1,271.00	$ 3,813.00
526	Item - 90 - Station Upgrader Feed Isolation Valve 2 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
527	Item - 91 - Vent Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
528	Item - 92 - Cover Gas Supply Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -			$ -
529	Item - 93 - Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
530	Item - 94 - Cover Gas Drain Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
531	Item - 95 - Feed Isolation Valve 2 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
532	Item - 96, 97, 98 & 99 - Isolation Valve 1 1/2"		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		2,577.00	$ 10,308.00
533	Item - 101 & 102 - Discharge Isolation Valve - 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
534	Item - 103 - Isolation Valve - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
535	Item - 104 - Clean Up Feed Isolation Valves - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
536	Item - 105 - Vacuum Relief Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
537	Item - 106 Recirculation Flow Orifice 1"		PROC 4.2.1.2				1.00	1.00	nr	0.33			Unzoned	1.70	0.56	Pipefitters	69.11	$ 38.77		$ -			$ -
538	Item - 107 & 108 - Commissioning Strainer 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -			$ -
539	Item - 109 - Cover Gas Pressure Transmitter		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Electrical Workers	68.23	$ 45.24		$ -		517.00	$ 517.00

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
540	Item - 110 & 111 - Level Transmitter		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Electrical Workers	68.23	$ 90.48		$ -		2,269.00	$ 4,538.00
541	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TIE-ins for new tanks with Exstg tanks (at Exstg bldg)							-						-	-		-	$ -		$ -		-	$ -
	PHT D20 Supply 38110 - 100 Mg (8 Tanks)							-						-	-		-	$ -		$ -		-	$ -
542	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				8.00	8.00	item	30.00			Zone 3	2.33	559.20	Pipefitters	69.11	$ 38,647.99		$ -	6,500.00	10,725.00	$ 85,800.00
	Moderator D20 Supply 38110 - 100 Mg (7 Tanks)							-						-	-		-	$ -		$ -			$ -
543	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				7.00	7.00	item	30.00			Zone 3	2.33	489.30	Pipefitters	69.11	$ 33,816.99		$ -	6,500.00	10,725.00	$ 75,075.00
	TRF/SUP Feed 38110 - 100 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
544	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	6,500.00	10,725.00	$ 21,450.00
	TRF/SUP Product 38110 - 100 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
545	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	6,500.00	10,725.00	$ 21,450.00
	Downgraded D20 38500 - 50 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
546	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	5,500.00	9,075.00	$ 18,150.00
	Downgraded D20 38500 - 25 Mg (1 Tank)							-						-	-		-	$ -		$ -			$ -
547	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				1.00	1.00	item	30.00			Zone 3	2.33	69.90	Pipefitters	69.11	$ 4,831.00		$ -	5,000.00	8,250.00	$ 8,250.00
	D20 Clean up - 38410 - 25 Mg (3 Tanks)							-						-	-		-	$ -		$ -			$ -
548	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				3.00	3.00	item	30.00			Zone 3	2.33	209.70	Pipefitters	69.11	$ 14,493.00		$ -	5,000.00	8,250.00	$ 24,750.00
								-						-	-		-	$ -		$ -			$ -
549	Rubber mats at all likely spill locations (25 ea) (6X4ft)		STIE 4.2.11.1				25.00	25.00	EA				Zone 3	2.33	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
550	Cathodic protection including all accessories (25 ea)		Bldg 4.1.5.1				25.00	25.00	EA	3.00			Zone 3	2.33	174.75	Electrical Workers	68.23	$ 11,923.72		$ -	1,500.00	2,475.00	$ 61,875.00
								-						-	-		-	$ -		$ -			$ -
551	Crane Heavy duty Rental (for 3 months @ $40,000/month)		Bldg 4.2.4.1				3.00	3.00	mnths				Zone 3	2.33	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
552	Stack Monitor (installation, electrical connections, switches)		PROC 4.2.2.6				2.00	2.00	nr				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
553	Stainless Steel Ducts in Effluent Stack (14" dia) - ALL		PROC 4.2.2.6				140.00	140.00	m				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
554	Stainless Steel hoods and cover		PROC 4.2.2.6				3.00	3.00	nr				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
	COMMON GENERAL ITEMS																-	$ -		$ -		-	$ -
555	Cable Trays c/w hanging supports and metal brackets		Bldg 4.1.3.1	200.00			1.00	200.00	m	0.60			Unzoned	1.70	204.00	Electrical Workers	68.23	$ 13,919.53		$ -	12.71	20.97	$ 4,194.30
556	Pipe supports c/w supports and rawl plugs		STIE 4.2.1.1				46.00	46.00	nr	1.20	nr		Unzoned	1.70	93.84	Pipefitters	69.11	$ 6,485.56	10.00	$ 460.00		54.00	$ 2,484.00
557	Instrumentation - SCADA (tanks to Control Room)		PROC 4.3.5.1				25.00	25.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
	Tie-ins to existing services							-						-	-		-	$ -		$ -		-	$ -
558	X-ray scanning of tie-in locations		STIE 4.2.11.1				4.00	4.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Sub-Total																	**$ 2,054,344.04**		**$ 460.00**			**$ 1,052,371.80**
	ELECTRICAL CONTROL SYSTEMS																						
559	Main Control Panel (600 wide x 800deep); 2000A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
560	Main Control Panel (600 wide x 800deep); 2500A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
561	Main Control Panel (600 wide x 800deep); 3000A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
562	Panel Boards; 2000A		Bldg 4.1.1.6				1.00	1.00	nr	4.00	nr	MEpg558	Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -	11,140.05	18,381.08	$ 18,381.08
														-	-		-	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
	Sub-Total																	**$ 463.98**		**$ -**			**$ 18,381.08**
	SPECIALIST EQUIPMENT																						
563	Mono rail system; 1T		Bldg 4.2.4.3				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
564	Mono rail system; 5T		Bldg 4.2.4.3				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	TOTAL																	**$ 6,765,676.84**		**$ 1,374,557.91**			**$ 3,837,858.83**

	LIFE CYCLE COSTINGS																						
	Replacement roof materials							-						-	-		-	$ -		$ -		-	$ -
565	Built up Roof at Lvl 115.00 - Re-roof at 25 years	2.3.1.3	Bldg 4.4.5.1				600.00	600.00	m2				Zone 3	2.33	-	Roofers	58.38	$ -		$ -		-	$ -
566	Epoxy floor coatings (1 re-coat)		Bldg 4.4.6.3				1,042.75	1,042.75	m2				Zone 3	2.33	-	Flooring	63.61	$ -		$ -		-	$ -
567	Duct controllers (15 years)		PROC 4.2.1.3				1.00	1.00	item				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
568	Control valves (15 years)		PROC 4.2.1.2				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
569	Valves (20 years)		PROC 4.2.1.2				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
570	SCADA (25 years)		PROC 4.3.5.1				1.00	1.00	item				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
571	Office furniture		Bldg 4.4.6.14-O				1.00	1.00	item				Zone 3	2.33	-		-	$ -		$ -		-	$ -
572	Office flooring		Bldg 4.4.6.3-O				250.00	250.00	m2				Zone 3	2.33	-	Flooring	63.61	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity						Labour									Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
573	Washroom appliances		Bldg 4.4.6.14-O				1.00	1.00	item				Zone 3	2.33	-	Plumbers	66.47	$ -		$ -		-	$ -
574	Pumps (20 years) - overhaul and new impellers		PROC 4.2.2.4				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
575	Replacement of valves and controls to HVAC systems		PROC 4.2.1.7				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
	[formulas >>>]				$ -		$ -	$ -				$ -	$ -	$ -	-		
	EXTERNAL WORKS																
	Remove existing surfaces				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
1	Clearing of Site / Site strip; 250mm deep	8.1.1.1	SPRP 4.4.7.1	5.60	$ 9,564.80	45%	$ 2,582.50	$ 12,147.30	60%	0%	40%	$ 7,288.38	$ -	$ 4,858.92	124.5 hrs		
2	Remove existing Conc Curbs & Dispose	8.1.2.3	SPRP 4.4.7.1		$ -	45%	$ 134.35	$ 957.62				$ 432.92	$ 524.70	$ -	12.5 hrs		
3	Remove existing Asphalt pavement and dispose	8.1.2.3	SPRP 4.4.7.1		$ -	45%	$ 752.38	$ 8,264.02				$ 2,424.34	$ 5,839.68	$ -	70.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Ground investigation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
4	Trial trenches, 3m deep; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ 854.49	$ 3,007.00				$ 2,753.36	$ 253.64	$ -	79.5 hrs		
5	Trial trenches, 3m deep, commencing from 3m depth; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ 854.49	$ 3,007.00				$ 2,753.36	$ 253.64	$ -	79.5 hrs		
	Temporary services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
6	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminaries		Bldg 4.7.2.5	2,279.39	$ 9,117.56	45%	$ 820.58	$ 9,938.14	20%	70%	10%	$ 1,987.63	$ 6,956.70	$ 993.81	30.9 hrs		
7	Lunchroom Trailers and Washroom Trailers 22ft * 7ft 6" c.w Drying Racks, Lockers, Tables, Seating, heaters, Microwave, etc. Including transportation @$1200/mnth		Bldg 4.7.2.4	1,200.00	$ 33,600.00	45%	$ -	$ 33,600.00	0%	100%	0%	$ -	$ 33,600.00	$ -	-		One Office trailer c/w Furniture and one Portable toilet for 24 months rental
8	Temporary Offices - 3 - 20' office trailers for 28 months rental @ $750 ea per month including furniture, mobilisation and demobilisation		Bldg 4.7.2.4	2,250.00	$ 63,000.00	45%	$ -	$ 63,000.00	0%	100%	0%	$ -	$ 63,000.00	$ -	-		One Office trailer c/w Furniture and one Portable toilet for 24 months rental
	Site access road				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
9	Temporary road to new site	8.2.1.1	Bldg 4.7.2.1	65.21	$ 54,774.72	45%	$ 7,394.59	$ 62,169.31	30%	50%	20%	$ 18,650.79	$ 31,084.65	$ 12,433.86	318.6 hrs		
	Temporary car parking				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
10	Car parking alternatives	8.2.1.3	Bldg 4.7.2.1	94.38	$ 33,976.80	45%	$ 4,586.87	$ 38,563.67	30%	50%	20%	$ 11,569.10	$ 19,281.83	$ 7,712.73	197.6 hrs		
	Temporary Fencing, Railing and Walls				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
11	Fencing, OPG Standard Security height, 2.4m; Corner posts braced, intermediate posts at 3m centres, 1.2m set in ground, concrete surround.	8.4.1.1	Bldg 4.7.2.3	164.00	$ 36,080.00	45%	$ 4,870.80	$ 40,950.80	30%	60%	10%	$ 12,285.24	$ 24,570.48	$ 4,095.08	182.7 hrs		
12	Pedestrian access around new site		Bldg 4.7.2.1		$ -	45%	$ 537.42	$ 8,123.17				$ 1,731.67	$ 402.00	$ 5,989.50	50.0 hrs		
13	Gates (3.6 Mx1.175 H)	8.4.1.3	Bldg 4.7.2.1	1,833.96	$ 7,335.84	45%	$ 990.34	$ 8,326.18	30%	60%	10%	$ 2,497.85	$ 4,995.71	$ 832.62	37.1 hrs		
	Street Furniture				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
14	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminnaire	8.7.9.2	SPRP 4.4.7.2	3,798.98	$ 18,994.91	45%	$ 2,564.31	$ 21,559.23	30%	60%	10%	$ 6,467.77	$ 12,935.54	$ 2,155.92	100.5 hrs		
15	Bollards; permanent bollard; non illuminated; galvanised steel removable and lockable pattern	8.4.4.3	SPRP 4.4.7.2		$ -	45%	$ 1,521.03	$ 14,325.23				$ 4,901.09	$ 760.98	$ 8,663.16	133.3 hrs		
16	Turnstiles		SPRP 4.4.7.2	5,060.84	$ 20,243.36	45%	$ 2,732.85	$ 22,976.21	30%	60%	10%	$ 6,892.86	$ 13,785.73	$ 2,297.62	114.1 hrs		
17	Directional signage		SPRP 4.4.7.2		$ -	45%	$ 42.78	$ 4,262.84				$ 137.84	$ -	$ 4,125.00	3.7 hrs		
18	Removal of one Light post incld UG cable		SPRP 4.4.7.2		$ -	45%	$ 30.04	$ 165.05				$ 96.81	$ 68.24	$ -	2.5 hrs		
	External drainage				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
19	Sewer line connections to main line		STIE 4.2.11.2	55.00	$ 2,200.00	45%	$ 396.00	$ 2,596.00	40%	40%	20%	$ 1,038.40	$ 1,038.40	$ 519.20	17.7 hrs		as per previous project
20	Storm water connections to main line		STIE 4.2.11.2	55.00	$ 2,750.00	45%	$ 495.00	$ 3,245.00	40%	40%	20%	$ 1,298.00	$ 1,298.00	$ 649.00	22.2 hrs		
21	Manholes/Access chambers; 750 x 700 chamber 1500 depth to invert; includes excavation, support, backfilling and disposal, concrete base, brickwork chamber, concrete cover slab, concrete benching and channels, step irons, access cover and frames	8.6.1.5	SPRP 4.4.7.2	2,786.44	$ 16,718.63	45%	$ 3,009.35	$ 19,727.98	40%	40%	20%	$ 7,891.19	$ 7,891.19	$ 3,945.60	134.8 hrs		
22	Valve Chambers; 1.2m diameter x 2.5m depth	8.6.1.5	SPRP 4.4.7.2	2,844.37	$ 11,377.48	45%	$ 2,047.95	$ 13,425.42	40%	40%	20%	$ 5,370.17	$ 5,370.17	$ 2,685.08	91.7 hrs		
23	Weeper tiles (perforated pipe in drainage under slab on grade c/w Geotextile membrane and stone surround (600mm Dia)		SPRP 4.4.7.1	200.00	$ 31,000.00	45%	$ 5,580.00	$ 36,580.00	40%	40%	20%	$ 14,632.00	$ 14,632.00	$ 7,316.00	249.9 hrs		
24	Excavation in rock for weeper tile (1mx1mx1m)		SPRP 4.4.7.1		$ -	45%	$ 5,553.29	$ 25,517.86				$ 17,893.95	$ 7,623.91	$ -	516.5 hrs		
	Connection to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
25	Main water line connections	8.7.1.1	Bldg 4.2.1.4	120.45	$ 2,409.00	45%	$ 433.62	$ 2,842.62	40%	40%	20%	$ 1,137.05	$ 1,137.05	$ 568.52	17.1 hrs		
26	Fire Hydrants		Bldg 4.2.10.2		$ -	45%	$ 762.75	$ 4,859.35				$ 2,457.74	$ -	$ 2,401.61	62.5 hrs		
27	CCTV cameras		Bldg 4.1.3.6-O	2,899.99	$ 46,399.84	45%	$ 6,263.98	$ 52,663.82	30%	50%	20%	$ 15,799.15	$ 26,331.91	$ 10,532.76	231.5 hrs		
28	Buried Services - Appendix - F - Standby Generator Cable Duct		SPRP 4.1.8.1	6,000.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	50%	20%	$ 2,043.00	$ 3,405.00	$ 1,362.00	29.9 hrs		
29	Buried Services - Appendix - F - Service water - Low pressure		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	15.4 hrs		
30	Buried Services - Appendix - F - Cables 500 below Ground		SPRP 4.1.8.1		$ -	45%	$ -	Excluded									
31	Buried Services - Appendix - F- 12" Steam & 3" Condensate return		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
32	Buried Services - Appendix - F- 6" Air		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
33	Buried Services - Appendix - F- 8" Water		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
34	Buried Services - Appendix - F- Inactive Drainage		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
35	Buried Services - Appendix - F- Misc Fire Line		SPRP 4.3.8.1		$ -	45%	$ -	Excluded									
36	Buried Services - Appendix - F-Fire Protection		SPRP 4.3.8.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
37	Buried Services - Appendix - F-Helium		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
38	Buried Services - Appendix - F- Oxygen		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
39	Buried Services - Appendix - F-Argon		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
40	Buried Services - Appendix - F-Nitrogen		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
41	Buried Services - Appendix - F-Box Drain Sump		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
42	Buried Services - Appendix - F-600 mm Dia Corrugated Steel Pipe CSP Yard Drainage		SPRP 4.2.12.1	1,500.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	50%	20%	$ 510.75	$ 851.25	$ 340.50	8.7 hrs		
43	Relocate Existing Cable Duct from Standby Generators OIL Tanks # 1 & 2		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	15.0 hrs		
44	Relocate existing Low Pressure Service Water open system piping.		SPRP 4.2.12.1	1,500.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	50%	20%	$ 510.75	$ 851.25	$ 340.50	7.7 hrs		
	Demolition/removal of existing structures				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
45	Demolition of existing building (Offices)	9.2.1.1	SPRP 4.4.8.1	43.84	$ 6,904.88	45%	$ 1,864.32	$ 8,769.20	60%	10%	30%	$ 5,261.52	$ 876.92	$ 2,630.76	89.9 hrs		
46	Demolition of existing underground services (Offices)	9.2.1.2	SPRP 4.4.8.1	43.84	$ 1,380.98	45%	$ 372.86	$ 1,753.84	60%	10%	30%	$ 1,052.30	$ 175.38	$ 526.15	18.0 hrs		
47	Temporary Terminating of services	9.4.1.2	Bldg 4.7.2.5	178.56	$ 714.25	45%	$ 192.85	$ 907.10	60%	30%	10%	$ 544.26	$ 272.13	$ 90.71	9.3 hrs		
	Asphalt road				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
48	Reinstatement of Asphalt road (incld roadbase)		SPRP 4.4.7.2	65.21	$ 10,433.28	45%	$ 1,408.49	$ 11,841.77	30%	50%	20%	$ 3,552.53	$ 5,920.89	$ 2,368.35	60.7 hrs		
49	New Kerbs at roads (reinstated road portions)		SPRP 4.4.7.2	41.68	$ 2,667.46	45%	$ 360.11	$ 3,027.56	30%	50%	20%	$ 908.27	$ 1,513.78	$ 605.51	15.5 hrs		
50	Line painting;Continuous line in reflectorised white 200mm wide		SPRP 4.4.7.2	2.15	$ 343.20	45%	$ 46.33	$ 389.53	30%	50%	20%	$ 116.86	$ 194.77	$ 77.91	2.0 hrs		
51	Road signs		SPRP 4.4.7.2	172.43	$ 689.70	45%	$ 93.11	$ 782.81	30%	50%	20%	$ 234.84	$ 391.40	$ 156.56	4.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 449,676.67**		**$ 63,794.83**	**$ 574,917.61**				**$ 171,252.73**	**$ 308,303.91**	**$ 95,360.96**	**3,216.0 hrs**		
	SITE INVESTIGATION																
52	CAT scan of existing buried services and other obstacles	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ -	Excluded									BY OWNER
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ -**		**$ -**	**$ -**				**$ -**	**$ -**	**$ -**	**-**		
	WORKS TO EXISTING STRUCTURES																
53	Remove existing Loading bay and Dock	7.1.1.1	SPRP 4.4.8.1	43.84	$ 3,616.84	45%	$ 976.55	$ 4,593.39	60%	10%	30%	$ 2,756.03	$ 459.34	$ 1,378.02	47.1 hrs		
54	Cut and patch at new openings for pipes	7.1.1.2	SPRP 4.4.7.2	300.00	$ 15,000.00	45%	$ 4,050.00	$ 19,050.00	60%	10%	30%	$ 11,430.00	$ 1,905.00	$ 5,715.00	189.1 hrs		
55	New door for Access to new building	7.1.1.2	Bldg 4.4.6.1	1,334.03	$ 1,334.03	45%	$ 180.09	$ 1,514.12	30%	60%	10%	$ 454.24	$ 908.47	$ 151.41	7.5 hrs		
	Minor building works				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
56	Repairs to existing building after Ramp removal	8.8.1.1	SPRP 4.4.7.2	50.04	$ 6,255.56	45%	$ 844.50	$ 7,100.06	30%	60%	10%	$ 2,130.02	$ 4,260.04	$ 710.01	35.2 hrs		
57	Repairs to existing building after Loading dock removal	8.8.1.3	SPRP 4.4.7.2	40.64	$ 1,015.99	45%	$ 137.16	$ 1,153.15	30%	60%	10%	$ 345.94	$ 691.89	$ 115.31	5.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 27,222.42**		**$ 6,188.30**	**$ 33,410.72**				**$ 17,116.23**	**$ 8,224.74**	**$ 8,069.75**	**284.7 hrs**		
	SUBSTRUCTURE																
	EXCAVATION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Bulk excavation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
58	Vacuum Excavation (uptp 2.5 M) at buried services (4 weeks@$40,000/week		SPRP 4.7.1.2	40,000.00	$ 160,000.00	45%	$ 14,400.00	$ 174,400.00	20%	20%	60%	$ 34,880.00	$ 34,880.00	$ 104,640.00	595.8 hrs		4 weeks rental of Vaccuum truck & pumps
59	Hand Excavation around buried services		SPRP 4.4.7.1		$ -	45%	$ 1,269.64	$ 4,091.08				$ 4,091.08	$ -	$ -	118.1 hrs		hand excavation around cables
60	Bulk excavation for tank farm; 10-15m max depth		SPRP 4.4.7.1		$ -	45%	$ 198,871.75	$ 913,172.40				$ 640,808.96	$ 272,363.44	$ -	18,495.2 hrs		
61	Extra over for excavation in rock; 1.0-2.0m maximum depth		SPRP 4.4.7.1		$ -	45%	$ 43,888.94	$ 201,673.37				$ 141,419.91	$ 60,253.46	$ -	4,081.7 hrs		
62	Disposal of excavated material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4		$ -	45%	$ 34,288.23	$ 175,164.30				$ 110,484.30	$ 64,680.00	$ -	3,188.8 hrs		
63	Disposal of excavated rock material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4		$ -	45%	$ 3,291.67	$ 16,831.94				$ 10,606.49	$ 6,225.45	$ -	306.1 hrs		
64	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 12,618.07	$ 67,884.46				$ 40,658.22	$ 27,226.24	$ -	1,173.5 hrs		
65	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 75,434.11	$ 405,776.09				$ 243,065.47	$ 162,710.63	$ -	7,015.4 hrs		
66	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper; ADDITIONAL for contaminated sludge		SPRP 4.4.7.4	217.80	$ 1,667,531.25	45%	$ 375,194.53	$ 2,042,725.78	50%	0%	50%	$ 1,021,362.89	$ -	$ 1,021,362.89	17,446.7 hrs		
67	Disposal of excavated material from temporary spoil heap to licensed tip; Un-contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 75,434.11	$ 405,776.09				$ 243,065.47	$ 162,710.63	$ -	7,015.4 hrs		
68	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 82,291.76	$ 400,080.77				$ 265,162.33	$ 134,918.44	$ -	7,653.2 hrs		
69	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 10,972.23	$ 53,364.31				$ 35,354.98	$ 18,009.34	$ -	1,020.4 hrs		
70	Contaminated waste disposal fees (766 loads x 10 = 7660 M3)		SPRP 4.4.7.4		$ -	45%	$ -	Excluded									By Owner - cost not carried
	Detailed excavation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
71	Detailed excavation for 100Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 28,870.63	$ 132,662.97				$ 93,027.58	$ 39,635.39	$ -	2,685.0 hrs		
72	Detailed excavation for 50Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 2,110.43	$ 9,697.59				$ 6,800.26	$ 2,897.32	$ -	196.3 hrs		
73	Detailed excavation for 25Mg tanks; in rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 3,418.89	$ 15,710.09				$ 11,016.42	$ 4,693.66	$ -	318.0 hrs		
74	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 2,984.45	$ 13,713.79				$ 9,616.55	$ 4,097.24	$ -	277.6 hrs		
75	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 6,090.71	$ 27,987.33				$ 19,625.62	$ 8,361.71	$ -	566.4 hrs		
76	Excavation for Inspection pit	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 5,107.35	$ 23,451.76				$ 16,457.02	$ 6,994.74	$ -	475.0 hrs		
77	Excavation for Inspection pit ; in rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 3,251.36	$ 14,940.29				$ 10,476.62	$ 4,463.67	$ -	302.4 hrs		
78	Detail Excavation for Weeper Tiles in Rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 862.73	$ 3,964.32				$ 2,779.91	$ 1,184.41	$ -	80.2 hrs		
79	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4		$ -	45%	$ 3,014.90	$ 16,217.79				$ 9,714.68	$ 6,503.11	$ -	280.4 hrs		
80	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4		$ -	45%	$ 6,029.80	$ 32,435.59				$ 19,429.36	$ 13,006.22	$ -	560.8 hrs		
81	Disposal of excavated rock material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4		$ -	45%	$ 3,569.19	$ 18,251.04				$ 11,500.72	$ 6,750.32	$ -	331.9 hrs		
82	Disposal of excavated material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4		$ -	45%	$ 880.58	$ 4,498.51				$ 2,837.42	$ 1,661.09	$ -	81.9 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
83	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 13,681.89	$ 73,607.77				$ 44,086.10	$ 29,521.67	$ -	1,272.4 hrs		
84	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 3,874.54	$ 20,841.99				$ 12,484.64	$ 8,357.35	$ -	360.3 hrs		
85	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 2,113.39	$ 10,274.73				$ 6,809.80	$ 3,464.93	$ -	196.5 hrs		
86	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 11,897.30	$ 57,863.44				$ 38,335.74	$ 19,527.70	$ -	1,106.5 hrs		
87	Contaminated waste disposal fees	1.2.1.2	SPRP 4.4.7.4		$ -	45%	$ 387.45	$ 1,248.46				$ 1,248.46	$ -	$ -	36.0 hrs		By Owner - cost not carried
	Earthwork support				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
88	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter cast-in-place piles; 20N/mm2 concrete; nominal reinforcement	8.8.3.1	SPRP 4.4.7.1	188.27	$ 1,328,397.84	45%	$ 119,555.81	$ 1,447,953.65	20%	40%	40%	$ 289,590.73	$ 579,181.46	$ 579,181.46	4,660.8 hrs		
89	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter empty bores	8.8.3.1	SPRP 4.4.7.1	86.30	$ 608,897.52	45%	$ 54,800.78	$ 663,698.30	20%	40%	40%	$ 132,739.66	$ 265,479.32	$ 265,479.32	2,267.4 hrs		
90	Trimming material other than topsoil, rock or artificial hard material; using D4H dozer, tractor loader or motor grader average rate to sides of caisson walls; 45-90˚ to horizontal	8.8.3.1	SPRP 4.4.7.1		$ -	45%	$ 5,004.68	$ 19,967.61				$ 16,126.20	$ 3,841.41	$ -	465.4 hrs		
91	Trimming rock; using D6E dozer; vertical to sides of caisson walls	8.8.3.1	SPRP 4.4.7.1		$ -	45%	$ 7,073.28	$ 28,684.72				$ 22,791.69	$ 5,893.02	$ -	657.8 hrs		
92	Steel in Caissons (Soldier Piles) IPN 280 @ 54Kgs/LM; 203 x 203 mm; length 15m		SPRP 4.4.7.1	10,534.74	$ 316,042.16	45%	$ 14,221.90	$ 330,264.05	10%	60%	30%	$ 33,026.41	$ 198,158.43	$ 99,079.22	531.5 hrs		
93	Waterproofing to sides of wall (inside face); Bituthene 4000; lapped joints; at any inclination	1.3.1.1	SPRP 4.4.7.1		$ -	45%	$ 8,007.49	$ 77,983.58				$ 25,801.92	$ 4,830.95	$ 47,350.71	744.7 hrs		
94	Shoring for inspection pit	8.8.3.1	SPRP 4.4.7.1	120.00	$ 53,760.00	45%	$ 7,257.60	$ 61,017.60	30%	60%	10%	$ 18,305.28	$ 36,610.56	$ 6,101.76	312.7 hrs		
	Dewatering				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
95	Dewatering equipment (rental 3months)	9.3.1.1	SPRP 4.7.1.3	60,000.00	$ 60,000.00	45%	$ -	$ 60,000.00	0%	0%	100%	$ -	$ -	$ 60,000.00	-		
96	Holding tanks and filter bags(rental 3months)	9.3.1.1	SPRP 4.7.1.3	75,000.00	$ 75,000.00	45%	$ -	$ 75,000.00	0%	0%	100%	$ -	$ -	$ 75,000.00	-		
97	75mm pipes for temp dewatering - 2 lines for 300m length discharge to Intake		SPRP 4.7.1.3	20.00	$ 12,000.00	45%	$ 1,620.00	$ 13,620.00	30%	60%	10%	$ 4,086.00	$ 8,172.00	$ 1,362.00	69.8 hrs		
98	Pumps rental (3 months) 600 V - 2 ea		SPRP 4.7.1.3	3,000.00	$ 18,000.00	45%	$ -	$ 18,000.00	0%	0%	100%	$ -	$ -	$ 18,000.00	-		
99	Diesel Genset for Pumps rental (3 months)		SPRP 4.7.1.3	3,000.00	$ 18,000.00	45%	$ -	$ 18,000.00	0%	0%	100%	$ -	$ -	$ 18,000.00	-		
100	Diesel fuel (50 liters daily for 60 daysx2 ea)		SPRP 4.7.1.3	1.50	$ 9,000.00	45%	$ -	$ 9,000.00	0%	0%	100%	$ -	$ -	$ 9,000.00	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	BELOW GROUND CONSTRUCTION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Slab on grade				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
101	Level and compact bottoms of excavations	1.4.1.1	Bldg 4.4.7.1		$ -	45%	$ 3,620.39	$ 41,827.61				$ 11,665.70	$ 30,161.91	$ -	336.7 hrs		
102	Formwork to sides of slab on grade; plane vertical; width 0.3m	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,367.50	$ 5,599.93				$ 4,406.39	$ 551.34	$ 642.21	119.8 hrs		
103	Reinforcement to insitu concrete slab; 100kg/m3; deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.4.1.1	Bldg 4.4.1.2		$ -	45%	$ 8,915.84	$ 67,671.61				$ 28,728.81	$ 4,573.03	$ 34,369.76	781.2 hrs		
104	Insitu concrete slab on grade; Grade C40 cement; 300mm thick	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,593.69	$ 82,343.46				$ 8,357.43	$ 5,777.28	$ 68,208.75	227.3 hrs		
105	Less: Pad foundations for tanks	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ (684.46)	$ (21,730.09)				$ (2,205.49)	$ (1,524.60)	$ (18,000.00)	(60.0 hrs)		
106	Surface finish to insitu concrete slab on grade; Float finish		Bldg 4.4.1.1		$ -	45%	$ 960.62	$ 3,095.34				$ 3,095.34	$ -	$ -	84.2 hrs		
107	Weeping tiles below slab on grade; 225mm pipes unplasticized pvc pipes	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 539.21	$ 22,315.78				$ 1,737.44	$ 127.71	$ 20,450.63	50.1 hrs		
	Pad foundations for tanks				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
108	Formwork for 19 - 100 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 20,654.85	$ 89,760.49				$ 66,554.53	$ 8,328.22	$ 14,877.74	1,809.9 hrs		
109	Formwork for 2 - 50 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,494.76	$ 6,495.82				$ 4,816.45	$ 602.70	$ 1,076.68	131.0 hrs		
110	Formwork for 4 - 25 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,329.49	$ 10,123.36				$ 7,506.15	$ 939.27	$ 1,677.94	204.1 hrs		
111	Reinforcement in Tank Foundations (150 Kgs/M3); deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.1.1.1	Bldg 4.4.1.2		$ -	45%	$ 72,897.94	$ 553,298.59				$ 234,893.38	$ 37,390.17	$ 281,015.05	6,387.7 hrs		
112	Concrete for 19 - 100 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 10,426.73	$ 385,997.43				$ 33,597.24	$ 23,357.63	$ 329,042.56	913.6 hrs		
113	Concrete for 2- 50 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 592.87	$ 21,948.16				$ 1,910.37	$ 1,328.14	$ 18,709.66	52.0 hrs		
114	Concrete for 4 - 25 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 839.96	$ 31,095.39				$ 2,706.54	$ 1,881.66	$ 26,507.19	73.6 hrs		
115	Connection to main inspection pit (600 dia PVC)	1.4.1.8	Bldg 4.4.1.1	750.00	$ 37,500.00	45%	$ 5,062.50	$ 42,562.50	30%	60%	10%	$ 12,768.75	$ 25,537.50	$ 4,256.25	218.1 hrs		
	Inspection chamber				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
116	Formwork in Inspection Chamber -Base slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 56.90	$ 273.09				$ 183.33	$ 22.92	$ 66.84	5.0 hrs		
117	Formwork in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 3,422.31	$ 17,625.80				$ 11,027.45	$ 1,381.05	$ 5,217.30	299.9 hrs		
118	Formwork in Inspection Chamber -Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 3,969.88	$ 20,445.93				$ 12,791.85	$ 1,602.02	$ 6,052.07	347.9 hrs		
119	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 112.89	$ 541.85				$ 363.75	$ 45.48	$ 132.62	9.9 hrs		
120	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 62.86	$ 301.70				$ 202.54	$ 25.32	$ 73.84	5.5 hrs		
121	Reinforcement in Inspection Chamber (150kgs/m3)	1.4.1.8	Bldg 4.4.1.2		$ -	45%	$ 292.32	$ 2,218.74				$ 941.93	$ 149.94	$ 1,126.88	25.6 hrs		
122	Concrete in Inspection Chamber - Blinding; 150-300mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 10.28	$ 341.75				$ 33.13	$ 4.42	$ 304.20	0.9 hrs		
123	Concrete in Inspection Chamber - Base Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 14.46	$ 459.05				$ 46.59	$ 32.21	$ 380.25	1.3 hrs		
124	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 227.44	$ 6,133.35				$ 732.87	$ 506.73	$ 4,893.75	19.9 hrs		
125	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 196.07	$ 5,287.37				$ 631.78	$ 436.84	$ 4,218.75	17.2 hrs		
126	Concrete in Inspection Chamber - Top Slab	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 17.99	$ 571.09				$ 57.96	$ 40.07	$ 473.06	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
	Basement Walls				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
127	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,440.94	$ 6,240.46				$ 4,643.02	$ 589.59	$ 1,007.84	126.3 hrs		
128	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,149.95	$ 13,641.93				$ 10,149.85	$ 1,288.88	$ 2,203.20	276.0 hrs		
129	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,048.08	$ 38,800.04				$ 3,377.16	$ 2,347.88	$ 33,075.00	91.8 hrs		
130	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,010.61	$ 74,432.73				$ 6,478.63	$ 4,504.10	$ 63,450.00	176.2 hrs		
131	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 12,753.82	$ 65,685.49				$ 41,095.64	$ 5,146.71	$ 19,443.14	1,117.6 hrs		
132	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 27,880.44	$ 143,591.55				$ 89,836.99	$ 11,250.95	$ 42,503.60	2,443.0 hrs		
133	Reinforcement in Walls/Dikes (@120kgs/M3)	1.3.1.1	Bldg 4.4.1.2		$ -	45%	$ 122,775.49	$ 931,871.32				$ 395,609.90	$ 62,972.91	$ 473,288.51	10,758.2 hrs		
134	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 9,991.73	$ 269,444.31				$ 32,195.57	$ 22,261.24	$ 214,987.50	875.5 hrs		
135	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 19,167.81	$ 516,893.16				$ 61,762.93	$ 42,705.23	$ 412,425.00	1,679.6 hrs		
	Concrete Ancillaries				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
136	Step ladders inside Inspection Chamber	1.4.1.8	Bldg 4.4.3.3	53.74	$ 2,687.03	45%	$ 362.75	$ 3,049.77	30%	60%	10%	$ 914.93	$ 1,829.86	$ 304.98	14.7 hrs		
137	Manhole cover to inspection chamber; Complete with frame; Bed and set in concrete; access cover and frame	1.4.1.8	Bldg 4.4.3.3	544.50	$ 544.50	45%	$ 73.51	$ 618.01	30%	60%	10%	$ 185.40	$ 370.80	$ 61.80	3.0 hrs		
138	Rock anchors; 25mm diameter; 2m length; including drilling, steel and grout	1.4.1.9	Bldg 4.4.1.2	50.00	$ 600.00	45%	$ 162.00	$ 762.00	60%	30%	10%	$ 457.20	$ 228.60	$ 76.20	7.8 hrs		
139	Rock Anchors 25mm - 2M Deep; including drilling, steel and grout	1.1.1.1	Bldg 4.4.1.2	50.00	$ 21,050.00	45%	$ 5,683.50	$ 26,733.50	60%	30%	10%	$ 16,040.10	$ 8,020.05	$ 2,673.35	274.0 hrs		
140	Rock anchors 25mm 2M length for Dike wall		Bldg 4.4.1.2	50.00	$ 7,250.00	45%	$ 978.75	$ 8,228.75	30%	60%	10%	$ 2,468.63	$ 4,937.25	$ 822.88	42.2 hrs		
141	Insulation at Basement upto 1.5 M; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 1,067.67	$ 6,233.11				$ 3,440.26	$ -	$ 2,792.86	99.3 hrs		
142	Insulation at Loading bay walls; boards; polystherene standard grade; fixing with adhesive; to floors; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 98.53	$ 575.20				$ 317.47	$ -	$ 257.73	9.2 hrs		
143	Insulation at Loading bay slab; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 22.17	$ 168.49				$ 71.43	$ -	$ 97.06	2.1 hrs		
144	Trace heating to Loading bay Ramp & slab		Bldg 4.4.5.1	261.83	$ 23,041.04	45%	$ 3,110.54	$ 26,151.58	30%	60%	10%	$ 7,845.47	$ 15,690.95	$ 2,615.16	115.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 4,419,301.33**		**$ 1,595,415.75**	**$ 11,691,224.08**				**$ 4,774,117.70**	**$ 2,534,689.27**	**$ 4,382,417.12**	**117,123.5 hrs**		
	SUPERSTRUCTURE																
	Insitu concrete walls to first floor				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
145	Formwork - wall above Lvl 100.00 - 5 M high external; basic finish; height 3m above floor level	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 132,842.79	$ 449,636.76				$ 428,048.99	$ -	$ 21,587.78	11,640.3 hrs		
146	Reinforcement in concrete walls; 120kgs/m3; 12 mm diameter; bent		Bldg 4.4.1.2		$ -	45%	$ 23,442.85	$ 92,627.78				$ 75,538.06	$ -	$ 17,089.72	2,054.2 hrs		
147	Concrete wall above Lvl 100.00 - 5 M high external; grade C40	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 22,221.86	$ 110,135.03				$ 71,603.78	$ -	$ 38,531.25	1,947.2 hrs		
148	Formwork Columns (400x400) - wall above Lvl 100.00 -7.8 M high	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 36,303.90	$ 118,839.92				$ 116,979.23	$ -	$ 1,860.69	3,181.1 hrs		
149	Reinforcement for Columns (400x400) @ 150 kgs/m3; 12mm diameter; bent		Bldg 4.4.1.2		$ -	45%	$ 2,562.63	$ 10,125.50				$ 8,257.36	$ -	$ 1,868.14	224.6 hrs		
150	Columns (400x400) - Concrete wall above Lvl 100.00 - 7.8 M high	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,160.57	$ 13,553.67				$ 10,184.07	$ -	$ 3,369.60	276.9 hrs		
151	Concrete topping finishes - Hardeners; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 12,391.03	$ 59,781.66				$ 39,926.66	$ -	$ 19,855.00	1,085.8 hrs		
	Insitu concrete upper floors - Beams				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
152	Formwork for Beams (300x750)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 15,464.58	$ 51,957.57				$ 49,830.31	$ -	$ 2,127.26	1,355.1 hrs		
153	Reinforcement in Beams (300x750) @ 200kg/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 3,878.62	$ 15,325.28				$ 12,497.78	$ -	$ 2,827.50	339.9 hrs		
154	Concrete in Beams (300x750)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,561.34	$ 15,272.32				$ 11,475.44	$ -	$ 3,796.88	312.1 hrs		
155	35mpa Concrete in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 24,375.43	$ 123,093.04				$ 78,543.04	$ -	$ 44,550.00	2,135.9 hrs		
156	Formwork in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 104,779.82	$ 347,795.13				$ 337,623.87	$ -	$ 10,171.26	9,181.3 hrs		
157	Formwork (sides) in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 4,905.60	$ 16,283.14				$ 15,806.94	$ -	$ 476.20	429.9 hrs		
158	Reinforcement in Suspended slab at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 33,880.90	$ 133,870.80				$ 109,171.79	$ -	$ 24,699.01	2,968.8 hrs		
159	35 mpa Concrete in Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,043.23	$ 13,050.48				$ 9,805.98	$ -	$ 3,244.50	266.7 hrs		
160	35 mpa Concrete in Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,171.63	$ 9,312.72				$ 6,997.47	$ -	$ 2,315.25	190.3 hrs		
161	Formwork for Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 9,484.94	$ 31,867.31				$ 30,562.59	$ -	$ 1,304.72	831.1 hrs		
162	Formwork for Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 6,735.68	$ 22,630.41				$ 21,703.87	$ -	$ 926.54	590.2 hrs		
163	Reinforcement in Beams at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 7,399.04	$ 29,235.22				$ 23,841.35	$ -	$ 5,393.86	648.3 hrs		
164	35 mpa Concrete in Column footing (1.2x1.2x1.5) 6 ea	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 110.88	$ 3,520.27				$ 357.29	$ 246.99	$ 2,916.00	9.7 hrs		
165	Rock anchors 25mm 2M length for Col footing 9ea/6ftgs	2.2.1.1	Bldg 4.4.1.2	50.00	$ 2,700.00	45%	$ 364.50	$ 3,064.50	30%	60%	10%	$ 919.35	$ 1,838.70	$ 306.45	14.8 hrs		
166	Reinforcement in Col footing at 120kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 1,774.13	$ 7,009.96				$ 5,716.63	$ -	$ 1,293.33	155.5 hrs		
167	35 mpa Concrete in Columns (600x600) lvl 87.00 to lvl100.00	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 5,743.74	$ 24,631.20				$ 18,507.60	$ -	$ 6,123.60	503.3 hrs		
168	Formwork for Columns (600x600)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 43,983.57	$ 143,979.13				$ 141,724.83	$ -	$ 2,254.30	3,854.1 hrs		
169	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 4,657.08	$ 18,401.15				$ 15,006.16	$ -	$ 3,394.99	408.1 hrs		
170	35 mpa Concrete in Columns (450x450) at Lvl 100.00 to Lvl 107.80	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,871.84	$ 8,027.13				$ 6,031.49	$ -	$ 1,995.64	164.0 hrs		
171	Formwork for Columns (450x450)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 19,111.91	$ 62,562.36				$ 61,582.81	$ -	$ 979.55	1,674.7 hrs		
172	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 1,517.71	$ 5,996.80				$ 4,890.40	$ -	$ 1,106.40	133.0 hrs		
173	Reinforcement at Column locations in Dike walls (ext) @150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 5,475.70	$ 21,635.68				$ 17,643.93	$ -	$ 3,991.76	479.8 hrs		
	Insitu concrete upper floor - Ground floor slab				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
174	Formwork for Suspended slab at 100.00	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 165,544.18	$ 549,489.96				$ 533,420.14	$ -	$ 16,069.82	14,505.8 hrs		
175	Reinforcement at Suspended slab at 100.00 (120Kg/m3)	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 50,308.00	$ 198,777.86				$ 162,103.57	$ -	$ 36,674.29	4,408.2 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
176	Concrete in Suspended slab at LVL-100.00; thickness 150-450mm	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 45,242.27	$ 228,468.14				$ 145,780.64	$ -	$ 82,687.50	3,964.4 hrs		
177	Less Concrete at Openings in slab - Elevators/Staircase	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 123.11	$ 621.68				$ 396.68	$ -	$ 225.00	10.8 hrs		
	Insitu concrete loading bay				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
178	Formwork for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 2,298.65	$ 7,611.62				$ 7,406.77	$ -	$ 204.85	201.4 hrs		
179	Formwork for Walls & Fdn to Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 3,296.83	$ 11,158.87				$ 10,623.11	$ -	$ 535.76	288.9 hrs		
180	Formwork for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 11,635.86	$ 39,384.24				$ 37,493.34	$ -	$ 1,890.90	1,019.6 hrs		
181	Reinforcement for Loading Bay Walls/Pit/Ramp (120kgs/m3)	5.10.7.1	Bldg 4.4.1.2		$ -	45%	$ 136,892.53	$ 540,892.12				$ 441,098.14	$ -	$ 99,793.98	11,995.2 hrs		
182	Concrete for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 5,763.75	$ 28,247.07				$ 18,572.07	$ -	$ 9,675.00	505.0 hrs		
183	Concrete for Walls at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 1,038.10	$ 5,144.99				$ 3,344.99	$ -	$ 1,800.00	91.0 hrs		
184	Concrete for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 4,022.64	$ 19,936.85				$ 12,961.85	$ -	$ 6,975.00	352.5 hrs		
	Miscellaneous concrete works				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
185	Formwork for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1		$ -	45%	$ 2,327.17	$ 7,876.85				$ 7,498.67	$ -	$ 378.18	203.9 hrs		
186	Rebar for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.2		$ -	45%	$ 328.54	$ 1,298.14				$ 1,058.64	$ -	$ 239.51	28.8 hrs		
187	Concrete at Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1		$ -	45%	$ 467.15	$ 2,315.25				$ 1,505.25	$ -	$ 810.00	40.9 hrs		
188	Nosing angle SS at Kerb walls at Cleaning at Drum Cleaning areas; angle section bearers; 90 x 90 x 6mm		Bldg 4.4.3.1		$ -	45%	$ 2,357.59	$ 18,798.21				$ 7,596.69	$ -	$ 11,201.52	206.6 hrs		
189	Precast concrete at mid landing slab inside Inspection chamber		Bldg 4.4.1.1	350.00	$ 1,260.00	45%	$ 170.10	$ 1,430.10	30%	60%	10%	$ 429.03	$ 858.06	$ 143.01	6.9 hrs		
190	Precast concrete cover slab to inspection chamber		Bldg 4.4.1.1	4,500.00	$ 4,500.00	45%	$ 607.50	$ 5,107.50	30%	60%	10%	$ 1,532.25	$ 3,064.50	$ 510.75	24.7 hrs		
191	Precast concrete inspection pit; 15m x 2.5m x 2.5m		Bldg 4.4.1.1	3,500.00	$ 52,500.00	45%	$ 7,087.50	$ 59,587.50	30%	60%	10%	$ 17,876.25	$ 35,752.50	$ 5,958.75	287.7 hrs		
	Structural steel frame				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
192	Base plates for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.3.3	120.00	$ 2,160.00	45%	$ 291.60	$ 2,451.60	30%	60%	10%	$ 735.48	$ 1,470.96	$ 245.16	10.9 hrs		
193	Foundation Bolts 20mm for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.1.2	45.00	$ 3,240.00	45%	$ 437.40	$ 3,677.40	30%	60%	10%	$ 1,103.22	$ 2,206.44	$ 367.74	16.4 hrs		
194	Grouting of Base plates (300x300)	2.1.1.1	Bldg 4.4.1.3	120.00	$ 2,160.00	45%	$ 291.60	$ 2,451.60	30%	60%	10%	$ 735.48	$ 1,470.96	$ 245.16	10.9 hrs		
195	Intumescent painting to Steel Columns; paint fire protection (60 minutes); spray applied	2.1.1.2	Bldg 4.4.5.3	22.72	$ 3,299.02	45%	$ 445.37	$ 3,744.38	30%	60%	10%	$ 1,123.32	$ 2,246.63	$ 374.44	18.6 hrs		
	Structural Steel frame work Lvl 107.80 to roof (7.2M Height)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
196	Steel members in frame work (15kgs/sqft)		Bldg 4.4.3.1	3,130.88	$ 344,396.25	45%	$ 46,493.49	$ 390,889.74	30%	60%	10%	$ 117,266.92	$ 234,533.85	$ 39,088.97	1,743.9 hrs		
197	Roof trusses at 115.00m level; Steel roof trusses and beams; thermal and acoustic insulation;aluminum profiled composite cladding	2.3.1.1	Bldg 4.4.3.1	399.30	$ 243,573.00	45%	$ 32,882.36	$ 276,455.36	30%	60%	10%	$ 82,936.61	$ 165,873.21	$ 27,645.54	1,233.4 hrs		
	Fire protection to structural steelwork				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
198	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3	22.72	$ 19,994.04	45%	$ 2,699.20	$ 22,693.24	30%	60%	10%	$ 6,807.97	$ 13,615.94	$ 2,269.32	112.7 hrs		
199	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3	22.72	$ 14,995.53	45%	$ 2,024.40	$ 17,019.93	30%	60%	10%	$ 5,105.98	$ 10,211.96	$ 1,701.99	84.5 hrs		
	Hoist gantries				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
200	Structural Steel Gantry for Hoists 1 T & 5 T	2.1.1.1	Bldg 4.4.3.2	3.13	$ 30,306.87	45%	$ 4,091.43	$ 34,398.30	30%	60%	10%	$ 10,319.49	$ 20,638.98	$ 3,439.83	153.5 hrs		
	Insitu concrete upper floors				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
201	Surface finish to insitu concrete; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.2.1	Bldg 4.4.1.1		$ -	45%	$ 10,457.07	$ 50,451.08				$ 33,695.00	$ -	$ 16,756.08	916.3 hrs		
	Tank inspection platforms				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
202	Open grid flooring for inspection around tanks on 94.00m level	2.1.1.1	Bldg 4.4.3.1	502.30	$ 296,357.74	45%	$ 40,008.29	$ 336,366.03	30%	60%	10%	$ 100,909.81	$ 201,819.62	$ 33,636.60	1,500.7 hrs		
	Roof structure				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
203	Built up Roof at Lvl 115.00m; steel roof trusses and beams; thermal and acoustic insulation; aluminum profiled composite cladding	2.3.1.3	Bldg 4.4.5.1	399.30	$ 239,580.00	45%	$ 32,343.30	$ 271,923.30	30%	60%	10%	$ 81,576.99	$ 163,153.98	$ 27,192.33	1,397.4 hrs		
204	Waterproofing to Roof	2.3.2.1	Bldg 4.4.5.1	121.95	$ 87,805.08	45%	$ 11,853.69	$ 99,658.77	30%	60%	10%	$ 29,897.63	$ 59,795.26	$ 9,965.88	512.1 hrs		
205	Waterproofing to openings	2.3.2.1	Bldg 4.4.5.1	134.15	$ 2,146.35	45%	$ 289.76	$ 2,436.10	30%	60%	10%	$ 730.83	$ 1,461.66	$ 243.61	12.5 hrs		
206	Metal Flashings	2.3.2.1	Bldg 4.4.3.1	147.56	$ 32,315.93	45%	$ 4,362.65	$ 36,678.58	30%	60%	10%	$ 11,003.57	$ 22,007.15	$ 3,667.86	188.5 hrs		
207	Roof anchors SS on roof (6 nrs)		Bldg 4.4.3.1	4,500.00	$ 27,000.00	45%	$ 3,645.00	$ 30,645.00	30%	60%	10%	$ 9,193.50	$ 18,387.00	$ 3,064.50	136.7 hrs		
208	600 x 600 x 2mm plain Cement tiles on roof at pathways c/w spacers & underpads		Bldg 4.4.6.6	42.19	$ 5,771.66	45%	$ 779.17	$ 6,550.83	30%	60%	10%	$ 1,965.25	$ 3,930.50	$ 655.08	33.7 hrs		
	Rainwater goods				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
209	Rainwater down take pipes; fixed to backgrounds; including offsets and shoes; 110mm diameter uPVC	2.3.4.2	Bldg 4.4.5.1	22.87	$ 2,058.21	45%	$ 277.86	$ 2,336.07	30%	60%	10%	$ 700.82	$ 1,401.64	$ 233.61	12.0 hrs		
	Cladding				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
210	Metal cladding External walls at Lvl 105.00 to 107.80; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	82.58	$ 42,992.45	45%	$ 5,803.98	$ 48,796.43	30%	60%	10%	$ 14,638.93	$ 29,277.86	$ 4,879.64	216.5 hrs		
211	Metal cladding External walls at Lvl 107.80 to 115.00; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	82.58	$ 92,839.25	45%	$ 12,533.30	$ 105,372.54	30%	60%	10%	$ 31,611.76	$ 63,223.53	$ 10,537.25	467.5 hrs		
212	Metal cladding external walls to staircase above 115.00m level; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.1.1	82.58	$ 4,162.16	45%	$ 561.89	$ 4,724.05	30%	60%	10%	$ 1,417.21	$ 2,834.43	$ 472.40	21.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 1,558,113.52**		**$ 1,189,301.79**	**$ 5,439,089.21**				**$ 3,684,952.92**	**$ 1,061,322.29**	**$ 692,813.99**	**93,998.5 hrs**		
	STAIRCASES																
213	Light duty metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide	2.44.1	Bldg 4.4.3.3	6,715.50	$ 53,724.00	45%	$ 7,252.74	$ 60,976.74	30%	60%	10%	$ 18,293.02	$ 36,586.04	$ 6,097.67	272.0 hrs		
214	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3	480.98	$ 6,733.65	45%	$ 909.04	$ 7,642.69	30%	60%	10%	$ 2,292.81	$ 4,585.62	$ 764.27	34.1 hrs		
215	Light duty spiral metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide - Lvl 87.00 to Lvl 94.00 at Platform -Emergency	2.44.1	Bldg 4.4.3.3	7,623.00	$ 15,246.00	45%	$ 2,058.21	$ 17,304.21	30%	60%	10%	$ 5,191.26	$ 10,382.53	$ 1,730.42	77.2 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
216	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3	598.95	$ 1,796.85	45%	$ 242.57	$ 2,039.42	30%	60%	10%	$ 611.83	$ 1,223.65	$ 203.94	9.1 hrs		
217	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	502.30	$ 16,073.64	45%	$ 2,169.94	$ 18,243.58	30%	60%	10%	$ 5,473.07	$ 10,946.15	$ 1,824.36	81.4 hrs		
218	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	502.30	$ 16,073.64	45%	$ 2,169.94	$ 18,243.58	30%	60%	10%	$ 5,473.07	$ 10,946.15	$ 1,824.36	81.4 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 109,647.78**		**$ 14,802.45**	**$ 124,450.23**				**$ 37,335.07**	**$ 74,670.14**	**$ 12,445.02**	**555.2 hrs**		
	WINDOWS AND EXTERNAL DOORS																
219	Aluminium Windows (Offices); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2-O	807.68	$ 18,172.69	45%	$ 2,453.31	$ 20,626.00	30%	60%	10%	$ 6,187.80	$ 12,375.60	$ 2,062.60	102.4 hrs		
220	Aluminium Windows (Drum Handling); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 10,903.61	45%	$ 1,471.99	$ 12,375.60	30%	60%	10%	$ 3,712.68	$ 7,425.36	$ 1,237.56	61.4 hrs		
221	Aluminium Windows (HVAC Rm); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 10,903.61	45%	$ 1,471.99	$ 12,375.60	30%	60%	10%	$ 3,712.68	$ 7,425.36	$ 1,237.56	61.4 hrs		
222	Aluminium Windows (Roof); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 3,634.54	45%	$ 490.66	$ 4,125.20	30%	60%	10%	$ 1,237.56	$ 2,475.12	$ 412.52	20.5 hrs		
223	Exterior Doors c/w Frame door; single external steel door, including frame, ironmongery, powder coated finish	2.6.2.1	Bldg 4.4.6.1	1,334.03	$ 8,004.15	45%	$ 1,080.56	$ 9,084.71	30%	60%	10%	$ 2,725.41	$ 5,450.83	$ 908.47	45.1 hrs		
224	Rolling Shutters and collapsible gtes; galvanised steel; 1 hr fire resisting; self coiling; activated by fusible link; fixing with bolts; 2400 mm x 2750 mm	2.6.1.3	Bldg 4.4.6.1	3,244.46	$ 6,488.92	45%	$ 876.00	$ 7,364.92	30%	60%	10%	$ 2,209.48	$ 4,418.95	$ 736.49	36.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 58,107.52**		**$ 7,844.51**	**$ 65,952.03**				**$ 19,785.61**	**$ 39,571.22**	**$ 6,595.20**	**327.4 hrs**		
	INTERNAL WALLS AND PARTITIONS																
	Internal walls and partitions				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
225	Concrete filled Hollow Block Masonry 200mm(Offices)	2.7.1.1	Bldg 4.4.2.2-O		$ -	45%	$ 9,554.36	$ 43,090.50				$ 30,786.26	$ -	$ 12,304.23	846.0 hrs		
226	Concrete filled Hollow Block Masonry 200mm(Clean up Rm)	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 4,725.81	$ 21,313.58				$ 15,227.61	$ -	$ 6,085.97	418.4 hrs		
227	Hollow Block Masonry 150 mm(HVAC/Elec))	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 2,912.71	$ 17,844.90				$ 9,385.39	$ 817.34	$ 7,642.17	257.9 hrs		
228	GWB on side of Block Masonry inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	98.01	$ 16,980.23	45%	$ 2,292.33	$ 19,272.56	30%	60%	10%	$ 5,781.77	$ 11,563.54	$ 1,927.26	95.7 hrs		
229	GWB (Acoustic) wall inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	117.98	$ 19,200.43	45%	$ 2,592.06	$ 21,792.49	30%	60%	10%	$ 6,537.75	$ 13,075.49	$ 2,179.25	108.2 hrs		
230	Metal Stud Cement Board walls (Washroom)	2.7.1.1	Bldg 4.4.3.3-O	141.57	$ 10,978.75	45%	$ 1,482.13	$ 12,460.89	30%	60%	10%	$ 3,738.27	$ 7,476.53	$ 1,246.09	61.9 hrs		
231	Hollow Block Masonry 150mm in Battery room (UPS system)	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 460.99	$ 2,824.29				$ 1,485.41	$ 129.36	$ 1,209.52	40.8 hrs		
	Surface finishes to internal walls and partitions				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
232	Masonry wall Finishes; Two coats emulsion paint finish	3.1.1.1	Bldg 4.4.6.6		$ -	45%	$ 13,970.09	$ 47,436.57				$ 45,014.73	$ -	$ 2,421.84	1,258.6 hrs		
233	GWB Wall Finishes	3.1.1.1	Bldg 4.4.6.15-O		$ -	45%	$ 12,093.63	$ 42,410.70				$ 38,968.37	$ -	$ 3,442.33	1,089.6 hrs		
234	Finishes to Concrete walls	3.1.1.1	Bldg 4.4.6.6		$ -	45%	$ 31,901.12	$ 108,322.83				$ 102,792.49	$ -	$ 5,530.34	2,874.1 hrs		
235	Epoxy painting to walls at Storage area		Bldg 4.4.6.6		$ -	45%	$ 21,163.68	$ 102,106.10				$ 68,194.08	$ -	$ 33,912.02	1,854.5 hrs		
236	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 1,025.19	$ 4,208.33				$ 3,303.37	$ -	$ 904.96	92.4 hrs		
237	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 284.77	$ 1,168.98				$ 917.60	$ -	$ 251.38	25.7 hrs		
238	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 56.95	$ 233.80				$ 183.52	$ -	$ 50.28	5.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	2.8 INTERNAL DOORS				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
239	Internal Doors c/w Frames (Offices); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; hardwood faced	2.8.1.2	Bldg 4.4.6.1-O	843.98	$ 4,219.88	45%	$ 569.68	$ 4,789.56	30%	60%	10%	$ 1,436.87	$ 2,873.73	$ 478.96	23.8 hrs		
240	Internal Doors c/w Frames (Washroom); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; single leaf	2.8.1.1	Bldg 4.4.6.1-O	816.75	$ 1,633.50	45%	$ 220.52	$ 1,854.02	30%	60%	10%	$ 556.21	$ 1,112.41	$ 185.40	9.2 hrs		
241	Internal Doors c/w Frames (HVAC); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1	1,361.25	$ 5,445.00	45%	$ 735.08	$ 6,180.08	30%	60%	10%	$ 1,854.02	$ 3,708.05	$ 618.01	30.7 hrs		
242	Fire Resistant doors c/w Frames; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1	2,132.63	$ 8,530.50	45%	$ 1,151.62	$ 9,682.12	30%	60%	10%	$ 2,904.64	$ 5,809.27	$ 968.21	48.1 hrs		
243	Internal Doors c/w Frames (Clean up room); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1	1,361.25	$ 2,722.50	45%	$ 367.54	$ 3,090.04	30%	60%	10%	$ 927.01	$ 1,854.02	$ 309.00	15.3 hrs		
244	New door for Access to new building from Exstg Bldg; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1	2,132.63	$ 6,397.88	45%	$ 863.71	$ 7,261.59	30%	60%	10%	$ 2,178.48	$ 4,356.95	$ 726.16	36.0 hrs		
245	Automatic door; magnetic locks	2.8.1.2	Bldg 4.4.6.1	600.00	$ 10,800.00	45%	$ 1,458.00	$ 12,258.00	30%	60%	10%	$ 3,677.40	$ 7,354.80	$ 1,225.80	60.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Internal floor finishes				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
246	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 2,268.75	45%	$ 306.28	$ 2,575.03	30%	60%	10%	$ 772.51	$ 1,545.02	$ 257.50	12.8 hrs		
247	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 4,719.00	45%	$ 637.07	$ 5,356.07	30%	60%	10%	$ 1,606.82	$ 3,213.64	$ 535.61	26.6 hrs		
248	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 12,024.38	45%	$ 1,623.29	$ 13,647.67	30%	60%	10%	$ 4,094.30	$ 8,188.60	$ 1,364.77	67.8 hrs		
249	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 25,010.70	45%	$ 3,376.44	$ 28,387.14	30%	60%	10%	$ 8,516.14	$ 17,032.29	$ 2,838.71	140.9 hrs		
250	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O	22.69	$ 4,537.50	45%	$ 612.56	$ 5,150.06	30%	60%	10%	$ 1,545.02	$ 3,090.04	$ 515.01	25.6 hrs		
251	Heavy duty carpet tiles; to cement and sand base - (Offices)		Bldg 4.4.6.3-O		$ -	45%	$ 2,725.18	$ 15,123.74				$ 8,781.14	$ -	$ 6,342.60	233.2 hrs		
252	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O	22.69	$ 1,134.38	45%	$ 153.14	$ 1,287.52	30%	60%	10%	$ 386.25	$ 772.51	$ 128.75	6.4 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
253	Glazed ceramic floor tile; anti-slip tiles		Bldg 4.4.6.3-O	76.23	$ 3,811.50	45%	$ 514.55	$ 4,326.05	30%	60%	10%	$ 1,297.82	$ 2,595.63	$ 432.61	21.5 hrs		
254	Line painting to Floors	3.2.1.6	Bldg 4.4.6.3		$ -	45%	$ 554.75	$ 1,881.59	30%	60%	10%	$ 1,787.54	$ -	$ 94.05	50.0 hrs		
255	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 13,612.50	45%	$ 1,837.69	$ 15,450.19	30%	60%	10%	$ 4,635.06	$ 9,270.11	$ 1,545.02	76.7 hrs		
256	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 28,314.00	45%	$ 3,822.39	$ 32,136.39	30%	60%	10%	$ 9,640.92	$ 19,281.83	$ 3,213.64	159.5 hrs		
257	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 22,914.38	45%	$ 3,093.44	$ 26,007.82	30%	60%	10%	$ 7,802.34	$ 15,604.69	$ 2,600.78	129.1 hrs		
258	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 47,661.90	45%	$ 6,434.36	$ 54,096.26	30%	60%	10%	$ 16,228.88	$ 32,457.75	$ 5,409.63	268.6 hrs		
	Ceiling finishes				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
259	Paints to ceilings (Storage); two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4	5.45	$ 5,499.45	45%	$ 742.43	$ 6,241.88	30%	60%	10%	$ 1,872.56	$ 3,745.13	$ 624.19	31.0 hrs		
260	Paints to ceilings; two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4	9.08	$ 5,445.00	45%	$ 735.08	$ 6,180.08	30%	60%	10%	$ 1,854.02	$ 3,708.05	$ 618.01	30.7 hrs		
261	Acoustic ceilings to Offices on anti vibration mounting	3.3.3.1	Bldg 4.4.6.4-O	98.01	$ 24,502.50	45%	$ 3,307.84	$ 27,810.34	30%	60%	10%	$ 8,343.10	$ 16,686.20	$ 2,781.03	138.1 hrs		
					$ -	45%	$ -	$ -	30%	60%	10%	$ -	$ -	$ -	-		
	Sub-Total				**$ 288,364.59**		**$ 140,358.46**	**$ 735,259.72**				**$ 425,015.68**	**$ 197,322.99**	**$ 112,921.05**	**10,671.0 hrs**		
	ELEVATORS, LIFTS AND HOISTS																
262	Dock Levellers (Elec Operated)	5.10.7.1	Bldg 4.4.6.7	8,000.00	$ 16,000.00	45%	$ 2,160.00	$ 18,160.00	30%	60%	10%	$ 5,448.00	$ 10,896.00	$ 1,816.00	90.2 hrs		
263	Rubber Bumpers on Wall at Loading Bay	5.10.7.1	Bldg 4.4.6.7	400.00	$ 3,200.00	45%	$ 432.00	$ 3,632.00	30%	60%	10%	$ 1,089.60	$ 2,179.20	$ 363.20	18.0 hrs		
264	Temporary prefabricated Loading dock (use during construction)		Bldg 4.4.6.7	6,000.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	33.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 25,200.00**		**$ 3,402.00**	**$ 28,602.00**				**$ 8,580.60**	**$ 17,161.20**	**$ 2,860.20**	**142.0 hrs**		
	BUILDING SERVICES																
	Sanitary appliances				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
265	Washroom Accessories (complete Male/Fe/HC)	5.1.1.1	Bldg 4.4.6.14-O	52,000.00	$ 52,000.00	45%	$ 7,020.00	$ 59,020.00	30%	60%	10%	$ 17,706.00	$ 35,412.00	$ 5,902.00	266.4 hrs		
	Disposal equipment				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
266	Garbage/Recycling Equipment	5.3.3.1	Bldg 4.4.6.14-O	562.65	$ 562.65	45%	$ 75.96	$ 638.61	30%	60%	10%	$ 191.58	$ 383.16	$ 63.86	3.2 hrs		
	Water installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
267	Hot and cold water installations; complete installation		Bldg 4.2.1.4	44.47	$ 11,116.88	45%	$ 1,500.78	$ 12,617.65	30%	60%	10%	$ 3,785.30	$ 7,570.59	$ 1,261.77	56.9 hrs		
268	Stand alone Demineralized water tank on Metal stand (1000 gallons Cap)		Bldg 4.2.6.2	12,000.00	$ 12,000.00	45%	$ 1,620.00	$ 13,620.00	30%	60%	10%	$ 4,086.00	$ 8,172.00	$ 1,362.00	67.6 hrs		
	Water installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
269	Water Heater 100 litres		Bldg 4.2.6.2		$ -	45%	$ 203.40	$ 3,814.95	30%	60%	10%	$ 655.40	$ -	$ 3,159.55	16.7 hrs		
	Uninterruptible Power Supply				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
270	Static UPS including Control panel & Batteries for 500 KVA @ $495/KVA		Bldg 4.1.1.5	820.00	$ 410,000.00	45%	$ 55,350.00	$ 465,350.00	30%	60%	10%	$ 139,605.00	$ 279,210.00	$ 46,535.00	2,046.0 hrs		
271	Inverter Panels		Bldg 4.1.1.5	750.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	60%	10%	$ 510.75	$ 1,021.50	$ 170.25	7.5 hrs		
272	Battery Racks		Bldg 4.1.1.5	2,400.00	$ 4,800.00	45%	$ 648.00	$ 5,448.00	30%	60%	10%	$ 1,634.40	$ 3,268.80	$ 544.80	24.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	ELECTRICAL				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
273	Sub Station (prefabricated) @ $45,000		Bldg 4.1.1.1	45,000.00	$ 45,000.00	45%	$ 6,075.00	$ 51,075.00	30%	60%	10%	$ 15,322.50	$ 30,645.00	$ 5,107.50	253.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
274	Transformer - 1000 KVA		Bldg 4.1.1.1	29,700.00	$ 29,700.00	45%	$ 4,009.50	$ 33,709.50	30%	60%	10%	$ 10,112.85	$ 20,225.70	$ 3,370.95	148.2 hrs		
275	Transformer - 1500 KVA		Bldg 4.1.1.1	61,000.00	$ 61,000.00	45%	$ 8,235.00	$ 69,235.00	30%	60%	10%	$ 20,770.50	$ 41,541.00	$ 6,923.50	304.4 hrs		
276	Transformer - 2000 KVA		Bldg 4.1.1.1	73,000.00	$ 73,000.00	45%	$ 9,855.00	$ 82,855.00	30%	60%	10%	$ 24,856.50	$ 49,713.00	$ 8,285.50	364.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
277	Standby Generator (Diesel powered) 1000 KVA @ $350,000		Bldg 4.1.2.1	350,000.00	$ 350,000.00	45%	$ 47,250.00	$ 397,250.00	30%	60%	10%	$ 119,175.00	$ 238,350.00	$ 39,725.00	1,746.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
278	Ring Main Unit 11 kv including Electrical terminations @ $29,700		Bldg 4.1.1.1	29,700.00	$ 89,100.00	45%	$ 12,028.50	$ 101,128.50	30%	60%	10%	$ 30,338.55	$ 60,677.10	$ 10,112.85	444.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
279	Lighting and power installation - Offices 250m2 -		Bldg 4.1.5.3-O	190.58	$ 47,643.75	45%	$ 6,431.91	$ 54,075.66	30%	60%	10%	$ 16,222.70	$ 32,445.39	$ 5,407.57	237.8 hrs		
280	Electrical Installation - Storage Area - 1010 m2 - Lighting Installation		Bldg 4.1.5.2	79.86	$ 80,658.60	45%	$ 10,888.91	$ 91,547.51	30%	60%	10%	$ 27,464.25	$ 54,928.51	$ 9,154.75	402.5 hrs		
281	Electrical Installation - Facility/Clean up/Drum Handling-630 m2		Bldg 4.1.5.2	79.86	$ 50,311.80	45%	$ 6,792.09	$ 57,103.89	30%	60%	10%	$ 17,131.17	$ 34,262.34	$ 5,710.39	251.1 hrs		
282	Electrical Installation -HVAC /Electrical Rm - 600 m2 - Lighting Installation		Bldg 4.1.5.2	79.86	$ 47,916.00	45%	$ 6,468.66	$ 54,384.66	30%	60%	10%	$ 16,315.40	$ 32,630.80	$ 5,438.47	239.1 hrs		
283	Lightening Arrestor (c/w earthing wire, copper rods)		Bldg 4.1.5.2	20,000.00	$ 20,000.00	45%	$ 2,700.00	$ 22,700.00	30%	60%	10%	$ 6,810.00	$ 13,620.00	$ 2,270.00	99.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Space Heating & Air Treatment				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
284	Heating - Offices - 250 m2		Bldg 4.2.1.10-O	47.45	$ 11,863.50	45%	$ 1,601.57	$ 13,465.07	30%	60%	10%	$ 4,039.52	$ 8,079.04	$ 1,346.51	58.4 hrs		
285	Cooling - Offices - 250 m2		Bldg 4.2.1.10-O	56.22	$ 14,053.88	45%	$ 1,897.27	$ 15,951.15	30%	60%	10%	$ 4,785.34	$ 9,570.69	$ 1,595.11	69.2 hrs		
286	Ductwork - Offices - 250 m2		Bldg 4.2.1.10-O	140.42	$ 35,103.75	45%	$ 4,739.01	$ 39,842.76	30%	60%	10%	$ 11,952.83	$ 23,905.65	$ 3,984.28	176.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
287	Heating - Storage Area - 1010 m2		PROC 4.2.1.7	39.01	$ 39,396.06	45%	$ 5,318.47	$ 44,714.53	30%	60%	10%	$ 13,414.36	$ 26,828.72	$ 4,471.45	194.1 hrs		
288	BMS System Installation		PROC 4.2.1.7	9.83	$ 9,932.34	45%	$ 1,340.87	$ 11,273.21	30%	60%	10%	$ 3,381.96	$ 6,763.92	$ 1,127.32	48.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
289	Heating - Facility/Clean up/Drum Handling - 630 m2		PROC 4.2.1.7	39.01	$ 24,573.78	45%	$ 3,317.46	$ 27,891.24	30%	60%	10%	$ 8,367.37	$ 16,734.74	$ 2,789.12	121.1 hrs		
290	BMS System Installation		PROC 4.2.1.7	9.83	$ 6,195.42	45%	$ 836.38	$ 7,031.80	30%	60%	10%	$ 2,109.54	$ 4,219.08	$ 703.18	30.5 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
291	Heating - HVAC/Elec Rm - 600 m2		PROC 4.2.1.7	39.01	$ 23,403.60	45%	$ 3,159.49	$ 26,563.09	30%	60%	10%	$ 7,968.93	$ 15,937.85	$ 2,656.31	115.3 hrs		
292	BMS System Installation		PROC 4.2.1.7	9.83	$ 5,900.40	45%	$ 796.55	$ 6,696.95	30%	60%	10%	$ 2,009.09	$ 4,018.17	$ 669.70	29.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	SPRINKLER INSTALLATION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
293	Offices - 250 m2		Bldg 4.2.10.3-O	36.96	$ 9,240.00	45%	$ 1,247.40	$ 10,487.40	30%	60%	10%	$ 3,146.22	$ 6,292.44	$ 1,048.74	45.5 hrs		
294	Storage Area - 1010 m2		Bldg 4.2.10.1	36.96	$ 37,329.60	45%	$ 5,039.50	$ 42,369.10	30%	60%	10%	$ 12,710.73	$ 25,421.46	$ 4,236.91	183.9 hrs		
295	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.2.10.1	36.96	$ 23,284.80	45%	$ 3,143.45	$ 26,428.25	30%	60%	10%	$ 7,928.47	$ 15,856.95	$ 2,642.82	114.7 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
					All-in Total	% of Labour Total	Indirect Total		Lab	Mat	Equip						
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
296	HVAC/Elec Rm - 600 m2		Bldg 4.2.10.1	36.96	$ 22,176.00	45%	$ 2,993.76	$ 25,169.76	30%	60%	10%	$ 7,550.93	$ 15,101.86	$ 2,516.98	109.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	COMMUNICATION INSTALLATION - Fire/Voice Alarm				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
297	Offices - 250 m2		Bldg 4.1.3.8-O	21.38	$ 5,346.00	45%	$ 721.71	$ 6,067.71	30%	60%	10%	$ 1,820.31	$ 3,640.63	$ 606.77	26.7 hrs		
298	Storage Area - 1010 m2		Bldg 4.1.3.4	21.38	$ 21,597.84	45%	$ 2,915.71	$ 24,513.55	30%	60%	10%	$ 7,354.06	$ 14,708.13	$ 2,451.35	107.8 hrs		
299	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.1.3.4	21.38	$ 13,471.92	45%	$ 1,818.71	$ 15,290.63	30%	60%	10%	$ 4,587.19	$ 9,174.38	$ 1,529.06	67.2 hrs		
300	HVAC/Elec Rm - 600 m2		Bldg 4.1.3.4	21.38	$ 12,830.40	45%	$ 1,732.10	$ 14,562.50	30%	60%	10%	$ 4,368.75	$ 8,737.50	$ 1,456.25	64.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Natural Gas Installation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Not Required				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Heating, Ventilation and Air Conditioning				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
301	Building Management system tie ins for Office building Heating & Cooling system	5.6.1.1	Bldg 4.2.2.7-O	32.88	$ 8,221.13	45%	$ 1,109.85	$ 9,330.98	30%	60%	10%	$ 2,799.29	$ 5,598.59	$ 933.10	40.5 hrs		
302	Main Steam line tie ins from Main Source	5.6.1.1	Bldg 4.2.2.7-O	25,000.00	$ 25,000.00	45%	$ 3,375.00	$ 28,375.00	30%	60%	10%	$ 8,512.50	$ 17,025.00	$ 2,837.50	123.2 hrs		
303	Local ventilation to WC	5.6.1.1	Bldg 4.2.2.7-O	435.60	$ 1,742.40	45%	$ 235.22	$ 1,977.62	30%	60%	10%	$ 593.29	$ 1,186.57	$ 197.76	8.6 hrs		
304	Ventilation system to toilet areas	5.6.1.1	Bldg 4.2.2.7-O	36.30	$ 1,815.00	45%	$ 245.03	$ 2,060.03	30%	60%	10%	$ 618.01	$ 1,236.02	$ 206.00	8.9 hrs		
305	Electrical Space Heaters at Storage Area - 1010 M2	5.6.2.1	Bldg 4.2.6.2	1,500.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	29.9 hrs		
306	Clean Breathing Air System Plant	5.7.1.1	PROC 4.2.1.7	45,900.00	$ 91,800.00	45%	$ 12,393.00	$ 104,193.00	30%	60%	10%	$ 31,257.90	$ 62,515.80	$ 10,419.30	452.3 hrs		
307	Service Air System Plant	5.7.1.1	PROC 4.2.1.7	23,000.00	$ 23,000.00	45%	$ 3,105.00	$ 26,105.00	30%	60%	10%	$ 7,831.50	$ 15,663.00	$ 2,610.50	113.3 hrs		
308	Instrument System Plant (with dessicant air dryer)	5.7.1.1	PROC 4.2.1.7	23,000.00	$ 23,000.00	45%	$ 3,105.00	$ 26,105.00	30%	60%	10%	$ 7,831.50	$ 15,663.00	$ 2,610.50	113.3 hrs		
307	Exhaust Fan with Mech operated Louvers c/w control system	5.7.3.1	Bldg 4.4.6.5	28,000.00	$ 168,000.00	45%	$ 22,680.00	$ 190,680.00	30%	60%	10%	$ 57,204.00	$ 114,408.00	$ 19,068.00	838.4 hrs		
309	Pre fab Mech Operated Metal Louvres (prefinished)2x3M	5.7.3.1	Bldg 4.4.6.5	1,200.00	$ 7,200.00	45%	$ 972.00	$ 8,172.00	30%	60%	10%	$ 2,451.60	$ 4,903.20	$ 817.20	35.5 hrs		
	Electrical installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
310	Electrical Main Junction & Distribution Box	5.8.1.1	Bldg 4.1.1.2		$ -	45%	$ 182.69	$ 17,475.08	30%	60%	10%	$ 588.68	$ -	$ 16,886.40	14.6 hrs		
311	Internal LV wiring	5.8.1.1	Bldg 4.1.1.2		$ -	45%	$ 5,115.43	$ 23,977.84	30%	60%	10%	$ 16,483.05	$ -	$ 7,494.80	408.2 hrs		
312	Lighting & Fixtures (Office)	5.8.3.1	Bldg 4.1.5.2-O	300.00	$ 3,600.00	45%	$ 486.00	$ 4,086.00	30%	60%	10%	$ 1,225.80	$ 2,451.60	$ 408.60	18.0 hrs		
313	Lighting & Fixtures (Storage)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	29.9 hrs		
314	Lighting & Fixtures (HVAC room)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 2,400.00	45%	$ 324.00	$ 2,724.00	30%	60%	10%	$ 817.20	$ 1,634.40	$ 272.40	12.0 hrs		
315	Lighting & Fixtures (External)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 5,400.00	45%	$ 729.00	$ 6,129.00	30%	60%	10%	$ 1,838.70	$ 3,677.40	$ 612.90	26.9 hrs		
316	Special Lighting systems	5.8.4.1	Bldg 4.1.5.2	500.00	$ 2,000.00	45%	$ 270.00	$ 2,270.00	30%	60%	10%	$ 681.00	$ 1,362.00	$ 227.00	10.0 hrs		
317	Way finding Signs (Illuminated)	5.8.4.1	Bldg 4.1.5.2	350.00	$ 5,600.00	45%	$ 756.00	$ 6,356.00	30%	60%	10%	$ 1,906.80	$ 3,813.60	$ 635.60	27.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Fire and lightening protection				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
318	Fire alarms/appliances		Bldg 4.1.6.1	14.00	$ 35,000.00	45%	$ 4,725.00	$ 39,725.00	30%	60%	10%	$ 11,917.50	$ 23,835.00	$ 3,972.50	174.7 hrs		
319	Lightening protection system	5.11.2.1	Bldg 4.1.6.1	2.00	$ 5,000.00	45%	$ 675.00	$ 5,675.00	30%	60%	10%	$ 1,702.50	$ 3,405.00	$ 567.50	25.0 hrs		
320	Fire and Smoke Detectors		Bldg 4.1.6.1	250.00	$ 4,000.00	45%	$ 540.00	$ 4,540.00	30%	60%	10%	$ 1,362.00	$ 2,724.00	$ 454.00	20.0 hrs		
	Communication, security and control systems				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
321	LAN	5.12.1.2	Bldg 4.1.3.5-O	1,200.00	$ 14,400.00	45%	$ 1,944.00	$ 16,344.00	30%	60%	10%	$ 4,903.20	$ 9,806.40	$ 1,634.40	71.9 hrs		
322	Internal Communication system; Telecommunication System	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
323	Public address system	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
324	Central security control devices; Security Systems; Security Lights and lighting system,	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
325	TV monitors	5.12.1.14	Bldg 4.1.3.6-O	1,200.00	$ 9,600.00	45%	$ 1,296.00	$ 10,896.00	30%	60%	10%	$ 3,268.80	$ 6,537.60	$ 1,089.60	47.9 hrs		
326	Surveillance equipment; detectors and alarms	5.12.1.1	Bldg 4.1.3.2	7.70	$ 19,173.00	45%	$ 2,588.36	$ 21,761.36	30%	60%	10%	$ 6,528.41	$ 13,056.81	$ 2,176.14	95.7 hrs		
	Builders work in connection with building services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
327	Cutting and Patching	5.14.1.1	STIE 4.2.11.1	300.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	169.0 hrs		
328	Fire & smoke stopping	5.14.1.1	Bldg 4.1.6.1	10.00	$ 24,900.00	45%	$ 3,361.50	$ 28,261.50	30%	60%	10%	$ 8,478.45	$ 16,956.90	$ 2,826.15	140.3 hrs		
329	Ducts/Pipe sleeves/Openings	5.14.1.1	STIE 4.2.11.1	300.00	$ 45,000.00	45%	$ 6,075.00	$ 51,075.00	30%	60%	10%	$ 15,322.50	$ 30,645.00	$ 5,107.50	253.6 hrs		
330	Housekeeping pads; 150mm thick	5.14.1.1	Bldg 4.4.1.1	400.00	$ 108,000.00	45%	$ 14,580.00	$ 122,580.00	30%	60%	10%	$ 36,774.00	$ 73,548.00	$ 12,258.00	591.9 hrs		
331	Housekeeping pads; 100mm thick	5.14.1.1	Bldg 4.4.1.1	300.00	$ 11,250.00	45%	$ 1,518.75	$ 12,768.75	30%	60%	10%	$ 3,830.63	$ 7,661.25	$ 1,276.88	61.7 hrs		
	Ducts for incoming services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
332	Excavation for Duct bank for services (incoming)		SPRP 4.4.7.1		$ -	45%	$ 876.66	$ 4,025.41	60%	30%	10%	$ 2,824.79	$ 1,200.62	$ -	81.5 hrs		
333	Concrete in blinding for Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 22.82	$ 543.22	60%	30%	10%	$ 73.52	$ 9.80	$ 459.90	2.0 hrs		
334	Concrete in base slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 34.65	$ 809.71	60%	30%	10%	$ 111.65	$ 77.18	$ 620.87	3.0 hrs		
335	Concrete in walls Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 98.82	$ 1,987.28	60%	30%	10%	$ 318.42	$ 220.17	$ 1,448.70	8.7 hrs		
336	Concrete in roof slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 34.65	$ 809.71	60%	30%	10%	$ 111.65	$ 77.18	$ 620.87	3.0 hrs		
337	Formwork in walls Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 6,108.83	$ 20,676.73	60%	30%	10%	$ 19,684.00	$ -	$ 992.72	535.3 hrs		
338	Formwork for Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 7,144.08	$ 23,713.30	60%	30%	10%	$ 23,019.81	$ -	$ 693.50	626.0 hrs		
339	Formwork for roof slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 3,572.04	$ 11,856.65	60%	30%	10%	$ 11,509.90	$ -	$ 346.75	313.0 hrs		
340	Reinforcement for Duct bank for services (incoming)		Bldg 4.4.1.2		$ -	45%	$ 1,140.77	$ 4,507.43	60%	30%	10%	$ 3,675.82	$ -	$ 831.62	100.0 hrs		
	Tie-ins to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Testing and commissioning building services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
341	Testing Telecommunication System;		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
342	Testing Public Address System;		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
343	Testing Fire Detection and Alarm Systems		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
344	Testing Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
345	Testing Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
346	Testing Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
347	Commissioning Telecommunication System;		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
348	Commissioning Public Address System;		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
349	Commissioning Fire Detection and Alarm Systems		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
350	Commissioning Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
351	Commissioning Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
352	Commissioning Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
353	Specialist Training and Information sharing	5.15.1.1	Bldg 4.4.8.1.3		$ -	45%	$ 4,292.54	$ 13,831.51	70%	15%	15%	$ 13,831.51	$ -	$ -	342.5 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 2,438,173.99**		**$ 361,635.58**	**$ 2,899,011.02**				**$ 934,862.76**	**$ 1,652,159.38**	**$ 311,988.88**	**14,937.9 hrs**		
	MISCELLANEOUS METALWORK																
354	Railings at Roof top; mild steel balustrade and steel handrail; 1100mm high		Bldg 4.4.3.3	490.05	$ 71,547.30	45%	$ 9,658.89	$ 81,206.19	30%	60%	10%	$ 24,361.86	$ 48,723.71	$ 8,120.62	362.3 hrs		
355	Miscellaneous metals (Offices)		Bldg 4.4.3.5-O	50,000.00	$ 50,000.00	45%	$ 6,750.00	$ 56,750.00	30%	60%	10%	$ 17,025.00	$ 34,050.00	$ 5,675.00	253.2 hrs		
356	Miscellaneous Mmetals (Building)		Bldg 4.4.3.1	200,000.00	$ 200,000.00	45%	$ 27,000.00	$ 227,000.00	30%	60%	10%	$ 68,100.00	$ 136,200.00	$ 22,700.00	1,012.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 321,547.30**		**$ 43,408.89**	**$ 364,956.19**				**$ 109,486.86**	**$ 218,973.71**	**$ 36,495.62**	**1,628.2 hrs**		
	INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT																
	General fixtures and fittings				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
357	Furniture to Offices (18 personnel)		Bldg 4.4.6.13-O	3,500.00	$ 63,000.00	45%	$ 8,505.00	$ 71,505.00	30%	60%	10%	$ 21,451.50	$ 42,903.00	$ 7,150.50	355.0 hrs		
358	Furniture to Conference room and Admin area		Bldg 4.4.6.13-O	75,000.00	$ 75,000.00	45%	$ 10,125.00	$ 85,125.00	30%	60%	10%	$ 25,537.50	$ 51,075.00	$ 8,512.50	422.6 hrs		
359	Window Blinds; 2.0m wide		Bldg 4.4.6.13-O		$ -	45%	$ 6,703.28	$ 23,410.81	30%	60%	10%	$ 21,599.44	$ -	$ 1,811.37	382.1 hrs		
360	Eye wash Station		Bldg 4.4.6.14-O	3,500.00	$ 7,000.00	45%	$ 945.00	$ 7,945.00	30%	60%	10%	$ 2,383.50	$ 4,767.00	$ 794.50	39.4 hrs		
361	Emergency Shower		Bldg 4.4.6.14-O	7,500.00	$ 15,000.00	45%	$ 2,025.00	$ 17,025.00	30%	60%	10%	$ 5,107.50	$ 10,215.00	$ 1,702.50	84.5 hrs		
362	Laboratory Shelving		Bldg 4.4.6.14-O	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	60%	10%	$ 1,021.50	$ 2,043.00	$ 340.50	16.9 hrs		
363	Change room station		Bldg 4.4.6.14-O	3,500.00	$ 3,500.00	45%	$ 472.50	$ 3,972.50	30%	60%	10%	$ 1,191.75	$ 2,383.50	$ 397.25	19.7 hrs		
364	Fume hoods - cover at all tanks		Bldg 4.2.2.5	12,000.00	$ 300,000.00	45%	$ 40,500.00	$ 340,500.00	30%	60%	10%	$ 102,150.00	$ 204,300.00	$ 34,050.00	1,690.4 hrs		
365	Fume hoods @ Drum Cleaning Area		Bldg 4.2.2.5	15,000.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	169.0 hrs		
365	Radiation monitors (Storage area)		Bldg 4.1.9.1		$ -	45%	$ -	Excluded	30%	60%	10%						
366	SAM - Small Article Monitor		Bldg 4.1.9.1	81,000.00	$ 81,000.00	45%	$ 10,935.00	$ 91,935.00	30%	60%	10%	$ 27,580.50	$ 55,161.00	$ 9,193.50	404.2 hrs		
367	Motion detector		Bldg 4.1.9.1	988.00	$ 7,904.00	45%	$ 1,067.04	$ 8,971.04	30%	60%	10%	$ 2,691.31	$ 5,382.62	$ 897.10	39.4 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 585,404.00**		**$ 85,732.82**	**$ 687,844.35**				**$ 220,929.50**	**$ 398,660.12**	**$ 68,254.72**	**3,623.3 hrs**		
	PROCESS EQUIPMENT																
	PHT D2O Supply Tanks (8 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
368	Tanks 100 Mg 38110 - SS 304 Class 6		PROC 4.2.5.4	572,000.00	$ 4,576,000.00	45%	$ -	$ 4,576,000.00	0%	100%	0%	$ -	$ 4,576,000.00	$ -	-		From previous estimate
369	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 108,000.00	45%	$ -	$ 108,000.00	0%	85%	15%	$ -	$ 91,800.00	$ 16,200.00	-		From previous estimate
370	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
371	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 2,537.83	$ 12,313.45				$ 8,177.45	$ -	$ 4,136.00	199.9 hrs		
372	Level sensors		PROC 4.2.1.3		$ -	45%	$ 3,383.77	$ 47,207.27				$ 10,903.27	$ -	$ 36,304.00	266.6 hrs		
373	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 3,383.77	$ 34,791.27				$ 10,903.27	$ -	$ 23,888.00	266.6 hrs		
374	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 18,240.65	$ 90,065.42				$ 58,775.42	$ -	$ 31,290.00	1,436.9 hrs		
375	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 18,240.65	$ 90,065.42				$ 58,775.42	$ -	$ 31,290.00	1,436.9 hrs		
376	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 2,923.10	$ 25,594.88				$ 9,418.88	$ -	$ 16,176.00	233.2 hrs		
377	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 3,340.69	$ 19,628.44				$ 10,764.44	$ -	$ 8,864.00	266.6 hrs		
378	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 1,670.34	$ 11,446.22				$ 5,382.22	$ -	$ 6,064.00	133.3 hrs		
379	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 164.96	$ 21,147.53				$ 531.53	$ -	$ 20,616.00	13.0 hrs		
380	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 8,712.00	45%	$ 784.08	$ 9,496.08	20%	60%	20%	$ 1,899.22	$ 5,697.65	$ 1,899.22	27.8 hrs		
381	Item-6- Cover gas Vent Control Valve pnuematic control Valve and Accessories		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
382	Item - 8 - Cover Gas Relief Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
383	Item - 9 - Main Outlet Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
384	Item - 11 & 12 - Outlet Isolation Valves		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
385	Item - 15 - Main Inlet Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
386	Item 24 & 25 - Inlet Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
387	Item - 26 - Cover Gas Supply Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
388	Item - 28 - Supply Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
389	Item - 29 - Vacuum Relief Valve		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
390	Item - 32 - Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 208.79	$ 1,189.78				$ 672.78	$ -	$ 517.00	16.7 hrs		
391	Item 33 & 34 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 365.39	$ 5,715.36				$ 1,177.36	$ -	$ 4,538.00	29.2 hrs		
392	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.5.4		$ -	45%	$ 317.23	$ 1,022.18				$ 1,022.18	$ -	$ -	25.0 hrs		
393	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	655,184.40	$ 655,184.40	45%	$ 117,933.19	$ 773,117.59	40%	0%	60%	$ 309,247.04	$ -	$ 463,870.55	4,474.5 hrs		
	Moderator D2O Supply Tanks(7 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
394	Tanks 100 Mg 38110; SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 4,887,120.00	45%	$ -	$ 4,887,120.00	0%	100%	0%	$ -	$ 4,887,120.00	$ -	-		From previous estimate
395	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 94,500.00	45%	$ -	$ 94,500.00	0%	85%	15%	$ -	$ 80,325.00	$ 14,175.00	-		From previous estimate
396	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
397	Valves		PROC 4.2.1.2		$ -	45%	$ 288.68	$ 930.18				$ 930.18	$ -	$ -	22.7 hrs		
398	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 2,220.60	$ 10,774.27				$ 7,155.27	$ -	$ 3,619.00	174.9 hrs		
399	Level sensors		PROC 4.2.1.3		$ -	45%	$ 2,960.80	$ 41,306.36				$ 9,540.36	$ -	$ 31,766.00	233.2 hrs		
400	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 2,960.80	$ 30,442.36				$ 9,540.36	$ -	$ 20,902.00	233.2 hrs		
401	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 222,060.07	$ 742,905.64				$ 715,526.89	$ -	$ 27,378.75	17,493.0 hrs		
402	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 166,545.05	$ 564,023.92				$ 536,645.17	$ -	$ 27,378.75	13,119.8 hrs		
403	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 2,557.71	$ 22,395.52				$ 8,241.52	$ -	$ 14,154.00	204.1 hrs		
404	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 2,923.10	$ 17,174.88				$ 9,418.88	$ -	$ 7,756.00	233.2 hrs		
405	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 1,461.55	$ 10,015.44				$ 4,709.44	$ -	$ 5,306.00	116.6 hrs		
406	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 144.34	$ 18,504.09				$ 465.09	$ -	$ 18,039.00	11.4 hrs		
407	Data Cables to Control room		Bldg 4.1.3.1		$ -	45%	$ 17,577.94	$ 64,263.04				$ 56,640.04	$ -	$ 7,623.00	1,402.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
408	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.1.3		$ -	45%	$ 317.23	$ 1,022.18				$ 1,022.18	$ -	$ -	25.0 hrs		
409	Item-5-Cover Gas Vent Control Pnuematic Valve & Accessories- 2 "		PROC 4.2.1.2		$ -	45%	$ 317.23	$ 1,812.18				$ 1,022.18	$ -	$ 790.00	25.0 hrs		
410	Item-7-Cover Gas Relief Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
411	item-10-Main Outlet Header Isolation Valve 3 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
412	Item-13&14- Outlet Isolation Valve - 3 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
413	Item - 18 & 19- Inlet Isolation Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,052.88				$ 132.88	$ -	$ 920.00	3.2 hrs		
414	Item - 27 - Cover Gas Supply Isolation Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
415	Item - 30 - Vacuum Relief Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 475.84	$ 3,873.27				$ 1,533.27	$ -	$ 2,340.00	37.5 hrs		
416	Item - 31- Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 313.19	$ 1,526.17				$ 1,009.17	$ -	$ 517.00	25.0 hrs		
417	Item- 35 & 36 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 5,883.55				$ 1,345.55	$ -	$ 4,538.00	33.3 hrs		
418	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	696,337.03	$ 696,337.03	45%	$ 125,340.66	$ 821,677.69	40%	0%	60%	$ 328,671.08	$ -	$ 493,006.61	4,755.6 hrs		
	TRF/SUP Feed Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
419	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 1,396,320.00	45%	$ -	$ 1,396,320.00	0%	100%	0%	$ -	$ 1,396,320.00	$ -	-		From previous estimate
420	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		From previous estimate
421	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
422	Valves		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 265.77				$ 265.77	$ -	$ -	6.5 hrs		
423	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
424	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
425	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
426	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
427	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
428	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
429	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
430	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
431	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
432	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
433	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	199,791.94	$ 199,791.94	45%	$ 35,962.55	$ 235,754.49	40%	0%	60%	$ 94,301.80	$ -	$ 141,452.70	1,364.5 hrs		
	TRF/SUP Product Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
434	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 1,396,320.00	45%	$ -	$ 1,396,320.00	0%	100%	0%	$ -	$ 1,396,320.00	$ -	-		From previous estimate
435	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		From previous estimate
436	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
437	Valves		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 265.77				$ 265.77	$ -	$ -	6.5 hrs		
438	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
439	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
440	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
441	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
442	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
443	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
444	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
445	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
446	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
447	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
448	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	199,791.94	$ 199,791.94	45%	$ 35,962.55	$ 235,754.49	40%	0%	60%	$ 94,301.80	$ -	$ 141,452.70	1,364.5 hrs		
	Downgraded D2O Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
449	Tanks 50 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	428,000.00	$ 856,000.00	45%	$ -	$ 856,000.00	0%	100%	0%	$ -	$ 856,000.00	$ -	-		Prorated
450	Tanks 50 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		Prorated
451	Tanks 50 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
452	Valves; 3"		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 3,425.77				$ 265.77	$ -	$ 3,160.00	6.5 hrs		
453	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
454	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
455	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
456	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
457	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
458	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
459	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
460	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
461	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
462	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
463	Item - 38 & 39 - Transfer Pump; including Item 40 & 41 24 HP motor		PROC 4.2.2.4		$ -	45%	$ 422.97	$ 29,272.91				$ 1,362.91	$ -	$ 27,910.00	33.3 hrs		
464	Item - 42 & 43 - Check Valve 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 2,210.88				$ 132.88	$ -	$ 2,078.00	3.2 hrs		
465	Item - 44 - Main Inlet Header Check valve 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
466	Item - 45 - Cover Gas Vent Control Valve pnuematic Control Valve and Accessories 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
467	Item - 46 & 47 - Outlet Control Valve and Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
468	Item 48 & 49 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
469	Item - 50 - Cover Gas Relief Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
470	Item 51 & 52 - Relief Valve - 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,372.88				$ 132.88	$ -	$ 1,240.00	3.2 hrs		
471	Item 53 & 54 - Inlet Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,672.88				$ 132.88	$ -	$ 1,540.00	3.2 hrs		
472	Item 55 - Cover Gas Supply Isolation Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
473	Item 56 - Cover Gas Drain Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
474	Item 57 - Vent Isolation Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
475	Item - 58 - Recirculation Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
476	Item - 59 - Clean up system Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
477	Item - 60 & 61 - Outlet Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
478	Item - 62 - Transfer System Supply Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
479	Item - 63 - Main Discharge Header Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
480	Item - 64 & 65 - Main Inlet Header Spare Connection Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
481	Item - 66 - Main Inlet Header Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 526.44				$ 66.44	$ -	$ 460.00	1.6 hrs		
482	Item - 67 - Vacuum Relief Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
483	Item - 68 - Recirculation Flow Orifice 1 1/2"		PROC 4.2.1.3		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
484	Item 69 & 70 - Commissioning Strainer 2 1/2"		PROC 4.2.1.3		$ -	45%	$ 41.24	$ 732.88				$ 132.88	$ -	$ 600.00	3.2 hrs		
485	Item 71 & 72 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 5,883.55				$ 1,345.55	$ -	$ 4,538.00	33.3 hrs		
486	Item 73 - Cover Gas Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 313.19	$ 1,526.17				$ 1,009.17	$ -	$ 517.00	25.0 hrs		
487	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	124,147.14	$ 124,147.14	45%	$ 22,346.49	$ 146,493.63	40%	0%	60%	$ 58,597.45	$ -	$ 87,896.18	847.8 hrs		
	Downgraded D2O Tank (1 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
488	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	264,000.00	$ 264,000.00	45%	$ -	$ 264,000.00	0%	100%	0%	$ -	$ 264,000.00	$ -	-		Prorated
489	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 13,500.00	45%	$ -	$ 13,500.00	0%	85%	15%	$ -	$ 11,475.00	$ 2,025.00	-		Prorated
490	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
491	Valves; 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,372.88				$ 132.88	$ -	$ 1,240.00	3.2 hrs		
492	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 211.49	$ 1,198.45				$ 681.45	$ -	$ 517.00	16.7 hrs		
493	Level sensors		PROC 4.2.1.3		$ -	45%	$ 422.97	$ 5,900.91				$ 1,362.91	$ -	$ 4,538.00	33.3 hrs		
494	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 422.97	$ 4,348.91				$ 1,362.91	$ -	$ 2,986.00	33.3 hrs		
495	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 2,280.08	$ 11,258.18				$ 7,346.93	$ -	$ 3,911.25	179.6 hrs		
496	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 2,280.08	$ 11,258.18				$ 7,346.93	$ -	$ 3,911.25	179.6 hrs		
497	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 365.39	$ 3,199.36				$ 1,177.36	$ -	$ 2,022.00	29.2 hrs		
498	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,453.55				$ 1,345.55	$ -	$ 1,108.00	33.3 hrs		
499	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 208.79	$ 1,430.78				$ 672.78	$ -	$ 758.00	16.7 hrs		
500	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
501	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 1,089.00	45%	$ 98.01	$ 1,187.01	20%	60%	20%	$ 237.40	$ 712.21	$ 237.40	3.5 hrs		
502	Item - 100 - Transfer System Feed Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
503	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	39,560.93	$ 39,560.93	45%	$ 7,120.97	$ 46,681.90	40%	0%	60%	$ 18,672.76	$ -	$ 28,009.14	270.2 hrs		
	CLEAN Up D2O Tank (3 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
504	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	264,000.00	$ 792,000.00	45%	$ -	$ 792,000.00	0%	100%	0%	$ -	$ 792,000.00	$ -	-		Prorated
505	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 40,500.00	45%	$ -	$ 40,500.00	0%	85%	15%	$ -	$ 34,425.00	$ 6,075.00	-		Prorated
506	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
507	Valves; 2"		PROC 4.2.1.2		$ -	45%	$ 123.72	$ 4,118.65				$ 398.65	$ -	$ 3,720.00	9.7 hrs		
508	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,595.36				$ 2,044.36	$ -	$ 1,551.00	50.0 hrs		
509	Level sensors		PROC 4.2.1.3		$ -	45%	$ 1,268.91	$ 17,702.73				$ 4,088.73	$ -	$ 13,614.00	100.0 hrs		
510	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 1,268.91	$ 13,046.73				$ 4,088.73	$ -	$ 8,958.00	100.0 hrs		
511	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 6,899.72	$ 33,966.19				$ 22,232.44	$ -	$ 11,733.75	543.5 hrs		
512	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 6,899.72	$ 33,966.19				$ 22,232.44	$ -	$ 11,733.75	543.5 hrs		
513	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 1,096.16	$ 9,598.08				$ 3,532.08	$ -	$ 6,066.00	87.5 hrs		
514	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 1,252.76	$ 7,360.66				$ 4,036.66	$ -	$ 3,324.00	100.0 hrs		
515	Beetle - Leak Detection - 1 ea		PROC 4.2.1.2		$ -	45%	$ 626.38	$ 4,292.33				$ 2,018.33	$ -	$ 2,274.00	50.0 hrs		
516	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 61.86	$ 7,930.33				$ 199.33	$ -	$ 7,731.00	4.9 hrs		
517	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 3,267.00	45%	$ 294.03	$ 3,561.03	20%	60%	20%	$ 712.21	$ 2,136.62	$ 712.21	10.4 hrs		
518	Item - 75 & 76 - Clean up Product Transfer Pump Suction 1 1/2" Discharge 1 1/2" including Item 78 & 79 Pump motor 4 HP		PROC 4.2.2.4		$ -	45%	$ 422.97	$ 29,272.91				$ 1,362.91	$ -	$ 27,910.00	33.3 hrs		
519	Item - 77 - Oxidation unit Feed Pump Suction 1" Discharge 1/2" including Item 80 Oxidation Pump Motor 1 HP		PROC 4.2.2.4		$ -	45%	$ 211.49	$ 14,636.45				$ 681.45	$ -	$ 13,955.00	16.7 hrs		
520	Item - 81 - Cover Gas Vent Control Valve Pnuematic Valve & Accessories 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
521	Item - 82 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
522	Item - 83 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
523	Item - 84 & 85- Outlet Control Valve Pnuematic Control Valve & Accessories 1"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
524	Item - 86 - Cover Gas Relief Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
525	Item - 87, 88,& 89 - Relief Valve 3/4"		PROC 4.2.1.2		$ -	45%	$ 61.86	$ 4,012.33				$ 199.33	$ -	$ 3,813.00	4.9 hrs		
526	Item - 90 - Station Upgrader Feed Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
527	Item - 91 - Vent Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
528	Item - 92 - Cover Gas Supply Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 66.44				$ 66.44	$ -	$ -	1.6 hrs		
529	Item - 93 - Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
530	Item - 94 - Cover Gas Drain Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
531	Item - 95 - Feed Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
532	Item - 96, 97, 98 & 99 - Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 10,573.77				$ 265.77	$ -	$ 10,308.00	6.5 hrs		
533	Item - 101 & 102 - Discharge Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
534	Item - 103 - Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
535	Item - 104 - Clean Up Feed Isolation Valves - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
536	Item - 105 - Vacuum Relief Valve 2"		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
537	Item - 106 Recirculation Flow Orifice 1"		PROC 4.2.1.2		$ -	45%	$ 17.45	$ 56.22				$ 56.22	$ -	$ -	1.4 hrs		
538	Item - 107 & 108 - Commissioning Strainer 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 132.88				$ 132.88	$ -	$ -	3.2 hrs		
539	Item - 109 - Cover Gas Pressure Transmitter		PROC 4.2.1.2		$ -	45%	$ 20.36	$ 582.60				$ 65.60	$ -	$ 517.00	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
540	Item - 110 & 111 - Level Transmitter		PROC 4.2.1.2		$ -	45%	$ 40.71	$ 4,669.19				$ 131.19	$ -	$ 4,538.00	3.2 hrs		
541	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	116,893.35	$ 116,893.35	45%	$ 21,040.80	$ 137,934.16	40%	0%	60%	$ 55,173.66	$ -	$ 82,760.49	798.3 hrs		
	TIE-ins for new tanks with Exstg tanks (at Exstg bldg)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	PHT D20 Supply 38110 - 100 Mg (8 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
542	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 17,391.60	$ 141,839.58				$ 56,039.58	$ -	$ 85,800.00	1,370.0 hrs		
	Moderator D20 Supply 38110 - 100 Mg (7 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
543	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 15,217.65	$ 124,109.64				$ 49,034.64	$ -	$ 75,075.00	1,198.8 hrs		
	TRF/SUP Feed 38110 - 100 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
544	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 35,459.90				$ 14,009.90	$ -	$ 21,450.00	342.5 hrs		
	TRF/SUP Product 38110 - 100 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
545	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 35,459.90				$ 14,009.90	$ -	$ 21,450.00	342.5 hrs		
	Downgraded D20 38500 - 50 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
546	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 32,159.90				$ 14,009.90	$ -	$ 18,150.00	342.5 hrs		
	Downgraded D20 38500 - 25 Mg (1 Tank)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
547	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 2,173.95	$ 15,254.95				$ 7,004.95	$ -	$ 8,250.00	171.3 hrs		
	D20 Clean up - 38410 - 25 Mg (3 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
548	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 6,521.85	$ 45,764.84				$ 21,014.84	$ -	$ 24,750.00	513.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
549	Rubber mats at all likely spill locations (25 ea) (6X4ft)		STIE 4.2.11.1	500.00	$ 12,500.00	45%	$ -	$ 12,500.00	0%	100%	0%	$ -	$ 12,500.00	$ -	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
550	Cathodic protection including all accessories (25 ea)		Bldg 4.1.5.1		$ -	45%	$ 5,365.67	$ 79,164.39				$ 17,289.39	$ -	$ 61,875.00	428.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
551	Crane Heavy duty Rental (for 3 months @ $40,000/month)		Bldg 4.2.4.1	40,000.00	$ 120,000.00	45%	$ -	$ 120,000.00	0%	0%	100%	$ -	$ -	$ 120,000.00	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
552	Stack Monitor (installation, electrical connections, switches)		PROC 4.2.2.6	275,000.00	$ 550,000.00	45%	$ 74,250.00	$ 624,250.00	30%	60%	10%	$ 187,275.00	$ 374,550.00	$ 62,425.00	2,769.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
553	Stainless Steel Ducts in Effluent Stack (14" dia) - ALL		PROC 4.2.2.6	190.00	$ 26,600.00	45%	$ 3,591.00	$ 30,191.00	30%	60%	10%	$ 9,057.30	$ 18,114.60	$ 3,019.10	134.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
554	Stainless Steel hoods and cover		PROC 4.2.2.6	50,000.00	$ 150,000.00	45%	$ 20,250.00	$ 170,250.00	30%	60%	10%	$ 51,075.00	$ 102,150.00	$ 17,025.00	755.4 hrs		
	COMMON GENERAL ITEMS				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
555	Cable Trays c/w hanging supports and metal brackets		Bldg 4.1.3.1		$ -	45%	$ 6,263.79	$ 24,377.62				$ 20,183.32	$ -	$ 4,194.30	499.8 hrs		
556	Pipe supports c/w supports and rawl plugs		STIE 4.2.1.1		$ -	45%	$ 2,918.50	$ 12,348.07				$ 9,404.07	$ 460.00	$ 2,484.00	229.9 hrs		
557	Instrumentation - SCADA (tanks to Control Room)		PROC 4.3.5.1	22,000.00	$ 550,000.00	45%	$ 74,250.00	$ 624,250.00	30%	60%	10%	$ 187,275.00	$ 374,550.00	$ 62,425.00	2,709.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Tie-ins to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
558	X-ray scanning of tie-in locations		STIE 4.2.11.1	1,200.00	$ 4,800.00	45%	$ 432.00	$ 5,232.00	20%	10%	70%	$ 1,046.40	$ 523.20	$ 3,662.40	17.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 18,197,268.74**		**$ 1,536,141.21**	**$ 22,840,585.80**				**$ 4,586,535.78**	**$ 15,395,038.81**	**$ 2,859,011.21**	**96,310.4 hrs**		
	ELECTRICAL CONTROL SYSTEMS																
559	Main Control Panel (600 wide x 800deep); 2000A		Bldg 4.1.1.6	20,000.00	$ 20,000.00	45%	$ 2,700.00	$ 22,700.00	30%	60%	10%	$ 6,810.00	$ 13,620.00	$ 2,270.00	99.8 hrs		
560	Main Control Panel (600 wide x 800deep); 2500A		Bldg 4.1.1.6	25,000.00	$ 25,000.00	45%	$ 3,375.00	$ 28,375.00	30%	60%	10%	$ 8,512.50	$ 17,025.00	$ 2,837.50	124.8 hrs		
561	Main Control Panel (600 wide x 800deep); 3000A		Bldg 4.1.1.6	30,000.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	149.7 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
562	Panel Boards; 2000A		Bldg 4.1.1.6		$ -	45%	$ 208.79	$ 19,053.86				$ 672.78	$ -	$ 18,381.08	16.7 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 75,000.00**		**$ 10,333.79**	**$ 104,178.86**				**$ 26,210.28**	**$ 51,075.00**	**$ 26,893.58**	**390.9 hrs**		
	SPECIALIST EQUIPMENT																
563	Mono rail system; 1T		Bldg 4.2.4.3	4,115.00	$ 4,115.00	45%	$ 185.18	$ 4,300.18	10%	80%	10%	$ 430.02	$ 3,440.14	$ 430.02	6.4 hrs		
564	Mono rail system; 5T		Bldg 4.2.4.3	9,897.00	$ 9,897.00	45%	$ 445.37	$ 10,342.37	10%	80%	10%	$ 1,034.24	$ 8,273.89	$ 1,034.24	15.4 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 14,012.00**		**$ 630.54**	**$ 14,642.54**				**$ 1,464.25**	**$ 11,714.03**	**$ 1,464.25**	**21.8 hrs**		
	TOTAL				**$ 28,567,039.86**		**$ 5,058,990.91**	**$ 45,604,124.36**				**$ 15,017,645.98**	**$ 21,968,886.81**	**$ 8,617,591.56**	**343,230.9 hrs**		
	LIFE CYCLE COSTINGS																
	Replacement roof materials				$ -		$ -	$ -									
565	Built up Roof at Lvl 115.00 - Re-roof at 25 years	2.3.1.3	Bldg 4.4.5.1	447.22	$ 268,329.60		$ -	$ 268,329.60									
566	Epoxy floor coatings (1 re-coat)		Bldg 4.4.6.3	47.35	$ 49,374.21		$ -	$ 49,374.21									
567	Duct controllers (15 years)		PROC 4.2.1.3	25,000.00	$ 25,000.00		$ -	$ 25,000.00									
568	Control valves (15 years)		PROC 4.2.1.2	90,000.00	$ 90,000.00		$ -	$ 90,000.00									
569	Valves (20 years)		PROC 4.2.1.2	73,000.00	$ 73,000.00		$ -	$ 73,000.00									
570	SCADA (25 years)		PROC 4.3.5.1	120,000.00	$ 120,000.00		$ -	$ 120,000.00									
571	Office furniture		Bldg 4.4.6.14-O	172,293.00	$ 172,293.00		$ -	$ 172,293.00									
572	Office flooring		Bldg 4.4.6.3-O	110.00	$ 27,500.00		$ -	$ 27,500.00									

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
					All-in Total	% of Labour Total	Indirect Total		Lab	Mat	Equip						
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
573	Washroom appliances		Bldg 4.4.6.14-O	57,200.00	$ 57,200.00		$ -	$ 57,200.00									
574	Pumps (20 years) - overhaul and new impellers		PROC 4.2.2.4	118,702.00	$ 118,702.00		$ -	$ 118,702.00									
575	Replacement of valves and controls to HVAC systems		PROC 4.2.1.7	155,000.00	$ 155,000.00		$ -	$ 155,000.00									
					$ -		$ -	$ -									
	Sub-Total				**$ 1,156,398.81**		**$ -**	**$ 1,156,398.81**									

11 Appendix E – Productivity Factors

11.1 Productivity Factor - Unzoned

The following represents the productivity factor for 'unzoned' areas:

Unzoned

Item	Event Description	Event Time		Events per Shift	Total Non-productive Time	Total Productive Time
		minutes	per			
1	Basic Shift					10.00 hrs
	Less					
2	Food	30 mins	4 hours	1 nr	0.50 hrs	
3	Restroom Breaks	15 mins	Shift	1 nr	0.25 hrs	
4	Walking Time	7 mins	Regulated Break	2 nr	0.23 hrs	
5	Wash Time	15 mins	Shift	2 nr	0.50 hrs	
6	Non RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
7	RP Change Time	-	Shift	2 nr	-	
8	Tools and Elecrical Tools Check	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
9	TCR's and Blanket Hot Work Permits, DCN83057 Work Plan, FME F	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
10	Job Brief Specific Hazards and JSAP Prior to Start	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
11	Job Brief Secific Hazards and JSAP Post Complete	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
12	Houskeeping	30 mins	Shift (at end of shift)	1 nr	0.50 hrs	
13	Working In Rubber Area (What is Max REM? Assume 5 Mins Per Hr	-	Hour	10 nr	-	
14	Constraints due to Night Shift	-	Shift (during shift)	1 nr	-	
15	Overtime Day and Saturday and Sunday	-	Shift (during shift)	1 nr	-	
16	Monitoring (Allow 5 events per shift @ 3mins)	-	Shift (during shift)	5 nr	-	
	Total To Work Site				**3.98 hrs**	**6.02 hrs**
17	Congestion Trade (Multi Trade in Same Area)	-	Mid	1 nr	-	
18	Congestion Physical (Limited Space)	-	Mid	1 nr	-	
19	Learning Curve	9 mins	Mid	1 nr	0.15 hrs	
	Total At Work Site				**0.15 hrs**	**-0.15 hrs**
	Total Productive Time					**5.87 hrs**
					Productivity	59%
					Factor Multiplier	**1.70**

11.2 Productivity Factor – Zone 3

The following represents the productivity factor for 'Zone 3' areas:

ZONE 3

Item	Event Description	Event Time		Events per Shift	Total Non-productive Time	Total Productive Time
		minutes	per			
1	Basic Shift					10.00 hrs
	Less					
2	Food	30 mins	4 hours	1 nr	0.50 hrs	
3	Restroom Breaks	15 mins	Shift	1 nr	0.25 hrs	
4	Walking Time	7 mins	Regulated Break	2 nr	0.23 hrs	
5	Wash Time	15 mins	Shift	2 nr	0.50 hrs	
6	Non RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
7	RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
8	Tools and Elecrical Tools Check	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
9	TCR's and Blanket Hot Work Permits, DCN83057 Work Plan, FME F	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
10	Job Brief Specific Hazards and JSAP Prior to Start	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
11	Job Brief Secific Hazards and JSAP Post Complete	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
12	Houskeeping	30 mins	Shift (at end of shift)	1 nr	0.50 hrs	
13	Working In Rubber Area (What is Max REM? Assume 5 Mins Per Hr	5 mins	Hour	10 nr	0.83 hrs	
14	Constraints due to Night Shift	-	Shift (during shift)	1 nr	-	
15	Overtime Day and Saturday and Sunday	-	Shift (during shift)	1 nr	-	
16	Monitoring (Allow 5 events per shift @ 3mins)	3 mins	Shift (during shift)	5 nr	0.25 hrs	
	Total To Work Site				**5.57 hrs**	**4.43 hrs**
17	Congestion Trade (Multi Trade in Same Area)	-	Mid	1 nr	-	
18	Congestion Physical (Limited Space)	-	Mid	1 nr	-	
19	Learning Curve	9 mins	Mid	1 nr	0.15 hrs	
	Total At Work Site				**0.15 hrs**	**-0.15 hrs**
	Total Productive Time					**4.28 hrs**
					Productivity	43%
					Factor Multiplier	**2.33**

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12 Appendix F – Crew Rates

DNGS Heavy Water Management Building - Crew Rates

(single 10 hour shifts, 5 days per week)

Crew	Rate	Rate (inc. Profit)
Groundworks	$ 53.22	$ 58.54
Fencing	$ 61.13	$ 67.24
Concrete	$ 56.49	$ 62.13
External Lighting	$ 58.53	$ 64.38
Roadworks Crew	$ 53.22	$ 58.54
Plumbers	$ 60.43	$ 66.47
Electrical Workers	$ 62.03	$ 68.23
Pipefitters	$ 62.83	$ 69.11
Building Works	$ 54.94	$ 60.43
Structural Steelwork	$ 61.13	$ 67.24
Roofers	$ 53.07	$ 58.38
Cladding	$ 61.47	$ 67.62
Masonry	$ 55.90	$ 61.49
Flooring	$ 57.83	$ 63.61

Crew Build-ups

Groundworks	Rate	%	Total
Laborer	$ 53.22	100%	$ 53.22
			$ -
		Crew rate	**$ 53.22**

Fencing	Rate	%	Total
Ironworker	$ 61.13	100%	$ 61.13
			$ -
		Crew rate	**$ 61.13**

Concrete	Rate	%	Total
Rodmen	$ 61.03	30%	$ 18.31
Carpenters	$ 57.83	20%	$ 11.57
Laborer	$ 53.22	50%	$ 26.61
			$ -
		Crew rate	**$ 56.49**

External Lighting	Rate	%	Total
Electrical worker	$ 62.03	25%	$ 15.51
Laborer	$ 53.22	25%	$ 13.31
Carpenters	$ 57.83	25%	$ 14.46
Rodmen	$ 61.03	25%	$ 15.26
			$ -
		Crew rate	**$ 58.53**

Roadworks Crew	Rate	%	Total
Laborer	$ 53.22	100%	$ 53.22
			$ -
		Crew rate	**$ 53.22**

Plumbers	Rate	%	Total
Laborer	$ 53.22	25%	$ 13.31
Plumbers and pipefitters	$ 62.83	75%	$ 47.12
			$ -
		Crew rate	**$ 60.43**

Electrical Workers	Rate	%	Total
Electrical worker	$ 62.03	100%	$ 62.03
			$ -
		Crew rate	**$ 62.03**

Pipefitters	Rate	%	Total
Plumbers and pipefitters	$ 62.83	100%	$ 62.83
			$ -
		Crew rate	**$ 62.83**

Building Works	Rate	%	Total
Laborer	$ 53.22	60%	$ 31.93
Carpenters	$ 57.83	30%	$ 17.35
Painters	$ 56.56	10%	$ 5.66
			$ -
		Crew rate	**$ 54.94**

Structural Steelwork	Rate	%	Total
Ironworker	$ 61.13	100%	$ 61.13
			$ -
		Crew rate	**$ 61.13**

Roofers	Rate	%	Total
Roofers	$ 53.07	100%	$ 53.07
			$ -
		Crew rate	**$ 53.07**

Cladding	Rate	%	Total
Sheet metal works	$ 61.47	100%	$ 61.47
			$ -
		Crew rate	**$ 61.47**

Masonry	Rate	%	Total
Cement mason	$ 55.90	100%	$ 55.90
			$ -
		Crew rate	**$ 55.90**

Flooring	Rate	%	Total
Carpenters	$ 57.83	100%	$ 57.83
			$ -
		Crew rate	**$ 57.83**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.68	$ 41.52	$ 55.36
Vacation Pay - See note (2)	$ 1.11	$ 1.66	$ 2.21
Holiday Pay - See note (3)	$ 1.66	$ 2.49	$ 3.32
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 39.98**	**$ 59.97**	**$ 79.96**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.59	$ 0.89	$ 1.19
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 47.52**	**$ 61.04**	**$ 81.32**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Carpenter - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Carpenter	Carpenter	Carpenter	Carpenter		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$59.20	$57.52	$55.28	$47.52		
		$13,321	**$77,655**	**$447,760**	**$96,225**		**$634,961**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$78.57	$76.04	$72.68	$61.04		
		$4,714	**$27,375**	**$156,985**	**$32,960**		**$222,035**
TOTAL	**50**					**14,820**	**$856,996**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$57.83**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.10	$ 57.15	$ 76.20
Vacation Pay - See note (2)	$ 1.52	$ 2.29	$ 3.05
Holiday Pay - See note (3)	$ 2.29	$ 3.43	$ 4.57
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 51.44**	**$ 77.16**	**$ 102.88**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.82	$ 1.23	$ 1.63
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 59.20**	**$ 78.57**	**$ 104.69**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - ourneyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 34.60	$ 51.90	$ 69.20
Vacation Pay - See note (2)	$ 1.38	$ 2.08	$ 2.77
Holiday Pay - See note (3)	$ 2.08	$ 3.11	$ 4.15
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 47.59**	**$ 71.39**	**$ 95.18**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.74	$ 1.11	$ 1.48
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 55.28**	**$ 72.68**	**$ 96.84**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - SubForeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.60	$ 54.90	$ 73.20
Vacation Pay - See note (2)	$ 1.46	$ 2.20	$ 2.93
Holiday Pay - See note (3)	$ 2.20	$ 3.29	$ 4.39
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 49.79**	**$ 74.69**	**$ 99.58**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.57
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.52**	**$ 76.04**	**$ 101.33**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 31.77	$ 47.66	$ 63.54
Vacation Pay - See note (2)	$ 1.27	$ 1.91	$ 2.54
Holiday Pay - See note (3)	$ 1.91	$ 2.86	$ 3.81
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 41.40**	**$ 62.10**	**$ 82.79**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.68	$ 1.02	$ 1.36
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 49.00**	**$ 63.27**	**$ 84.31**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Cement Mason - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3		
		Cement Mason	Cement Mason	Cement Mason	Cement Mason		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$56.32	$54.64	$52.95	$49.00		
		$12,672	**$73,759**	**$428,928**	**$99,216**		**$614,574**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$74.25	$71.73	$69.21	$63.27		
		$4,455	**$25,822**	**$149,484**	**$34,165**		**$213,927**
TOTAL	**50**					**14,820**	**$828,501**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$55.90**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Cement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Cement Mason - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.30	$ 57.45	$ 76.60
Vacation Pay - See note (2)	$ 1.53	$ 2.30	$ 3.06
Holiday Pay - See note (3)	$ 2.30	$ 3.45	$ 4.60
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 48.58**	**$ 72.87**	**$ 97.16**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.82	$ 1.23	$ 1.64
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 56.32**	**$ 74.25**	**$ 98.95**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - ourneyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 35.30	$ 52.95	$ 70.60
Vacation Pay - See note (2)	$ 1.41	$ 2.12	$ 2.82
Holiday Pay - See note (3)	$ 2.12	$ 3.18	$ 4.24
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 45.28**	**$ 67.92**	**$ 90.56**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.76	$ 1.14	$ 1.51
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 52.95**	**$ 69.21**	**$ 92.22**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.80	$ 55.20	$ 73.60
Vacation Pay - See note (2)	$ 1.47	$ 2.21	$ 2.94
Holiday Pay - See note (3)	$ 2.21	$ 3.31	$ 4.42
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 46.93**	**$ 70.40**	**$ 93.86**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.58
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 54.64**	**$ 71.73**	**$ 95.59**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Apprentice (3rd year)		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 23.44	$ 35.16	$ 46.88
Vacation Pay - See note (2)	$ 0.94	$ 1.41	$ 1.88
Holiday Pay - See note (3)	$ 1.41	$ 2.11	$ 2.81
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 35.73**	**$ 53.60**	**$ 71.47**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.50	$ 0.75	$ 1.01
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 43.10**	**$ 54.46**	**$ 72.57**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Electrical Worker- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Elect Worker	Elect Worker	Elect Worker	Elect Worker		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$66.33	$63.69	$60.63	$43.10		
		$14,924	**$85,986**	**$491,119**	**$87,285**		**$679,314**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$89.29	$85.34	$80.75	$54.46		
		$5,358	**$30,722**	**$174,415**	**$29,406**		**$239,901**
TOTAL	**50**					**14,820**	**$919,214**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$62.03**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 44.15	$ 66.23	$ 88.30
Vacation Pay - See note (2)	$ 1.77	$ 2.65	$ 3.53
Holiday Pay - See note (3)	$ 2.65	$ 3.97	$ 5.30
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 58.52**	**$ 87.77**	**$ 117.03**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.95	$ 1.42	$ 1.89
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 66.33**	**$ 89.29**	**$ 119.02**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.07	$ 58.61	$ 78.14
Vacation Pay - See note (2)	$ 1.56	$ 2.34	$ 3.13
Holiday Pay - See note (3)	$ 2.34	$ 3.52	$ 4.69
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 52.93**	**$ 79.39**	**$ 105.85**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.26	$ 1.68
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.63**	**$ 80.75**	**$ 107.63**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.80	$ 62.70	$ 83.60
Vacation Pay - See note (2)	$ 1.67	$ 2.51	$ 3.34
Holiday Pay - See note (3)	$ 2.51	$ 3.76	$ 5.02
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 55.93**	**$ 83.90**	**$ 111.86**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.90	$ 1.34	$ 1.79
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.69**	**$ 85.34**	**$ 113.75**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.85	$ 41.78	$ 55.70
Vacation Pay - See note (2)	$ 1.67	$ 2.51	$ 3.34
Holiday Pay - See note (3)	$ 1.11	$ 1.67	$ 2.23
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 40.72**	**$ 61.07**	**$ 81.43**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.60	$ 0.90	$ 1.19
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 48.23**	**$ 62.12**	**$ 82.77**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Ironworker- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd		
		Ironworker	Ironworker	Ironworker	Ironworker		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$63.64	$61.44	$58.64	$48.23		
		$14,319	$82,944	$474,954	$97,664		$669,881
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$85.23	$81.93	$77.73	$62.12		
		$5,114	$29,496	$167,895	$33,544		$236,049
TOTAL	**50**					**14,820**	$905,930
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.13**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.59	$ 62.39	$ 83.18
Vacation Pay - See note (2)	$ 2.50	$ 3.74	$ 4.99
Holiday Pay - See note (3)	$ 1.66	$ 2.50	$ 3.33
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 55.83**	**$ 83.74**	**$ 111.66**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.89	$ 1.34	$ 1.78
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.64**	**$ 85.23**	**$ 113.59**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - ourneyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.13	$ 55.70	$ 74.26
Vacation Pay - See note (2)	$ 2.23	$ 3.34	$ 4.46
Holiday Pay - See note (3)	$ 1.49	$ 2.23	$ 2.97
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 50.92**	**$ 76.38**	**$ 101.85**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.19	$ 1.59
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 58.64**	**$ 77.73**	**$ 103.59**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.63	$ 59.45	$ 79.26
Vacation Pay - See note (2)	$ 2.38	$ 3.57	$ 4.76
Holiday Pay - See note (3)	$ 1.59	$ 2.38	$ 3.17
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 53.67**	**$ 80.51**	**$ 107.35**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.85	$ 1.28	$ 1.70
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.44**	**$ 81.93**	**$ 109.20**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Apprentice (3rd year)		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.14	$ 48.21	$ 64.28
Vacation Pay - See note (2)	$ 1.29	$ 1.93	$ 2.57
Holiday Pay - See note (3)	$ 1.93	$ 2.89	$ 3.86
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 43.83**	**$ 65.75**	**$ 87.67**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.69	$ 1.03	$ 1.38
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 51.44**	**$ 66.94**	**$ 89.20**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Laborer- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Laborer	Laborer	Laborer	Laborer		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$52.84	$51.44	$49.48	$51.44		
		$11,889	**$69,444**	**$400,770**	**$104,167**		**$586,270**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$69.04	$66.94	$63.99	$66.94		
		$4,142	**$24,097**	**$138,221**	**$36,145**		**$202,605**
TOTAL	**50**					**14,820**	**$788,875**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$53.23**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 33.39	$ 50.09	$ 66.78
Vacation Pay - See note (2)	$ 1.34	$ 2.00	$ 2.67
Holiday Pay - See note (3)	$ 2.00	$ 3.01	$ 4.01
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 45.21**	**$ 67.81**	**$ 90.42**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.72	$ 1.07	$ 1.43
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 52.84**	**$ 69.04**	**$ 92.00**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 30.39	$ 45.59	$ 60.78
Vacation Pay - See note (2)	$ 1.22	$ 1.82	$ 2.43
Holiday Pay - See note (3)	$ 1.82	$ 2.74	$ 3.65
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 41.91**	**$ 62.86**	**$ 83.82**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.65	$ 0.98	$ 1.30
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 49.48**	**$ 63.99**	**$ 85.27**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.14	$ 48.21	$ 64.28
Vacation Pay - See note (2)	$ 1.29	$ 1.93	$ 2.57
Holiday Pay - See note (3)	$ 1.93	$ 2.89	$ 3.86
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 43.83**	**$ 65.75**	**$ 87.67**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.69	$ 1.03	$ 1.38
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 51.44**	**$ 66.94**	**$ 89.20**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Painters - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.43	$ 56.15	$ 74.86
Vacation Pay - See note (2)	$ 1.50	$ 2.25	$ 2.99
Holiday Pay - See note (3)	$ 2.25	$ 3.37	$ 4.49
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 49.87**	**$ 74.81**	**$ 99.75**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.20	$ 1.61
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.59**	**$ 76.16**	**$ 101.50**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.54	$ 41.31	$ 55.08
Vacation Pay - See note (2)	$ 1.10	$ 1.65	$ 2.20
Holiday Pay - See note (3)	$ 1.65	$ 2.48	$ 3.30
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 38.99**	**$ 58.49**	**$ 77.99**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.59	$ 0.89	$ 1.18
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 46.50**	**$ 59.53**	**$ 79.32**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Painters- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Painters	Painters	Painters	Painters		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$57.59	$55.63	$54.23	$46.50		
		$12,958	**$75,101**	**$439,250**	**$94,166**		**$621,475**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$76.16	$73.22	$71.12	$59.53		
		$4,570	**$26,359**	**$153,613**	**$32,145**		**$216,687**
TOTAL	**50**					**14,820**	**$838,162**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$56.56**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 34.43	$ 51.65	$ 68.86
Vacation Pay - See note (2)	$ 1.38	$ 2.07	$ 2.75
Holiday Pay - See note (3)	$ 2.07	$ 3.10	$ 4.13
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 46.57**	**$ 69.86**	**$ 93.15**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.74	$ 1.11	$ 1.48
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 54.23**	**$ 71.12**	**$ 94.77**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 35.68	$ 53.52	$ 71.36
Vacation Pay - See note (2)	$ 1.43	$ 2.14	$ 2.85
Holiday Pay - See note (3)	$ 2.14	$ 3.21	$ 4.28
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 47.95**	**$ 71.92**	**$ 95.90**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.77	$ 1.15	$ 1.53
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 55.63**	**$ 73.22**	**$ 97.58**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 25.29	$ 37.94	$ 50.58
Vacation Pay - See note (2)	$ 1.52	$ 2.28	$ 3.03
Holiday Pay - See note (3)	$ 1.01	$ 1.52	$ 2.02
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 38.37**	**$ 57.55**	**$ 76.74**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.54	$ 0.81	$ 1.08
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 45.83**	**$ 58.52**	**$ 77.97**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Plumbers/Pipefitters- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Plumbers/Pipefitters	Plumbers/Pipefitters	Plumbers/Pipefitters	Plumbers/Pipefitters		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$65.46	$63.29	$61.10	$45.83		
		$14,730	$85,441	$494,930	$92,802		$687,903
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$87.97	$84.71	$81.43	$58.52		
		$5,278	$30,495	$175,885	$31,599		$243,258
TOTAL	**50**					**14,820**	$931,161
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$62.83**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 42.80	$ 64.20	$ 85.60
Vacation Pay - See note (2)	$ 2.57	$ 3.85	$ 5.14
Holiday Pay - See note (3)	$ 1.71	$ 2.57	$ 3.42
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 57.63**	**$ 86.45**	**$ 115.26**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.92	$ 1.38	$ 1.84
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 65.46**	**$ 87.97**	**$ 117.25**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.91	$ 58.37	$ 77.82
Vacation Pay - See note (2)	$ 2.33	$ 3.50	$ 4.67
Holiday Pay - See note (3)	$ 1.56	$ 2.33	$ 3.11
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 53.35**	**$ 80.03**	**$ 106.70**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.83	$ 1.25	$ 1.67
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.10**	**$ 81.43**	**$ 108.52**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - SubForeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.86	$ 61.29	$ 81.72
Vacation Pay - See note (2)	$ 2.45	$ 3.68	$ 4.90
Holiday Pay - See note (3)	$ 1.63	$ 2.45	$ 3.27
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 55.50**	**$ 83.24**	**$ 110.99**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.88	$ 1.31	$ 1.75
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.29**	**$ 84.71**	**$ 112.89**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.68	$ 49.02	$ 65.36
Vacation Pay - See note (2)	$ 1.96	$ 2.94	$ 3.92
Holiday Pay - See note (3)	$ 1.31	$ 1.96	$ 2.61
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 45.71**	**$ 68.56**	**$ 91.42**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.70	$ 1.05	$ 1.40
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 53.33**	**$ 69.76**	**$ 92.97**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Rodmen - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	rentice (3rd y		
		Rodmen	Rodmen	Rodmen	Rodmen		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$61.60	$60.76	$57.40	$53.33		
		$13,860	$82,027	$464,914	$107,985		$668,786
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$82.18	$80.92	$75.87	$69.76		
		$4,931	$29,130	$163,879	$37,672		$235,612
TOTAL	**50**					**14,820**	$904,398
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.03**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.06	$ 60.09	$ 80.12
Vacation Pay - See note (2)	$ 2.40	$ 3.61	$ 4.81
Holiday Pay - See note (3)	$ 1.60	$ 2.40	$ 3.20
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 53.83**	**$ 80.74**	**$ 107.65**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.86	$ 1.29	$ 1.72
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.60**	**$ 82.18**	**$ 109.52**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.31	$ 54.47	$ 72.62
Vacation Pay - See note (2)	$ 2.18	$ 3.27	$ 4.36
Holiday Pay - See note (3)	$ 1.45	$ 2.18	$ 2.90
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 49.70**	**$ 74.55**	**$ 99.40**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.78	$ 1.17	$ 1.56
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.40**	**$ 75.87**	**$ 101.11**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.31	$ 58.97	$ 78.62
Vacation Pay - See note (2)	$ 2.36	$ 3.54	$ 4.72
Holiday Pay - See note (3)	$ 1.57	$ 2.36	$ 3.14
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 53.00**	**$ 79.50**	**$ 106.00**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.26	$ 1.69
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.76**	**$ 80.92**	**$ 107.84**

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 29.40	$ 44.10	$ 58.80
Vacation Pay - See note (2)	$ 1.18	$ 1.76	$ 2.35
Holiday Pay - See note (3)	$ 1.76	$ 2.65	$ 3.53
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 7.48	$ 11.22	$ 14.96
Union Funds $1.04 - See note (4), (5) & (6)	$ 1.04	$ 1.56	$ 2.08
Total Wage Package	**$ 40.86**	**$ 61.29**	**$ 81.72**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.63	$ 0.95	$ 1.26
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 48.41**	**$ 62.39**	**$ 83.13**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Roofers- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd		
		Roofers	Roofers	Roofers	Roofers		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$62.01	$0.00	$58.02	$48.41		
		$13,952	**$0**	**$469,922**	**$98,025**		**$581,899**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$82.79	$0.00	$76.80	$62.39		
		$4,967	**$0**	**$165,882**	**$33,688**		**$204,538**
TOTAL	**50**					**14,820**	**$786,437**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$53.07**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.29	$ 60.44	$ 80.58
Vacation Pay - See note (2)	$ 1.61	$ 2.42	$ 3.22
Holiday Pay - See note (3)	$ 2.42	$ 3.63	$ 4.83
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 8.61	$ 12.92	$ 17.22
Union Funds $1.30 - See note (4), (5) & (6)	$ 1.30	$ 1.95	$ 2.60
Total Wage Package	**$ 54.23**	**$ 81.34**	**$ 108.46**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.86	$ 1.30	$ 1.73
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 62.01**	**$ 82.79**	**$ 110.34**

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.79	$ 55.19	$ 73.58
Vacation Pay - See note (2)	$ 1.47	$ 2.21	$ 2.94
Holiday Pay - See note (3)	$ 2.21	$ 3.31	$ 4.41
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 8.61	$ 12.92	$ 17.22
Union Funds $1.30 - See note (4), (5) & (6)	$ 1.23	$ 1.85	$ 2.46
Total Wage Package	**$ 50.31**	**$ 75.46**	**$ 100.62**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.58
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 58.02**	**$ 76.80**	**$ 102.35**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 21.45	$ 32.18	$ 42.90
Vacation Pay - See note (2)	$ 0.86	$ 1.29	$ 1.72
Holiday Pay - See note (3)	$ 1.29	$ 1.93	$ 2.57
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 4.14	$ 6.21	$ 8.28
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 32.01**	**$ 48.01**	**$ 64.01**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.46	$ 0.69	$ 0.92
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 39.38**	**$ 48.85**	**$ 65.08**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Sheet metal Workers- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd yea		
		Sheet Metal Workers	Sheet Metal Workers	Sheet Metal Workers	Sheet Metal Workers		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$65.47	$63.05	$60.98	$39.38		
		$14,730	**$85,124**	**$493,938**	**$79,749**		**$673,541**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$87.97	$84.36	$81.24	$48.85		
		$5,278	**$30,368**	**$175,489**	**$26,378**		**$237,513**
TOTAL	**50**					**14,820**	**$911,054**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.47**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.49	$ 62.24	$ 82.98
Vacation Pay - See note (2)	$ 1.66	$ 2.49	$ 3.32
Holiday Pay - See note (3)	$ 2.49	$ 3.73	$ 4.98
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 57.66**	**$ 86.49**	**$ 115.32**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.89	$ 1.33	$ 1.78
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 65.47**	**$ 87.97**	**$ 117.25**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.49	$ 56.24	$ 74.98
Vacation Pay - See note (2)	$ 1.50	$ 2.25	$ 3.00
Holiday Pay - See note (3)	$ 2.25	$ 3.37	$ 4.50
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 53.26**	**$ 79.89**	**$ 106.52**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.21	$ 1.61
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.98**	**$ 81.24**	**$ 108.28**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.34	$ 59.01	$ 78.68
Vacation Pay - See note (2)	$ 1.57	$ 2.36	$ 3.15
Holiday Pay - See note (3)	$ 2.36	$ 3.54	$ 4.72
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 55.29**	**$ 82.94**	**$ 110.59**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.27	$ 1.69
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.05**	**$ 84.36**	**$ 112.43**

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Exhibit L-D2-02-AMPCO-137
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13 Appendix G – Indirect Cost Breakdown

DNGS Heavy Water Management Building - Indirect Costs

Item	Description	Typical Allowance	Allowance for D2O Storage
1	Average Trade Rate		
2	Construction Equipment	18.00%	10.00%
3	Small Tools and Consumables	10.00%	Inc. Elsewhere
4	Subcontractors Staff	6.00%	6.00%
5	Temporary Facilities	2.00%	Inc. Elsewhere
6	Indirect Supplies	5.00%	5.00%
7	Business Expenses	2.00%	2.00%
8	Non Productive Labor	3.00%	Inc. Elsewhere
9	Training	0.50%	0.50%
10	Safety Training	5.00%	5.00%
11	General Foreman	2.00%	2.00%
12	Dedicated Material Handling Team	3.00%	Inc. Elsewhere
13	Scaffold	3.00%	3.00%
14	Welder Testing	0.10%	0.10%
15	Premium Time over 40Hr Week	6.50%	Inc. Elsewhere
16	Profit	10.00%	Inc. Elsewhere
		76.10%	**33.60%**
	Union Security - Employers EPSCA	0.00%	0.00%
	Protective Clothing	0.16%	0.16%
	Call In Pay	0.12%	0.12%
	Reporting Pay	0.12%	0.12%
	Inclement Weather Pay	0.06%	0.00%
	Replacement Tools	0.01%	0.01%
	Rubber Suits	0.15%	0.00%
	Work ing Premiums	0.00%	0.00%
	Fire Duty	27.13%	5.00%
	Zone 3 Meal Allowance	0.28%	0.00%
	Zone 3 Rest Allowance	1.54%	0.00%
	Other Zone Rest Allowance	0.00%	0.00%
	Other Meals in Overtime	4.42%	4.42%
	Daily Travel Allowance (i.e. NOT receivir	3.19%	1.00%
	Room and Board (in effect Travel Allowa	0.00%	0.00%
	Room and Board (in effect Subsistence b	5.04%	0.00%
	Subsistence Allowance (Temp Accommo	2.04%	0.00%
	Initial Travel and Transportation	0.11%	0.11%
	Bill 162 Contributions	0.00%	0.00%
	Trade Improvement Plan	0.00%	0.00%
	Stabilization Fund	0.00%	0.00%
		44.36%	**10.94%**

Total		**44.54%**

14 Appendix H – AACE Estimate Classification

The following represents an assessment of the AACE Estimate classification:

	ESTIMATE CLASSIFICATION				
GENERAL PROJECT DATA :	**CLASS 5**	**CLASS 4**	**CLASS 3**	**CLASS 2**	**CLASS 1**
Project Scope Description	General	Preliminary	Defined	Defined	Defined
Plant Production / Facility Capacity	Assumed	Preliminary	Defined	Defined	Defined
Plant Location	General	Approximate	Specific	Specific	Specific
Soils & Hydrology	None	Preliminary	Defined	Defined	Defined
Integrated Project Plan	None	Preliminary	Defined	Defined	Defined
Project Master Schedule	None	Preliminary	Defined	Defined	Defined
Escalation Strategy	None	Preliminary	Defined	Defined	Defined
Work Breakdown Structure	None	Preliminary	Defined	Defined	Defined
Project Code of Accounts	None	Preliminary	Defined	Defined	Defined
Contracting Strategy	Assumed	Assumed	Preliminary	Defined	Defined
ENGINEERING DELIVERABLES :					
Block Flow Diagrams	Started / Prelim.	Prelim. / Complete	Complete	Complete	Complete
Plot Plans	None	Started	Prelim. / Complete	Complete	Complete
Process Flow Diagrams (PFD's)	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Utility Flow Diagrams (UFD's)	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Piping & Instrumentation Diagrams (P&ID's)	None	Started	Prelim. / Complete	Complete	Complete
Process Equipment List	None	Started	Prelim. / Complete	Complete	Complete
Electrical Line Diagrams	None	Started / Prelim.	Prelim. / Complete	Complete	Complete

Specifications and Data Sheets	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
General Equipment Arrangement Drawings	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Spare Parts List	None	Started	Prelim. / Complete	Complete	Complete
Mechanical Drawings	None	Started	Prelim. / Complete	Complete	Complete
Electrical Drawings	None	None	Started / Prelim.	Preliminary	Complete
Instrument and Control System Drawings	None	None	Started	Preliminary	Prelim. / Complete
Civil Drawings	None	None	Started	Preliminary	Prelim. / Complete
Structural Drawings	None	None	Started	Preliminary	Prelim. / Complete
Other discipline trade drawings	None	None	Started	Preliminary	Prelim. / Complete

CONSTRUCTIVE EXPERTISE

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WBS Path ID	PIEPCCC	Work Package ID	Name	Total CF	Related to the last BCS		
NR.CP.IN.01.UF.31555_0_01_01	0	3155500101	LTD 2008 Cost	0			
NR.CP.IN.01.UF.31555_0_05_02	0	3155500502	Ellis Don Fuel Costs	1,400,574			
NR.CP.IN.01.UF.31555_0_05_05	0	3155500505	EPSCA Expenses	1,847,409			
NR.CP.IN.01.UF.31555_0_05_06	0	3155500506	EPSCA Training	1,018,578			
NR.CP.IN.01.UF.31555_0_05_07	0	3155500507	CTP Proxy for WP 3155500505	0			
NR.CP.IN.01.UF.31555_0_07_01	0	3155500701	Project 31555 - interest	25,288,722			
NR.CP.IN.01.UF.31555_0_09_01	0	3155500901	D2O Storage Project Contingency	0			
NR.CP.IN.01.UF.31555_0_09_02	0	3155500902	P&M SNC/AECON JV PO Contingency (moved to WP 3155510504 per ONCORE)	0			
NR.CP.IN.01.UF.31555_0_09_99	0	3155500999	For Forecast Only	0			
NR.CP.IN.01.UF.31555_0_65_00	0	3155506500	JV Contingency	0	Yes		
NR.CP.IN.01.UF.31555_0_65_01	0	3155506501	Business Exp./LOA - Construction	1,170,000	Yes		
NR.CP.IN.01.UF.31555_0_65_02	0	3155506502	Business Exp./LOA - Engineering	630,000	Yes		
NR.CP.IN.01.UF.31555_0_65_03	0	3155506503	Construction - Other	0	Yes		
NR.CP.IN.01.UF.31555_0_65_04	0	3155506504	Personal Protective Equipment (PPE)	106,312	Yes		
NR.CP.IN.01.UF.31555_0_65_06	0	3155506506	D20 Allowable Overhead	7,766,889	Yes		
NR.CP.IN.01.UF.31555_0_65_07	0	3155506507	Mobilization/De-Mobilization	0	Yes		
NR.CP.IN.01.UF.31555_0_65_08	0	3155506508	Engineering - Other	0	Yes		
NR.CP.IN.01.UF.31555_0_77_01	0	3155507701	Phase 2 | Interest	19,014,590	Yes		
NR.CP.IN.01.UF.31555_0_79_00	0	3155507900	Cost Phase 2 - CCF 7058	0			
NR.CP.IN.01.UF.31555_0_79_01	0	3155507901	Cost - Phase 2 | Project Contingency and Management Reserve	2,234,538	Yes		
NR.CP.IN.01.UF.31555_0_98_88	0	3155509888	Cost Management Living Allowance CCF003587	1,358			
NR.CP.IN.01.UF.31555_1_01_02	1	3155510102	Aecon-SNC Project Management	24,324,012			
NR.CP.IN.01.UF.31555_1_01_03	1	3155510103	CTP Proxy for WP 3155510102	229,593			
NR.CP.IN.01.UF.31555_1_01_04	1	3155510104	ES Fox CFEP	120,000			
NR.CP.IN.01.UF.31555_1_01_05	1	3155510105	SNC Engineering Management, DC, Metrology (HO)	1,804,231			
NR.CP.IN.01.UF.31555_1_02_01	1	3155510201	Project Controls 2012	346,046			
NR.CP.IN.01.UF.31555_1_02_02	1	3155510202	Project Controls 2013	940,058			
NR.CP.IN.01.UF.31555_1_02_03	1	3155510203	Project Controls Execution Partial	680,211			
NR.CP.IN.01.UF.31555_1_02_04	1	3155510204	Project Controls Execution Full	6,108,161			
NR.CP.IN.01.UF.31555_1_02_05	1	3155510205	OPG Support FE/CMO to EPC 2013-Phase I	547,896			
NR.CP.IN.01.UF.31555_1_02_40	1	3155510240	OPG EPSCA - Direct Hires	2,733,800			
NR.CP.IN.01.UF.31555_1_02_41	1	3155510241	RP Escort to support JV	49,149			
NR.CP.IN.01.UF.31555_1_05_02	1	3155510502	Training (Engineering softwares)	111,941			
NR.CP.IN.01.UF.31555_1_05_04	1	3155510504	Aecon-SNC PO Contingency	0			
NR.CP.IN.01.UF.31555_1_05_40	1	3155510540	Training (OPG operators)	660,682			
NR.CP.IN.01.UF.31555_1_07_01	1	3155510701	Legacy Interest for 2012	231,090			
NR.CP.IN.01.UF.31555_1_07_02	1	3155510702	Legacy Interest 2013 Pt1 Execution Phase	214,846			
NR.CP.IN.01.UF.31555_1_07_05	1	3155510705	Legacy Contingency Interest for 2013/2014/2015 Execution Full	164,576			
NR.CP.IN.01.UF.31555_1_07_06	1	3155510706	Interest for 2013/2014/2015 Execution Full	1,485,630			
NR.CP.IN.01.UF.31555_1_20_01	1	3155512001	NEW EPC VENDOR PROJECT MANAGEMENT	0			
NR.CP.IN.01.UF.31555_1_61_01	1	3155516101	Project Management Team - Construction PMT	12,373,259	Yes		
NR.CP.IN.01.UF.31555_1_61_02	1	3155516102	Project Management Team - Engineering PMT	2,094,900	Yes		
NR.CP.IN.01.UF.31555_1_71_01	1	3155517101	PMT - Oversight Phase 2 | Project Management and MTL	2,608,146	Yes		
NR.CP.IN.01.UF.31555_1_71_02	1	3155517102	PMT - Refurb. Exe. Support not in BCS	1,051,984	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_1_72_01	1	3155517201	PMT - Oversight Phase 2 | PCC and CSA	145,050	Yes		
NR.CP.IN.01.UF.31555_1_98_01	1	3155519801	Travelling Expenses for 2012/2013-Phase I	5,413			
NR.CP.IN.01.UF.31555_1_98_02	1	3155519802	Core Team Project Support 2013/2014/2015- Phase III	2,994,678			
NR.CP.IN.01.UF.31555_1_98_05	1	3155519805	CMO Project Support Overhead 2012/2013 Pt - Phase I	0			
NR.CP.IN.01.UF.31555_1_98_06	1	3155519806	Travelling Expenses for 2013 Pt 1-Phase II Exe Part	0			
NR.CP.IN.01.UF.31555_1_98_07	1	3155519807	Travelling Expenses for 2013/2014/2015	9,536			
NR.CP.IN.01.UF.31555_1_98_09	1	3155519809	Supply Chain Project Support .4% 2013/2014/2015 - Phase III	0			
NR.CP.IN.01.UF.31555_1_99_01	1	3155519901	LTD to end of 2010 -DEV	1,863,352			
NR.CP.IN.01.UF.31555_1_99_02	1	3155519902	LTD to end of 2011-DEV	1,111,732			

NR.CP.IN.01.UF.31555_1_99_06	1	3155519906	LTD to end of 2012-DEV	372,850			
NR.CP.IN.01.UF.31555_1_99_98	1	3155519998	PMT under CCF003587	2,010,978			
NR.CP.IN.01.UF.31555_1_99_99	1	3155519999	Not Required	0			
NR.CP.IN.01.UF.31555_3_02_01	3	3155530201	OPG Support Design/FE/TRF/PE/DCC 2012-Phase I	452,124			
NR.CP.IN.01.UF.31555_3_02_02	3	3155530202	OPG Support Design/FE/TRF/PE/DCC 2013-Phase I	1,649,345			
NR.CP.IN.01.UF.31555_3_02_03	3	3155530203	OPG Support Design/FE/TRF/PE/DCC to Support -Phase III	1,886,359			
NR.CP.IN.01.UF.31555_3_04_01	3	3155530401	EPC Contract 2012 Phase I Detaileld Design	0			
NR.CP.IN.01.UF.31555_3_04_02	3	3155530402	EPC Contract 2012 Modification Planning Payment	1,117,738			
NR.CP.IN.01.UF.31555_3_04_03	3	3155530403	EPC Contract 2012 Eng Specifications for LL Items Accept by OPG Payment	970,000			
NR.CP.IN.01.UF.31555_3_04_04	3	3155530404	EPC Contract 2012 100% of TMods Accepted by OPG Payment	970,000			
NR.CP.IN.01.UF.31555_3_04_05	3	3155530405	EPC Contract 2012 25% of all design EC's Accepted by OPG Payment	485,000			
NR.CP.IN.01.UF.31555_3_04_06	3	3155530406	EPC Contract 2012 50% of all design EC's Accepted by OPG Payment	1,455,000			
NR.CP.IN.01.UF.31555_3_04_07	3	3155530407	EPC Contract 2012 65% of all design EC's Accepted by OPG Payment	2,989,977			
NR.CP.IN.01.UF.31555_3_04_08	3	3155530408	EPC Contract 2012 75% of all design EC's Accepted by OPG Payment	2,234,399			
NR.CP.IN.01.UF.31555_3_04_09	3	3155530409	EPC Contract 2012 100% of all design EC's Accepted by OPG Payment	437,447			
NR.CP.IN.01.UF.31555_3_04_10	3	3155530410	EPC Contract 2012 Completion of Final COMS Payment	1,022,582			
NR.CP.IN.01.UF.31555_3_04_11	3	3155530411	EPC Design and Construction - 2012/2013 - Phase II (Accruals and Billing Errors)	0			
NR.CP.IN.01.UF.31555_3_04_15	3	3155530415	SNC Engineering - Civil	499,520			
NR.CP.IN.01.UF.31555_3_04_16	3	3155530416	SNC Engineering - Mechanical	573,072			
NR.CP.IN.01.UF.31555_3_04_17	3	3155530417	SNC Engineering - Electrical	1,975,772			
NR.CP.IN.01.UF.31555_3_04_18	3	3155530418	SNC Engineering - I&C	968,611			
NR.CP.IN.01.UF.31555_3_04_19	3	3155530419	CTP Proxy for WP 3155530416	0			
NR.CP.IN.01.UF.31555_3_04_20	3	3155530420	CTP Proxy for WP 3155530417	0			
NR.CP.IN.01.UF.31555_3_04_21	3	3155530421	CTP Proxy for WP 3155530418	0			
NR.CP.IN.01.UF.31555_3_04_22	3	3155530422	CTP Proxy for WP 3155530415	0			
NR.CP.IN.01.UF.31555_3_05_01	3	3155530501	OSS Contract Support Design 2012 Pt 1-Phase I	4,706,970			
NR.CP.IN.01.UF.31555_3_05_02	3	3155530502	OSS Contract Support Design 2013-Phase I	479,256			
NR.CP.IN.01.UF.31555_3_05_03	3	3155530503	OSS/OPG Contract Support Design 2012/2013-Phase II	74,909			
NR.CP.IN.01.UF.31555_3_05_04	3	3155530504	OPG Contract Support Design/TRF/PE 2013/2014/2015-Phase II and Phase III	286,805			
NR.CP.IN.01.UF.31555_3_05_05	3	3155530505	OSS Contract Support Design 2012/2013-Phase II	0			
NR.CP.IN.01.UF.31555_3_05_06	3	3155530506	OSS Contract Support Design EPC 2013/2014/2015	1,266,445			
NR.CP.IN.01.UF.31555_3_05_07	3	3155530507	NOSS Contract Support Design EPC 2017/2018	9,377			
NR.CP.IN.01.UF.31555_3_05_08	3	3155530508	Engineering Support - Civil	1,179,287			
NR.CP.IN.01.UF.31555_3_05_09	3	3155530509	Engineering Support - Mechanical	3,344,531			
NR.CP.IN.01.UF.31555_3_05_10	3	3155530510	Engineering Support - Electrical	279,619			
NR.CP.IN.01.UF.31555_3_05_11	3	3155530511	Engineering Support - I&C	1,492,262			
NR.CP.IN.01.UF.31555_3_05_12	3	3155530512	CTP Proxy for WP 3155530511	0			
NR.CP.IN.01.UF.31555_3_07_01	3	3155530701	SNC Field Engineering & Pre-Commissioning Support	12,925,633			
NR.CP.IN.01.UF.31555_3_07_02	3	3155530702	CTP Proxy for WP 3155530701	0			
NR.CP.IN.01.UF.31555_3_14_09	3	3155531409	RCMT Contract for R00 Engineering	4,819,700			
NR.CP.IN.01.UF.31555_3_14_20	3	3155531420	RCMT Contract for Materials	0			
NR.CP.IN.01.UF.31555_3_14_21	3	3155531421	RCMT Claim	0			
NR.CP.IN.01.UF.31555_3_20_01	3	3155532001	NEW EPC VENDOR ENGININEERING	0			
NR.CP.IN.01.UF.31555_3_65_67	3	3155536567	Engineering	6,089,978	Yes		
NR.CP.IN.01.UF.31555_3_72_01	3	3155537201	Eng - Oversight of Phase 2 | Design Engineer	4,700,355	Yes		
NR.CP.IN.01.UF.31555_3_72_02	3	3155537202	Eng - Oversight of Phase 2 | Construction Design Engineer not in BCS	0	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_72_03	3	3155537203	Eng- OPG Oversight and Support to Contractor's not in BCS	309,388	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_74_01	3	3155537401	Eng - Phase 2 | Drawing Office and OLW Support	612,352	Yes		
NR.CP.IN.01.UF.31555_3_74_02	3	3155537402	Eng - TRF Control Computer Mod | Design not in BCS	219,654	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_74_03	3	3155537403	Eng - Drum Handling Tools | Design not in BCS	15,270	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_74_04	3	3155537404	Eng – EC Detailed Design Activities Not in BCS| Design Engineer	80,220	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_74_05	3	3155537405	Maintenance TPAR Preparation Not in BCS	485,575	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_3_76_01	3	3155537601	Eng - Oversight Phase 2 | Field Engineer	1,644,644	Yes		
NR.CP.IN.01.UF.31555_3_77_01	3	3155537701	Eng - Phase 2 | OPG Commissioning FTL	404,723	Yes		
NR.CP.IN.01.UF.31555_3_79_01	3	3155537901	Eng - Phase 2 | OPG Ops TPARs	36,714	Yes		

NR.CP.IN.01.UF.31555_4_02_01	4	3155540201	OPG Procurement of Welding Materials	24,925			
NR.CP.IN.01.UF.31555_4_02_02	4	3155540202	OPG Procurement Support for Free Issue Materials	14,278			
NR.CP.IN.01.UF.31555_4_02_03	4	3155540203	OPG Free Issue Purchase of Valves & Tanks	1,566,611			
NR.CP.IN.01.UF.31555_4_03_01	4	3155540301	OPG Support CMO/FE to EPC 2013/2014/2015 Execution Full	5,262,696			
NR.CP.IN.01.UF.31555_4_03_02	4	3155540302	OPG Support CMO to EPC 2012/2013-Phase I	2,796,320			
NR.CP.IN.01.UF.31555_4_05_01	4	3155540501	EPC Materials - 2012 - Phase II	970,000			
NR.CP.IN.01.UF.31555_4_05_02	4	3155540502	RCMT Contract for Materials	4,301,194			
NR.CP.IN.01.UF.31555_4_05_40	4	3155540540	EPC Materials - 2012 - Phase II	143,092			
NR.CP.IN.01.UF.31555_4_06_01	4	3155540601	New Horizons LAN Spec. 2012-Phase I	0			
NR.CP.IN.01.UF.31555_4_06_02	4	3155540602	EPC Contract - Materials 2013/2014/2015 Phase III	10,733,299			
NR.CP.IN.01.UF.31555_4_06_03	4	3155540603	New Horizons Procurement - LAN- Phase III Material	0			
NR.CP.IN.01.UF.31555_4_06_04	4	3155540604	New Horizons Procurement - LAN- Phase III Contract	0			
NR.CP.IN.01.UF.31555_4_06_05	4	3155540605	Procure Spare Parts 7% of Mat'l Costs Phase III	0			
NR.CP.IN.01.UF.31555_4_06_12	4	3155540612	Materials - Valves and Bulks	18,228,102			
NR.CP.IN.01.UF.31555_4_06_13	4	3155540613	CTP Proxy for WP 3155540612	0			
NR.CP.IN.01.UF.31555_4_06_92	4	3155540692	OPG Material Costs	29,421			
NR.CP.IN.01.UF.31555_4_07_01	4	3155540701	Manufacturing and Delivery Diesel Gen Set	889,592			
NR.CP.IN.01.UF.31555_4_07_02	4	3155540702	Manufacturing and Delivery Switchgear	1,389,178			
NR.CP.IN.01.UF.31555_4_07_03	4	3155540703	Manufacturing and Delivery UPS	486,480			
NR.CP.IN.01.UF.31555_4_07_04	4	3155540704	Manufacturing and Delivery MCC	762,800			
NR.CP.IN.01.UF.31555_4_07_05	4	3155540705	Manufacturing and Delivery Control Panels	747,876			
NR.CP.IN.01.UF.31555_4_07_06	4	3155540706	Manufacturing and Delivery Instrumentation Air/Service Air	504,777			
NR.CP.IN.01.UF.31555_4_07_07	4	3155540707	Manufacturing and Delivery Stack Monitor	1,236,434			
NR.CP.IN.01.UF.31555_4_07_08	4	3155540708	Manufacture and Delivery Munter Drier (Munter)	606,707			
NR.CP.IN.01.UF.31555_4_07_09	4	3155540709	Manufacture and DeliveryHVAC Control (JCI)	2,731,700			
NR.CP.IN.01.UF.31555_4_07_10	4	3155540710	Manufacture and Delivery Chiller (JCI)	4,068,563			
NR.CP.IN.01.UF.31555_4_07_12	4	3155540712	Manufacture and Delivery Hand & Foot Monitors,Whole Body Monitor Proportional Counter	148,232			
NR.CP.IN.01.UF.31555_4_07_13	4	3155540713	Manufacture and Delivery Tritium Air Monitors	857,488			
NR.CP.IN.01.UF.31555_4_07_14	4	3155540714	Manufacture and Delivery Gamma Monitors	84,800			
NR.CP.IN.01.UF.31555_4_07_15	4	3155540715	Manufacture and Delivery Vapor Recovery Drier- CCI Thermal	2,715,834			
NR.CP.IN.01.UF.31555_4_07_16	4	3155540716	CTP Proxy for WP 3155540701	0			
NR.CP.IN.01.UF.31555_4_07_17	4	3155540717	CTP Proxy for WP 3155540702	0			
NR.CP.IN.01.UF.31555_4_07_18	4	3155540718	CTP Proxy for WP 3155540703	0			
NR.CP.IN.01.UF.31555_4_07_19	4	3155540719	CTP Proxy for WP 3155540704	0			
NR.CP.IN.01.UF.31555_4_07_20	4	3155540720	CTP Proxy for WP 3155540705	0			
NR.CP.IN.01.UF.31555_4_07_21	4	3155540721	CTP Proxy for WP 3155540706	0			
NR.CP.IN.01.UF.31555_4_07_22	4	3155540722	CTP Proxy for WP 3155540708	0			
NR.CP.IN.01.UF.31555_4_07_23	4	3155540723	CTP Proxy for WP 3155540713	0			
NR.CP.IN.01.UF.31555_4_07_24	4	3155540724	D2O Drum Heeling Vacuum Tank	29,862			
NR.CP.IN.01.UF.31555_4_07_25	4	3155540725	Weight Scale	30,486			
NR.CP.IN.01.UF.31555_4_07_26	4	3155540726	Vertical Flooded Heat Exchanger	44,044			
NR.CP.IN.01.UF.31555_4_07_30	4	3155540730	General - Procurement Engineering/Quality Compliance**	1,666,447			
NR.CP.IN.01.UF.31555_4_07_66	4	3155540766	Manufacturing and Delivery Filter Unit 0-73690-FR21/FR22	1,517,597			
NR.CP.IN.01.UF.31555_4_07_72	4	3155540772	Sampling Cabinet	91,849			
NR.CP.IN.01.UF.31555_4_07_73	4	3155540773	Active / Inactive Drainage Pumps for HWMB WA	25,660			
NR.CP.IN.01.UF.31555_4_16_01	4	3155541601	Resources to Procure Urgent Material incl Valves/Pumps/Piping	0			
NR.CP.IN.01.UF.31555_4_16_02	4	3155541602	Material (Urgent Material incl Valves/Pumps/Piping)	8,213,047			
NR.CP.IN.01.UF.31555_4_20_01	4	3155542001	NEW EPC VENDOR PROCUREMENT	0			
NR.CP.IN.01.UF.31555_4_20_02	4	3155542002	D2O Transfer System Related Instrumentation (DEC120488, 120489)	599,019			
NR.CP.IN.01.UF.31555_4_20_03	4	3155542003	Active/Inactive Drainage and D2O Liquid Recovery Pump Control Panels (DEC 120485) (I&C)	77,090			
NR.CP.IN.01.UF.31555_4_20_04	4	3155542004	Fire Alarm System Control Panel (DEC 120351)	67,585			
NR.CP.IN.01.UF.31555_4_20_05	4	3155542005	Moisture Indicating Alarm Units	5,372			
NR.CP.IN.01.UF.31555_4_20_06	4	3155542006	45V DC Instrument Power Supply	7,206			
NR.CP.IN.01.UF.31555_4_20_07	4	3155542007	Chilled Water System AC Units	279,277			
NR.CP.IN.01.UF.31555_4_65_13	4	3155546513	Procurement of Materials	2,683,704	Yes		

NR.CP.IN.01.UF.31555_4_65_14	4	3155546514	Procurement of Equipment	441,720	Yes			
NR.CP.IN.01.UF.31555_4_74_01	4	3155547401	Proc - Phase 2 | OPG Purchased Materials and Equipment	133,332	Yes			
NR.CP.IN.01.UF.31555_4_78_01	4	3155547801	HWMB West Annex Quantities Assessment not in BCS	91,143	Yes - Was not estimated in BCS			
NR.CP.IN.01.UF.31555_4_99_91	4	3155549991	Procurement Engineering Material CCF003587	706,347				
NR.CP.IN.01.UF.31555_4_99_92	4	3155549992	Procurement Bulk Material CCF003587	252,737				
NR.CP.IN.01.UF.31555_4_99_93	4	3155549993	Not Required	0				
NR.CP.IN.01.UF.31555_5_01_01	5	3155550101	Exterior Works - Mechanical (Install PHT Drain)	118				
NR.CP.IN.01.UF.31555_5_01_11	5	3155550111	Causeway Construction - Civil / Structural	243,393				
NR.CP.IN.01.UF.31555_5_01_12	5	3155550112	Causeway Construction - Electrical And I&C	203,415				
NR.CP.IN.01.UF.31555_5_01_13	5	3155550113	Causeway Construction - Mechanical	188,523				
NR.CP.IN.01.UF.31555_5_02_01	5	3155550201	Pipe Chase Construction - Civil / Structural	2,286,045				
NR.CP.IN.01.UF.31555_5_02_02	5	3155550202	Pipe Chase Construction - Electrical And I&C	253,023				
NR.CP.IN.01.UF.31555_5_02_03	5	3155550203	Pipe Chase Construction - Mechanical	84,315				
NR.CP.IN.01.UF.31555_5_02_05	5	3155550205	ES Fox - Tie-ins, Services & Trailers	4,661,703				
NR.CP.IN.01.UF.31555_5_02_06	5	3155550206	ES Fox - Embedded Parts	0				
NR.CP.IN.01.UF.31555_5_02_08	5	3155550208	Detox Environmental	419,049				
NR.CP.IN.01.UF.31555_5_02_09	5	3155550209	Dave Boyle Excavating	379,959				
NR.CP.IN.01.UF.31555_5_02_15	5	3155550215	Other Contracts (United Rentals/ModSpace/etc.)	27,449				
NR.CP.IN.01.UF.31555_5_02_16	5	3155550216	MOD SPACE Contract	90,627				
NR.CP.IN.01.UF.31555_5_02_17	5	3155550217	EXP Services	7,100				
NR.CP.IN.01.UF.31555_5_02_19	5	3155550219	Skyway Sevices	26,109				
NR.CP.IN.01.UF.31555_5_02_20	5	3155550220	United Rentals	1,225,824				
NR.CP.IN.01.UF.31555_5_02_22	5	3155550222	Maxxam Services	0				
NR.CP.IN.01.UF.31555_5_02_23	5	3155550223	Aecon Support	0				
NR.CP.IN.01.UF.31555_5_02_24	5	3155550224	Black Tie Rentals	21,335				
NR.CP.IN.01.UF.31555_5_03_01	5	3155550301	Existing TRF Building - Mechanical Basement	2,630,259				
NR.CP.IN.01.UF.31555_5_03_03	5	3155550303	Existing TRF Building - Mechanical Level 1	735,508				
NR.CP.IN.01.UF.31555_5_03_09	5	3155550309	ED - Dewatering Sys Installation & Dewatering Ellis Don	4,512,605				
NR.CP.IN.01.UF.31555_5_03_10	5	3155550310	ED - Dewatering Sys Installation & Dewatering OPG	0				
NR.CP.IN.01.UF.31555_5_03_11	5	3155550311	Aquatech Costs	1,863,765				
NR.CP.IN.01.UF.31555_5_03_12	5	3155550312	PGL Dewatering	1,346,915				
NR.CP.IN.01.UF.31555_5_03_15	5	3155550315	ED - F1 Soil Management	1,371,231				
NR.CP.IN.01.UF.31555_5_03_20	5	3155550320	Existing TRF Building - Electrical And I&C	395,060				
NR.CP.IN.01.UF.31555_5_04_01	5	3155550401	EPC Contract Phase II Site Prep 2012	3,314,593				
NR.CP.IN.01.UF.31555_5_04_02	5	3155550402	EPC Contract 2013-Phase II	6,151,184				
NR.CP.IN.01.UF.31555_5_04_03	5	3155550403	OPG Field Engineering 2013-Phase II	12,706				
NR.CP.IN.01.UF.31555_5_04_04	5	3155550404	OPG Security Support for EPC 2014-Phase III	1,201,268				
NR.CP.IN.01.UF.31555_5_04_05	5	3155550405	EPC Contract - Construction 2013/2014/2015 Phase III	47,145,467				
NR.CP.IN.01.UF.31555_5_04_06	5	3155550406	EPC CCF261- Phase II Soil/Water Mgmnt, Trailers, CTP001	3,165,018				
NR.CP.IN.01.UF.31555_5_04_07	5	3155550407	EPC CCF273 Part 1 - Design and Fabrication of F1 Area to accept Soil	8,641,917				
NR.CP.IN.01.UF.31555_5_04_08	5	3155550408	EPC CCF273 Part 2 - Soil Management in Area C-13	0				
NR.CP.IN.01.UF.31555_5_04_09	5	3155550409	EPC CCF 285 Pipe Chase Engineering	190,195				
NR.CP.IN.01.UF.31555_5_04_10	5	3155550410	EPC CCF 289 Part 1 - Contaminated Soil - 488k	0				
NR.CP.IN.01.UF.31555_5_04_11	5	3155550411	EPC CCF 289 Part 2 - Discovery of Asbestos - 119.7k	0				
NR.CP.IN.01.UF.31555_5_04_12	5	3155550412	EPC CCF 289 Part 3 - Changing the USI Assignment - 53.5k	0				
NR.CP.IN.01.UF.31555_5_04_13	5	3155550413	EPC CCF 289 Part 4 - Underestimate of the DCC Support - 610k	3,553				
NR.CP.IN.01.UF.31555_5_04_14	5	3155550414	EPC CCF 293 - Facilitate the Storage and Treatment of the Contaminated Soil Part 1 - 3289k	0				
NR.CP.IN.01.UF.31555_5_04_21	5	3155550421	Budget for Restoration of F1	515,150				
NR.CP.IN.01.UF.31555_5_04_22	5	3155550422	Ellis Don Concrete & Formwork to Dyke	22,977,963				
NR.CP.IN.01.UF.31555_5_04_23	5	3155550423	ES Fox - Dyke Support Services (237909)	2,963,782				
NR.CP.IN.01.UF.31555_5_04_25	5	3155550425	West Annex Building - Work Area Below 100 -Staircases	263,688				
NR.CP.IN.01.UF.31555_5_04_26	5	3155550426	Work Area Below 100 - 1 - Civil / Structural	3,238,526				
NR.CP.IN.01.UF.31555_5_04_27	5	3155550427	Work Area Below 100 - 1 - Mechanical	9,001,982				
NR.CP.IN.01.UF.31555_5_04_28	5	3155550428	Work Area Below 100 - 1 - Electrical and I&C	2,847,659				
NR.CP.IN.01.UF.31555_5_04_29	5	3155550429	West Annex Building - Work Area Below 100 -2 - Civil / Structural	5,688,850				

NR.CP.IN.01.UF.31555_5_04_30	5	3155550430	West Annex Building - Work Area Below 100 -2 - Mechanical	6,971,319			
NR.CP.IN.01.UF.31555_5_04_31	5	3155550431	West Annex Building - Work Area Below 100 -2 - Electrical and I&C	1,447,526			
NR.CP.IN.01.UF.31555_5_04_32	5	3155550432	West Annex Building - Work Area Below 100-3 - Civil / Structural	2,390,864			
NR.CP.IN.01.UF.31555_5_04_33	5	3155550433	West Annex Building - Work Area Below 100-3 - Mechanical	8,250,509			
NR.CP.IN.01.UF.31555_5_04_34	5	3155550434	West Annex Building - Work Area Below 100-3 - Electrical and I&C	799,809			
NR.CP.IN.01.UF.31555_5_04_35	5	3155550435	West Annex Building - Slab 100	593,235			
NR.CP.IN.01.UF.31555_5_05_01	5	3155550501	Work Area Elevation 100 - Civil / Structural - Structural Steel / Concrete	5,062,184			
NR.CP.IN.01.UF.31555_5_05_02	5	3155550502	Work Area Elevation 100 - Civil / Structural - Finishes	90,757			
NR.CP.IN.01.UF.31555_5_05_03	5	3155550503	West Annex Building - Work Area Elevation 100 - Mechanical	1,350,803			
NR.CP.IN.01.UF.31555_5_05_04	5	3155550504	West Annex Building - Work Area Elevation 100 - Electrical and I&C	841,098			
NR.CP.IN.01.UF.31555_5_06_01	5	3155550601	West Annex Building - Work Area Elevation 107 - Structural Steel / Concrete	2,821,631			
NR.CP.IN.01.UF.31555_5_06_02	5	3155550602	West Annex Building - Work Area Elevation 107 - Finishes	781,202			
NR.CP.IN.01.UF.31555_5_06_03	5	3155550603	West Annex Building - Work Area Elevation 107 - Mechanical	923,773			
NR.CP.IN.01.UF.31555_5_06_04	5	3155550604	West Annex Building - Work Area Elevation 107 - Electrical and I&C	522,574			
NR.CP.IN.01.UF.31555_5_07_01	5	3155550701	West Annex Building - Work Area Elevation 115 - Civil / Structural	503,310			
NR.CP.IN.01.UF.31555_5_07_02	5	3155550702	West Annex Building - Work Area Elevation 115 - Mechanical	835,328			
NR.CP.IN.01.UF.31555_5_07_03	5	3155550703	West Annex Building - Work Area Elevation 115 - Electrical and I&C	0			
NR.CP.IN.01.UF.31555_5_08_01	5	3155550801	Building Envelope - West Elevation	37,100			
NR.CP.IN.01.UF.31555_5_08_02	5	3155550802	Building Envelope - North Elevation	86,733			
NR.CP.IN.01.UF.31555_5_08_03	5	3155550803	Building Envelope - East Elevation	136,367			
NR.CP.IN.01.UF.31555_5_08_04	5	3155550804	Building Envelope - South Elevation	86,733			
NR.CP.IN.01.UF.31555_5_09_01	5	3155550901	Exterior Works - Civil / Structural	158,845			
NR.CP.IN.01.UF.31555_5_09_02	5	3155550902	Exterior Works - Mechanical	458			
NR.CP.IN.01.UF.31555_5_09_03	5	3155550903	Exterior Works - Electrical And I&C	2,651,561			
NR.CP.IN.01.UF.31555_5_09_51	5	3155550951	Indirect Labour	4,380,852			
NR.CP.IN.01.UF.31555_5_09_52	5	3155550952	CTP Proxy for WP 3155550951	0			
NR.CP.IN.01.UF.31555_5_09_61	5	3155550961	Construction Tools & Equipment	842,567			
NR.CP.IN.01.UF.31555_5_09_71	5	3155550971	Crane lifting	0			
NR.CP.IN.01.UF.31555_5_09_72	5	3155550972	Scaffolding	4,770,000			
NR.CP.IN.01.UF.31555_5_09_73	5	3155550973	Other Services (Permit TSSA…etc)	403,543			
NR.CP.IN.01.UF.31555_5_10_01	5	3155551001	ED - Mud Slab Anchoring	0			
NR.CP.IN.01.UF.31555_5_10_02	5	3155551002	ED Dyke Construction - 1st Lift	0			
NR.CP.IN.01.UF.31555_5_10_03	5	3155551003	ED Dyke Construction - 2nd Lift	0			
NR.CP.IN.01.UF.31555_5_10_06	5	3155551006	ED Dyke Construction - Topping Slab & Anchor Bolts	0			
NR.CP.IN.01.UF.31555_5_10_09	5	3155551009	ED Dyke Construction Basement Slab Waterproofing	0			
NR.CP.IN.01.UF.31555_5_10_10	5	3155551010	Ellis Don PMT & Other	0			
NR.CP.IN.01.UF.31555_5_10_11	5	3155551011	Ellis Don Tiebacks and Excavation	0			
NR.CP.IN.01.UF.31555_5_10_13	5	3155551013	ES Fox - Dyke Support Services (237909)	0			
NR.CP.IN.01.UF.31555_5_20_01	5	3155552001	NEW EPC CONSTRUCTION	1,584,157			
NR.CP.IN.01.UF.31555_5_20_88	5	3155552088	NEW EPC VENDOR INDIRECTS	0			
NR.CP.IN.01.UF.31555_5_20_89	5	3155552089	NEW EPC VENDOR CORE TEAM/OH/PROFIT	0			
NR.CP.IN.01.UF.31555_5_55_01	5	3155555501	Transition Period | HWMB West Annex Roof and Drain Installation | Flynn	0			
NR.CP.IN.01.UF.31555_5_55_02	5	3155555502	Transition Period | HVAC Installation | Cullition	0			
NR.CP.IN.01.UF.31555_5_55_03	5	3155555503	Transition Period | Scaffolding support (includes rental) | Safeway	0			
NR.CP.IN.01.UF.31555_5_55_04	5	3155555504	Transition Period | Building civil works | Masonry Block Installation | OPG	0			
NR.CP.IN.01.UF.31555_5_55_05	5	3155555505	Transition Period | Building civil works | Sealing Precast Walls | OPG	0			
NR.CP.IN.01.UF.31555_5_55_06	5	3155555506	Transition Period | Building civil works | Caisson Removal | OPG	0			
NR.CP.IN.01.UF.31555_5_55_07	5	3155555507	Transition Period | Equipment Rental | Rental Hub	0			
NR.CP.IN.01.UF.31555_5_55_08	5	3155555508	Transition Period | Equipment Rental | United Rental	0			
NR.CP.IN.01.UF.31555_5_55_09	5	3155555509	Transition Period | Equipment Rental | PA Wash-car Servicing | Nature's Call	0			
NR.CP.IN.01.UF.31555_5_55_10	5	3155555510	Transition Period | Construction Support | Boyle	0			
NR.CP.IN.01.UF.31555_5_55_11	5	3155555511	Transition Period | JV Costs (Canatom) April 22 2017 to June 27 2017	937,732			
NR.CP.IN.01.UF.31555_5_60_00	5	3155556000	JV Phase 2 GMAX + Commissioning Option and Possible CO's	0	Yes		
NR.CP.IN.01.UF.31555_5_61_00	5	3155556100	DFL - Construction	27,322,010	Yes		
NR.CP.IN.01.UF.31555_5_61_01	5	3155556101	Construction Activities	4,264,022	Yes		

NR.CP.IN.01.UF.31555_5_61_72	5	3155556172	Rental of Equipment	903,177	Yes		
NR.CP.IN.01.UF.31555_5_61_73	5	3155556173	Small Tools & Consumables	788,120	Yes		
NR.CP.IN.01.UF.31555_5_61_74	5	3155556174	Contractor EPSCA	1,735,234	Yes		
NR.CP.IN.01.UF.31555_5_74_22	5	3155557422	Const - Repair Dyke Repair Not in BCS	35,832	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_5_79_01	5	3155557901	Const - Oversight Phase 2 | Construction Oversight	2,898,057	Yes		
NR.CP.IN.01.UF.31555_5_79_02	5	3155557902	Const – Construction Contracts | 2018 Tie-In's	155,343	Yes		
NR.CP.IN.01.UF.31555_5_79_03	5	3155557903	Const – Construction Contracts | TMOD Removal Not in BCS	420,179	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_5_79_04	5	3155557904	Const. Phase 2 , Radiation Protection Not Incl. in the BCS	1,163,705	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_5_79_05	5	3155557905	Const. DNGS H.W.M.B. - Ice Plug Support to you	45,723	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_5_79_06	5	3155557906	Const. DNGS H.W.M.B. - LAN Cable Design and Install	107,815	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_5_99_91	5	3155559991	Construction Equipment Rental CCF003587	290,710			
NR.CP.IN.01.UF.31555_5_99_92	5	3155559992	Construction Sub-Contractors CCF003587	846,680			
NR.CP.IN.01.UF.31555_5_99_93	5	3155559993	Construction Field Labour CCF003587	0			
NR.CP.IN.01.UF.31555_6_02_02	6	3155560202	Commissioning - Commissioning and Close Out Activities ** (Engineering Support Only)	0			
NR.CP.IN.01.UF.31555_6_04_01	6	3155560401	OPG Commissioning Phase III	222,157			
NR.CP.IN.01.UF.31555_6_64_01	6	3155566401	Commissioning Project Controls & Mgmt	484,968	Yes		
NR.CP.IN.01.UF.31555_6_64_02	6	3155566402	Commissioning Field Team Lead	1,977,942	Yes		
NR.CP.IN.01.UF.31555_6_64_03	6	3155566403	Commissioning OEM Support	2,242,599	Yes		
NR.CP.IN.01.UF.31555_6_64_04	6	3155566404	Commissioning Business Expenses	195,000	Yes		
NR.CP.IN.01.UF.31555_6_64_05	6	3155566405	Commissioning Scaffolding	76,923	Yes		
NR.CP.IN.01.UF.31555_6_75_01	6	3155567501	Comm - Phase 2 | OPG Commissioning Ops	1,460,915	Yes		
NR.CP.IN.01.UF.31555_9_03_01	9	3155590301	Administration of Project Financial Close Out	0			
NR.CP.IN.01.UF.31555_9_04_02	9	3155590402	EPC Contract - Close out the Contract	373,607			
NR.CP.IN.01.UF.31555_9_06_11	9	3155590611	Ellis Don Fuel Costs	0			
NR.CP.IN.01.UF.31555_9_76_01	9	3155597601	CLS - Phase 2 | Project Closeout Labour not in BCS	168,282	Yes - Was not estimated in BCS		
NR.CP.IN.01.UF.31555_u_an_ll	u	31555uanll	31555 Unallocated Costs	(25,712)			

Project 31555 "D2O Storage Facility" Cost at Completion Projection (Summary)

Data Date: End of Dec 2016

Description	CB	AC	ETC	EAC
JV	$147,189,818	$131,788,590	$75,019,207	**$206,807,797**
OPG	$20,594,660	$15,523,489	$5,952,850	**$21,476,339**
Interest	$24,091,920	$20,500,969	$11,000,000	**$31,500,969**
Contingency	$14,630,620	$0	$0	**$0**
OPG Legacy	$119,317,560	$118,268,411	$137,087	**$118,405,498**
Other Vendors	$55,348,951	$54,814,373	$828,219	**$55,642,592**
Grand Total	**$381,173,529**	**$340,895,832**	**$92,937,364**	**$433,833,196**
Percentage		**89.4%**	**24.4%**	

Notes:

Unallocated Cost includes some engineered equipment, small tools and consumables, LOA, non EPSCA expenses, indirect labour, EPSCA expenses, EPSCA training, other services.

Actuals include month of December 2016.

Current projection is developed based on the schedule as January 6, 2017

Interest updated based on the new projection.

P&M OPG numbers are as per PMs forecast at the end of December 2016.

There is no contingency allowance in presented EAC. The contingency carried in CB has been assigned into new ETC.

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,833,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155500101	P&M Legacy	LTD 2008 Cost	0 - Cost Management	$0	$0	$0	$0
3155500502	P&M Ellis Don	Ellis Don Fuel Costs	0 - Cost Management	$1,400,574	$1,400,574	$0	$1,400,574
3155500505	P&M SNC/AECON JV	EPSCA Expenses	0 - Cost Management	$1,532,464	$385,064	$500,000	$885,064
3155500506	P&M SNC/AECON JV	EPSCA Training	0 - Cost Management	$734,983	$0	$100,000	$100,000
3155500701	Vendors Managed by Projects and Mods	Project 31555 - interest	0 - Cost Management	$24,091,920	$20,500,969	$11,000,000	$31,500,969
3155500901	Vendors Managed by Projects and Mods	D2O Storage Project Contingency	0 - Cost Management	$14,630,620	$0	$0	$0
3155500902	P&M SNC/AECON JV	P&M SNC/AECON JV PO Contingency (formerly WP 3155510504)	0 - Cost Management	$5,000,000	$0	$0	$0
3155509999	Vendors Managed by Projects and Mods	For Forecast Only	0 - Cost Management	$0	$0	$0	$0
3155510102	P&M SNC/AECON JV	Aecon-SNC Project Management	1 - Project Management	$18,320,350	$19,960,366	$9,249,302	$29,209,668
3155510103	P&M Other Vendors	Aecon CFEP (NTP)	1 - Project Management	$0	$0	$0	$0
3155510104	ESFOX Under PM	ES Fox CFEP	1 - Project Management	$120,000	$120,000	$0	$120,000
3155510105	P&M SNC/AECON JV	SNC Engineering Management, DC, Metrology (HO)	1 - Project Management	$1,171,361	$1,798,898	$555,143	$2,354,041
3155510201	P&M Legacy	Project Controls 2012	1 - Project Management	$346,046	$346,046	$0	$346,046
3155510202	P&M Legacy	Project Controls 2013	1 - Project Management	$940,058	$940,058	$0	$940,058
3155510203	P&M Legacy	Project Controls Execution Partial	1 - Project Management	$680,211	$680,211	$0	$680,211
3155510204	Vendors Managed by Projects and Mods	Project Controls Execution Full	1 - Project Management	$5,857,840	$4,889,981	$1,309,821	$6,199,802
3155510205	P&M Legacy	OPG Support FE/CMO to EPC 2013-Phase I	1 - Project Management	$547,896	$547,896	$0	$547,896
3155510240	Vendors Managed by Projects and Mods	OPG EPSCA - Direct Hires	1 - Project Management	$2,321,955	$2,055,070	$335,530	$2,390,600
3155510502	P&M SNC/AECON JV	Training (Engineering softwares)	1 - Project Management	$150,247	$142,832	$7,415	$150,247
3155510540	P&M SNC/AECON JV	Training (OPG operators)	1 - Project Management	$1,013,624	$668,700	$344,924	$1,013,624
3155510706	Vendors Managed by Projects and Mods	Interest for 2013/2014/2015 Execution Full	1 - Project Management	$1,485,630	$1,485,630	$0	$1,485,630
3155512001	P&M SNC/AECON JV	NEW EPC VENDOR PROJECT MANAGEMENT	1 - Project Management	$0	$0	$0	$0
3155519801	P&M Legacy	Travelling Expenses for 2012/2013-Phase I	1 - Project Management	$5,413	$5,413	$0	$5,413

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$433,833,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155519802	P&M Other Vendors	Core Team Project Support 2013/2014/2015- Phase III	1 - Project Management	$2,437,168	$2,405,903	$243,786	$2,649,688
3155519805	P&M Legacy	CMO Project Support Overhead 2012/2013 Pt - Phase I	1 - Project Management	$0	$0	$0	$0
3155519806	P&M Legacy	Travelling Expenses for 2013 Pt 1-Phase II Exe Part	1 - Project Management	$0	$0	$0	$0
3155519807	Vendors Managed by Projects and Mods	Travelling Expenses for 2013/2014/2015	1 - Project Management	$15,600	$9,223	$5,371	$14,594
3155519809	P&M Legacy	Supply Chain Project Support .4% 2013/2014/2015 - Phase III	1 - Project Management	$0	$0	$0	$0
3155519901	P&M Legacy	LTD to end of 2010 -DEV	1 - Project Management	$1,863,352	$1,863,352	$0	$1,863,352
3155519902	P&M Legacy	LTD to end of 2011-DEV	1 - Project Management	$1,111,732	$1,111,732	$0	$1,111,732
3155519906	P&M Legacy	LTD to end of 2012-DEV	1 - Project Management	$372,850	$372,850	$0	$372,850
3155530201	P&M Legacy	OPG Support Design/FE/TRF/PE/DCC 2012-Phase I	3 - Engineering	$452,124	$452,124	$0	$452,124
3155530202	P&M Legacy	OPG Support Design/FE/TRF/PE/DCC 2013-Phase I	3 - Engineering	$1,649,345	$1,649,345	$0	$1,649,345
3155530203	Vendors Managed by Projects and Mods	OPG Support Design/FE/TRF/PE/DCC to Support -Phase III	3 - Engineering	$3,796,722	$1,293,098	$2,749,362	$4,042,459
3155530401	P&M Legacy	EPC Contract 2012 Phase I Detaileld Design	3 - Engineering	$0	($1,049,977)	$0	($1,049,977)
3155530402	P&M Legacy	EPC Contract 2012 Modification Planning Payment	3 - Engineering	$1,117,738	$1,117,738	$0	$1,117,738
3155530403	P&M Legacy	EPC Contract 2012 Eng Specifications for LL Items Accept by OPG Payment	3 - Engineering	$970,000	$970,000	$0	$970,000
3155530404	P&M Legacy	EPC Contract 2012 100% of TMods Accepted by OPG Payment	3 - Engineering	$970,000	$970,000	$0	$970,000
3155530405	P&M Legacy	EPC Contract 2012 25% of all design EC's Accepted by OPG Payment	3 - Engineering	$485,000	$485,000	$0	$485,000
3155530406	P&M Legacy	EPC Contract 2012 50% of all design EC's Accepted by OPG Payment	3 - Engineering	$1,455,000	$1,455,000	$0	$1,455,000
3155530407	P&M Legacy	EPC Contract 2012 65% of all design EC's Accepted by OPG Payment	3 - Engineering	$2,989,977	$2,989,977	$0	$2,989,977
3155530408	P&M Legacy	EPC Contract 2012 75% of all design EC's Accepted by OPG Payment	3 - Engineering	$2,234,399	$2,234,399	$0	$2,234,399
3155530409	P&M Legacy	EPC Contract 2012 100% of all design EC's Accepted by OPG Payment	3 - Engineering	$437,447	$437,447	$0	$437,447
3155530410	P&M Legacy	EPC Contract 2012 Completion of Final COMS Payment	3 - Engineering	$1,022,582	$1,022,582	$0	$1,022,582

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,233,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155530411	P&M Legacy	EPC Design and Construction - 2012/2013 - Phase II (Accruals and Billing Errors)	3 - Engineering	$0	$0	$0	$0
3155530415	P&M SNC/AECON JV	SNC Engineering - Civil	3 - Engineering	$422,642	$341,553	$13,720	$355,273
3155530416	P&M SNC/AECON JV	SNC Engineering - Mechanical	3 - Engineering	$515,535	$495,683	$46,276	$541,960
3155530417	P&M SNC/AECON JV	SNC Engineering - Electrical	3 - Engineering	$1,362,402	$2,054,815	$59,275	$2,114,090
3155530418	P&M SNC/AECON JV	SNC Engineering - I&C	3 - Engineering	$548,673	$977,519	$112,311	$1,089,830
3155530501	P&M Legacy	OSS Contract Support Design 2012 Pt 1-Phase I	3 - Engineering	$4,706,970	$4,706,970	$0	$4,706,970
3155530502	P&M Legacy	OSS Contract Support Design 2013-Phase I	3 - Engineering	$479,256	$479,256	$0	$479,256
3155530503	P&M Legacy	OSS/OPG Contract Support Design 2012/2013-Phase II	3 - Engineering	$74,909	$74,909	$0	$74,909
3155530504	P&M Legacy	OPG Contract Support Design/TRF/PE 2013/2014/2015-Phase II and Phase III	3 - Engineering	$286,805	$286,805	$0	$286,805
3155530505	P&M Legacy	OSS Contract Support Design 2012/2013-Phase II	3 - Engineering	$0	$0	$0	$0
3155530506	P&M Other Vendors	OSS Contract Support Design EPC 2013/2014/2015	3 - Engineering	$130,851	$131,836	$0	$131,836
3155530508	P&M SNC/AECON JV	Engineering Support - Civil	3 - Engineering	$1,352,503	$1,167,836	$984,704	$2,152,540
3155530509	P&M SNC/AECON JV	Engineering Support - Mechanical	3 - Engineering	$1,269,828	$3,214,424	$692,020	$3,906,444
3155530510	P&M SNC/AECON JV	Engineering Support - Electrical	3 - Engineering	$508,688	$211,286	$1,809,185	$2,020,471
3155530511	P&M SNC/AECON JV	Engineering Support - I&C	3 - Engineering	$998,809	$1,453,557	$556,533	$2,010,090
3155530701	P&M SNC/AECON JV	SNC Field Engineering & Pre-Commissioning Support	3 - Engineering	$8,978,546	$12,213,265	$3,916,802	$16,130,067
3155531409	P&M Other Vendors	RCMT Contract for R00 Engineering	3 - Engineering	$4,968,388	$4,800,538	$131,156	$4,931,694
3155531420	P&M Other Vendors	RCMT Contract for Materials	3 - Engineering	$0	$0	$0	$0
3155531421	P&M Other Vendors	RCMT Claim	3 - Engineering	$0	$0	$0	$0
3155532001	P&M SNC/AECON JV	NEW EPC VENDOR ENGININEERING	3 - Engineering	($0)	$0	$0	$0
3155540201	Vendors Managed by Projects and Mods	OPG Procurement of Welding Materials	4 - Procurement	$24,925	$24,925	$0	$24,925
3155540202	Vendors Managed by Projects and Mods	OPG Procurement Support for Free Issue Materials	4 - Procurement	$14,278	$14,278	$0	$14,278
3155540203	Vendors Managed by Projects and Mods	OPG Free Issue Purchase of Valves & Tanks	4 - Procurement	$1,439,127	$1,545,246	$0	$1,545,246
3155540301	Vendors Managed by Projects and Mods	OPG Support CMO/FE to EPC 2013/2014/2015 Execution Full	4 - Procurement	$5,017,242	$4,123,789	$1,102,208	$5,225,997
3155540302	P&M Legacy	OPG Support CMO to EPC 2012/2013-Phase I	4 - Procurement	$2,796,320	$2,796,320	$0	$2,796,320
3155540501	P&M Legacy	EPC Materials - 2012 - Phase II	4 - Procurement	$2,019,977	$2,019,977	$0	$2,019,977

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,233,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155540502	P&M Other Vendors	RCMT Contract for Materials	4 - Procurement	$4,424,546	$4,249,842	$0	$4,249,842
3155540540	P&M Legacy	EPC Materials - 2012 - Phase II	4 - Procurement	$143,092	$143,092	$0	$143,092
3155540601	P&M Legacy	New Horizons LAN Spec. 2012-Phase I	4 - Procurement	$0	$0	$0	$0
3155540602	P&M Legacy	EPC Contract - Materials 2013/2014/2015 Phase III	4 - Procurement	$10,733,299	$10,733,299	$0	$10,733,299
3155540603	P&M Legacy	New Horizons Procurement - LAN- Phase III Material	4 - Procurement	$0	$0	$0	$0
3155540604	P&M Legacy	New Horizons Procurement - LAN- Phase III Contract	4 - Procurement	$0	$0	$0	$0
3155540605	P&M Legacy	Procure Spare Parts 7% of Mat'l Costs Phase III	4 - Procurement	$0	$0	$0	$0
3155540612	P&M SNC/AECON JV	Materials - Valves and Bulks	4 - Procurement	$13,631,484	$13,671,124	$228,876	$13,900,000
3155540692	P&M Legacy	OPG Material Costs	4 - Procurement	$29,928	$29,928	$137,087	$167,015
3155540701	P&M SNC/AECON JV	Manufacturing and Delivery Diesel Gen Set	4 - Procurement	$957,866	$1,104,975	$65,025	$1,170,000
3155540702	P&M SNC/AECON JV	Manufacturing and Delivery Switchgear	4 - Procurement	$1,279,741	$1,433,527	$163,469	$1,596,996
3155540703	P&M SNC/AECON JV	Manufacturing and Delivery UPS	4 - Procurement	$389,393	$486,480	$0	$486,480
3155540704	P&M SNC/AECON JV	Manufacturing and Delivery MCC	4 - Procurement	$717,651	$861,905	$106,595	$968,500
3155540705	P&M SNC/AECON JV	Manufacturing and Delivery Control Panels	4 - Procurement	$675,711	$777,109	$153,891	$931,000
3155540706	P&M SNC/AECON JV	Manufacturing and Delivery Instrumentation Air/Service Air	4 - Procurement	$214,700	$397,684	$45,316	$443,000
3155540707	P&M SNC/AECON JV	Manufacturing and Delivery Stack Monitor	4 - Procurement	$1,231,603	$1,084,380	$85,620	$1,170,000
3155540708	P&M SNC/AECON JV	Manufacture and Delivery Munter Drier (Munter)	4 - Procurement	$565,961	$614,695	$0	$614,695
3155540709	P&M SNC/AECON JV	Manufacture and DeliveryHVAC Control (JCI)	4 - Procurement	$2,882,966	$2,147,189	$252,811	$2,400,000
3155540710	P&M SNC/AECON JV	Manufacture and Delivery Chiller (JCI)	4 - Procurement	$4,612,746	$3,012,761	$987,239	$4,000,000
3155540712	P&M SNC/AECON JV	Manufacture and Delivery Hand & Foot Monitors,Whole Body Monitor Proportional Counter	4 - Procurement	$353,783	$148,259	$0	$148,259
3155540713	P&M SNC/AECON JV	Manufacture and Delivery Tritium Air Monitors	4 - Procurement	$820,925	$953,089	$0	$953,089
3155540714	P&M SNC/AECON JV	Manufacture and Delivery Gamma Monitors	4 - Procurement	$95,657	$80,560	$4,440	$85,000
3155540715	P&M SNC/AECON JV	Manufacture and Delivery Vapor Recovery Drier- CCI Thermal	4 - Procurement	$3,120,762	$2,546,006	$574,756	$3,120,762
3155540724	P&M SNC/AECON JV	D2O Drum Heeling Vacuum Tank	4 - Procurement	$0	$29,892	$0	$29,892
3155540725	P&M SNC/AECON JV	Weight Scale	4 - Procurement	$0	$30,486	$0	$30,486
3155540726	P&M SNC/AECON JV	Vertical Flooded Heat Exchanger	4 - Procurement	$0	$440,436	$0	$440,436

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,233,302
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155540730	P&M SNC/AECON JV	General - Procurement Engineering/Quality Compliance**	4 - Procurement	$1,010,683	$1,729,945	$436,154	$2,166,099
3155540766	P&M SNC/AECON JV	Manufacturing and Delivery Filter Unit 0-73690-FR21/FR22	4 - Procurement	$3,282,000	$1,318,956	$311,044	$1,630,000
3155540772	P&M SNC/AECON JV	Sampling Cabinet	4 - Procurement	$0	$174,513	$10,487	$185,000
3155540773	P&M SNC/AECON JV	Active / Inactive Drainage Pumps for HWMB WA	4 - Procurement	$0	$128,298	$0	$128,298
3155541601	P&M Legacy	Resources to Procure Urgent Material incl Valves/Pumps/Piping	4 - Procurement	$0	$0	$0	$0
3155541602	P&M Legacy	Material (Urgent Material incl Valves/Pumps/Piping)	4 - Procurement	$8,213,047	$8,213,047	$0	$8,213,047
3155542001	P&M SNC/AECON JV	NEW EPC VENDOR PROCUREMENT	4 - Procurement	$0	$0	$0	$0
3155550101	P&M SNC/AECON JV	Exterior Works - Mechanical (Install PHT Drain)	5 - Construction	$1,488,000	$118	$1,257,280	$1,257,398
3155550111	P&M SNC/AECON JV	Causeway Construction - Civil / Structural	5 - Construction	$453,557	$20,903	$485,268	$506,171
3155550112	P&M SNC/AECON JV	Causeway Construction - Electrical And I&C	5 - Construction	$51,299	$144	$86,856	$87,000
3155550113	P&M SNC/AECON JV	Causeway Construction - Mechanical	5 - Construction	$103,031	$88,246	$388,557	$476,803
3155550201	P&M SNC/AECON JV	Pipe Chase Construction - Civil / Structural	5 - Construction	$917,816	$887,236	$612,764	$1,500,000
3155550202	P&M SNC/AECON JV	Pipe Chase Construction - Electrical And I&C	5 - Construction	$146,004	$40,087	$54,913	$95,000
3155550203	P&M SNC/AECON JV	Pipe Chase Construction - Mechanical	5 - Construction	$334,780	$73,566	$426,434	$500,000
3155550205	ESFOX Under PM	ES Fox - Tie-ins, Services & Trailers	5 - Construction	$4,579,302	$4,465,745	$0	$4,465,745
3155550206	ESFOX Under PM	ES Fox - Embedded Parts	5 - Construction	$0	$0	$388,415	$388,415
3155550208	P&M Other Vendors	Detox Environmental	5 - Construction	$418,822	$418,822	$0	$418,822
3155550209	P&M Other Vendors	Dave Boyle Excavating	5 - Construction	$379,959	$379,959	$0	$379,959
3155550215	P&M Other Vendors	Other Contracts (United Rentals/ModSpace/etc.)	5 - Construction	$27,449	$27,449	$0	$27,449
3155550216	P&M Other Vendors	MOD SPACE Contract	5 - Construction	$94,083	$94,083	$0	$94,083
3155550217	P&M Other Vendors	EXP Services	5 - Construction	$7,100	$7,100	$0	$7,100
3155550219	P&M Other Vendors	Skyway Sevices	5 - Construction	$26,109	$26,109	$0	$26,109
3155550220	P&M Other Vendors	United Rentals	5 - Construction	$1,225,824	$1,225,824	$0	$1,225,824
3155550222	P&M Other Vendors	Maxxam Services	5 - Construction	$0	$0	$0	$0
3155550223	P&M SNC/AECON JV	Aecon Support	5 - Construction	$0	$0	$0	$0
3155550224	P&M Other Vendors	Black Tie Rentals	5 - Construction	$21,335	$21,335	$0	$21,335
3155550301	P&M SNC/AECON JV	Existing TRF Building - Mechanical Basement	5 - Construction	$1,553,851	$2,498,363	$416,394	$2,914,757

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$433,833,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155550303	P&M SNC/AECON JV	Existing TRF Building - Mechanical Level 1	5 - Construction	$1,294,567	$341,487	$783,731	$1,125,218
3155550309	P&M Ellis Don	ED - Dewatering Sys Installation & Dewatering Ellis Don	5 - Construction	$4,512,605	$4,512,605	$0	$4,512,605
3155550310	P&M Ellis Don	ED - Dewatering Sys Installation & Dewatering OPG	5 - Construction	$0	$0	$0	$0
3155550311	P&M Other Vendors	Aquatech Costs	5 - Construction	$876,467	$1,880,959	$47,257	$1,928,216
3155550312	P&M Other Vendors	PGL Dewatering	5 - Construction	$1,905,667	$844,939	$17,606	$862,545
3155550315	P&M Ellis Don	ED - F1 Soil Management	5 - Construction	$1,371,231	$1,371,231	$0	$1,371,231
3155550320	P&M SNC/AECON JV	Existing TRF Building - Electrical And I&C	5 - Construction	$1,120,120	$199,398	$10,475	$209,873
3155550401	P&M Legacy	EPC Contract Phase II Site Prep 2012	5 - Construction	$3,314,571	$3,314,571	$0	$3,314,571
3155550402	P&M Legacy	EPC Contract 2013-Phase II	5 - Construction	$6,150,507	$6,150,548	$0	$6,150,548
3155550403	P&M Legacy	OPG Field Engineering 2013-Phase II	5 - Construction	$12,706	$12,706	$0	$12,706
3155550404	P&M Legacy	OPG Security Support for EPC 2014-Phase III	5 - Construction	$1,201,268	$1,201,268	$0	$1,201,268
3155550405	P&M Legacy	EPC Contract - Construction 2013/2014/2015 Phase III	5 - Construction	$47,129,447	$47,130,232	$0	$47,130,232
3155550406	P&M Legacy	EPC CCF261- Phase II Soil/Water Mgmnt, Trailers, CTP001	5 - Construction	$3,165,018	$3,165,018	$0	$3,165,018
3155550407	P&M Legacy	EPC CCF273 Part 1 - Design and Fabrication of F1 Area to accept Soil	5 - Construction	$8,641,917	$8,641,917	$0	$8,641,917
3155550408	P&M Legacy	EPC CCF273 Part 2 - Soil Management in Area C-13	5 - Construction	$0	$0	$0	$0
3155550409	P&M Legacy	EPC CCF 285 Pipe Chase Engineering	5 - Construction	$190,195	$190,195	$0	$190,195
3155550410	P&M Legacy	EPC CCF 289 Part 1 - Contaminated Soil - 488k	5 - Construction	($1)	$0	$0	$0
3155550411	P&M Legacy	EPC CCF 289 Part 2 - Discovery of Asbestos - 119.7k	5 - Construction	$0	$0	$0	$0
3155550412	P&M Legacy	EPC CCF 289 Part 3 - Changing the USI Assignment - 53.5k	5 - Construction	($1)	$0	$0	$0
3155550413	P&M Legacy	EPC CCF 289 Part 4 - Underestimate of the DCC Support - 610k	5 - Construction	$3,553	$3,553	$0	$3,553
3155550414	P&M Legacy	EPC CCF 293 - Facilitate the Storage and Treatment of the Contaminated Soil Part 1 - 3289k	5 - Construction	$0	$0	$0	$0
3155550421	P&M Other Vendors	Budget for Restoration of F1	5 - Construction	$500,000	$515,150	$0	$515,150
3155550422	P&M Ellis Don	Ellis Don Concrete & Formwork to Dyke	5 - Construction	$22,977,963	$22,977,963	$0	$22,977,963
3155550423	ESFOX Under PM	ES Fox - Dyke Support Services (237909)	5 - Construction	$2,943,507	$2,967,163	$0	$2,967,163

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,833,302
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155550425	P&M SNC/AECON JV	West Annex Building - Work Area Below 100 -Staircases	5 - Construction	$355,400	$257,277	$111,676	$368,953
3155550426	P&M SNC/AECON JV	Work Area Below 100 - 1 - Civil / Structural	5 - Construction	$1,740,787	$2,526,738	$254,368	$2,781,106
3155550427	P&M SNC/AECON JV	Work Area Below 100 - 1 - Mechanical	5 - Construction	$7,753,272	$8,170,295	$1,508,944	$9,679,239
3155550428	P&M SNC/AECON JV	Work Area Below 100 - 1 - Electrical and I&C	5 - Construction	$2,621,271	$2,322,365	$921,035	$3,243,400
3155550429	P&M SNC/AECON JV	West Annex Building - Work Area Below 100 -2 - Civil / Structural	5 - Construction	$2,155,396	$4,999,488	$0	$4,999,488
3155550430	P&M SNC/AECON JV	West Annex Building - Work Area Below 100 -2 - Mechanical	5 - Construction	$7,692,749	$7,733,616	$1,954,701	$9,688,317
3155550431	P&M SNC/AECON JV	West Annex Building - Work Area Below 100 -2 - Electrical and I&C	5 - Construction	$2,627,404	$997,180	$2,157,305	$3,154,485
3155550432	P&M SNC/AECON JV	West Annex Building - Work Area Below 100-3 - Civil / Structural	5 - Construction	$1,255,098	$1,054,438	$302,164	$1,356,602
3155550433	P&M SNC/AECON JV	West Annex Building - Work Area Below 100-3 - Mechanical	5 - Construction	$5,633,526	$6,402,903	$2,837,650	$9,240,553
3155550434	P&M SNC/AECON JV	West Annex Building - Work Area Below 100-3 - Electrical and I&C	5 - Construction	$1,343,046	$587,798	$1,272,515	$1,860,313
3155550435	P&M SNC/AECON JV	West Annex Building - Slab 100	5 - Construction	$1,682,917	$518,467	$0	$518,467
3155550501	P&M SNC/AECON JV	Work Area Elevation 100 - Civil / Structural - Structural Steel / Concrete	5 - Construction	$2,567,263	$1,492,355	$315,777	$1,808,132
3155550502	P&M SNC/AECON JV	Work Area Elevation 100 - Civil / Structural - Finishes	5 - Construction	$500,000	$103,424	$72,504	$175,928
3155550503	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 100 - Mechanical	5 - Construction	$3,504,142	$292,628	$4,129,745	$4,422,373
3155550504	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 100 - Electrical and I&C	5 - Construction	$2,557,622	$588,467	$2,632,195	$3,220,662
3155550601	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 107 - Structural Steel / Concrete	5 - Construction	$2,633,123	$1,284,260	$107,021	$1,391,281
3155550602	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 107 - Finishes	5 - Construction	$650,000	$96,932	$101,829	$198,761
3155550603	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 107 - Mechanical	5 - Construction	$3,259,177	$297,390	$4,420,741	$4,718,131
3155550604	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 107 - Electrical and I&C	5 - Construction	$3,047,965	$714,236	$3,775,872	$4,490,108
3155550701	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 115 - Civil / Structural	5 - Construction	$1,184,611	$3,366	$890,986	$894,352
3155550702	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 115 - Mechanical	5 - Construction	$289,536	$298,412	$1,011,479	$1,309,891
3155550703	P&M SNC/AECON JV	West Annex Building - Work Area Elevation 115 - Electrical and I&C	5 - Construction	$13,750	$0	$270,763	$270,763

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,833,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**
3155550801	P&M SNC/AECON JV	Building Envelope - West Elevation	5 - Construction	$479,167	$0	$479,167	$479,167
3155550802	P&M SNC/AECON JV	Building Envelope - North Elevation	5 - Construction	$239,583	$0	$239,583	$239,583
3155550803	P&M SNC/AECON JV	Building Envelope - East Elevation	5 - Construction	$479,167	$0	$479,167	$479,167
3155550804	P&M SNC/AECON JV	Building Envelope - South Elevation	5 - Construction	$239,583	$0	$239,583	$239,583
3155550901	P&M SNC/AECON JV	Exterior Works - Civil / Structural	5 - Construction	$1,122,634	$36,832	$163,231	$200,063
3155550902	P&M SNC/AECON JV	Exterior Works - Mechanical	5 - Construction	$219,695	$21,232	$24,178	$45,410
3155550903	P&M SNC/AECON JV	Exterior Works - Electrical And I&C	5 - Construction	$1,627,675	$2,358,004	$780,280	$3,138,284
3155551001	P&M Ellis Don	ED - Mud Slab Anchoring	5 - Construction	$0	$0	$0	$0
3155551002	P&M Ellis Don	ED Dyke Construction - 1st Lift	5 - Construction	$0	$0	$0	$0
3155551003	P&M Ellis Don	ED Dyke Construction - 2nd Lift	5 - Construction	$0	$0	$0	$0
3155551006	P&M Ellis Don	ED Dyke Construction - Topping Slab & Anchor Bolts	5 - Construction	$0	$0	$0	$0
3155551009	P&M Ellis Don	ED Dyke Construction Basement Slab Waterproofing	5 - Construction	$0	$0	$0	$0
3155551010	P&M Ellis Don	Ellis Don PMT & Other	5 - Construction	$0	$0	$0	$0
3155551011	P&M Ellis Don	Ellis Don Tiebacks and Excavation	5 - Construction	$0	$0	$0	$0
3155551013	ESFOX Under PM	ES Fox - Dyke Support Services (237909)	5 - Construction	$0	($30,757)	$0	($30,757)
3155552001	P&M SNC/AECON JV	NEW EPC CONSTRUCTION	5 - Construction	$0	$0	$0	$0
3155552088	P&M SNC/AECON JV	NEW EPC VENDOR INDIRECTS	5 - Construction	$0	$0	$0	$0
3155552089	P&M SNC/AECON JV	NEW EPC VENDOR CORE TEAM/OH/PROFIT	5 - Construction	$0	$0	$0	$0
3155560202	P&M SNC/AECON JV	Commissioning - Commissioning and Close Out Activities ** (Engineering Support Only)	6 - Commissioning	$526,948	$0	$2,107,792	$2,107,792
3155560401	Vendors Managed by Projects and Mods	OPG Commissioning Phase III	6 - Commissioning	$621,341	$82,249	$450,560	$532,809
3155590301	P&M Legacy	Administration of Project Financial Close Out	9 - Close-Out	$0	$0	$0	$0
3155590402	P&M Legacy	EPC Contract - Close out the Contract	9 - Close-Out	$373,607	$373,607	$0	$373,607
3155590611	P&M Ellis Don	Ellis Don Fuel Costs	9 - Close-Out	$0	$0	$0	$0
31555uanll	P&M SNC/AECON JV	31555 Unallocated Costs	u - Unallocated Costs	$0	$6,222,872	$14,560,954	$20,783,826

Notes:

Unallocated Cost includes some engineered equipment, small tools and consumables, LOA, non EPSCA expenses, indirect labour, EPSCA expenses, EPSCA training, other services.

Actuals include month of December 2016.

Based on the schedule as January 6, 2017

Project 31555 "D2O Storage Facility" Cost at Completion Projection

Data Date: End of Dec 2016

				$381,173,529	$340,895,838	$92,937,364	$238,833,202
WP	**Work Organization**	**Name**	**PIEPCCC**	**CB**	**AC**	**Projected ETC**	**Projected EAC**

Interest updated based on the new projection.

P&M OPG numbers not updated.

There is no contingency allowance in EAC. The contingency carried in CB has been deducted from EAC.

Darlington Refurbishment

Oversight Report

Solutions for Managing Project Risk

August 13, 2013

Primary Conclusions

In our *Project Assessment of the Darlington Nuclear Refurbishment Project*, BMcD/Modus has found that the DR Project is appropriately advanced at this stage, with processes and procedures that comport with industry standards. The DR Project is also benefitting from:

- Scope Rationalization – Current efforts to right-size the Project's scope are occurring at an appropriate time and are necessary to remove stress from Engineering.

- Schedule – The schedule embedded in the 2014 Business Plan's revised planning assumptions appears to be reasonably calculated at reducing the Project's overall risk and likelihood for success.

The Project Team has an intense effort ahead and there is still an enormous amount of work to be done over the next year – both in planning and field execution (Campus and Outage Work) that will require significant focus, coordination and effort.

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Major Recommendations

Scope and Schedule Optimization

- The DR Project's Scope needs to meet OPG's core commitments; process needs to be in place for life-cycle management and non-core scope removed from DR Project.
- Potential risks / opportunities related to revised schedule assumptions need thorough vetting.
- Scope optimization should be completed as soon as practicable to avoid unnecessary work and allow maximum time for planning of needed scope.

Re-tube and Feeder Replacement (RFR)

- The next phase of estimating will shift from OPEX based on Wolsong/Lepreau to SNC/Aecon's specific plan for the DR Project – need more project-focused information to increase confidence in plan/estimate.
- DR Team should seek/obtain increased transparency from SNC/Aecon regarding risks, contingency and schedule/work flow to obtain best achievable schedule in Class 3 submissions.
- OPG and SNC/Aecon need to clarify requirements for project controls and reporting.

Balance of Plant (BOP)

- Begin detailed design as soon as practicable to improve likelihood of mature cost estimate at RQE.
- Consider changing the procurement model to assign smaller bundles of work to the ESMSA contractors under existing terms and conditions.
- Provide more visibility to potential budget/schedule risks from upcoming scope defining inspections.

Major Recommendations

Campus Plan

- Significant management focus will be needed due to size, breadth and schedule urgency of Campus Plan work.
- Apply OPEX from D20 Storage Facility regarding upfront planning, schedule development, procurement and engineering and performance of ESMSA Vendors.
- Eliminate unnecessary projects from the program.

Engineering

- Improve metrics for engineering to provide management with comprehensive view of progress.
- Progress work to detailed design as expeditiously as possible, including shoulder-to-shoulder work between OSS and EPC vendors.
- Prepare organization for oversight of detailed design and multiple review cycles.

Budget and Schedule Development

- The 2014 Business Plan methodology will suffice for the Project's current level of maturity; however, we recommend that next year's 2015 Business Plan should be a full-program reforecast.
- Adherence to processes and procedures for developing cost estimates will assist management in understanding nature and risks of cost estimates.
- The current Level 2 Coordination & Control Schedule ultimately needs to merge into a single detailed Level 3 schedule for the Execution Phase.

Recommendations – Functional Groups

Project Management

- OPG's roles as (1) integrator and manager of a multi-prime project and (2) Design Authority need to be better understood by the Project Team.
- Break down silos and move toward managing as a Program rather than 7 independent projects.
- Right-size the Project Team and processes to incorporate and embrace OPG's oversight role on the Project.
- Build-up and involve construction team as early as possible.
- Clarify reporting lines of authority for matrixed Project Controls personnel to assert P&C's independence from Projects.

Risk Management

- Risk collection and identification needs significant vetting to eliminate management concerns and appropriate score/evaluate risks.
- Raise level of importance within the DR Team by creating a separate, risk-focused functional group with a dedicated leader and a formal training program.

Recommendations—Major Projects

Turbine Generator

- Continue vetting of options for Turbine Generator work schedule and scope
- Increase focus on risk identification

OPG Critical Path Work

- Review and vet schedule activities and look for risk/opportunities.
- Continue improvements to Fuel Handling system prior to start of DR Project .
- Continue Site Integration efforts.
- Review OPEX from upcoming unit outage.

Next Steps – 3Q 2013

Functional Groups

- Engineering – review of quality program and organizational changes.
- Project Management – Organizational review of the Project Team's needed resources/capabilities.
- Commercial Management – continue review of commercial options for multiple scopes.

Project Controls

- Vet 2014 Business Plan.
- Review schedule and earned value development.
- Ongoing review of Risk Management Program.

Major Projects

- RFR - Review plan based on OPEX from Wolsong, etc.; Review portions of estimate and contingency as available; Review commercial options.
- Balance of Plant – review progress/options for improving schedule.
- Campus Plan – review status, progress and potential OPEX.
- OPG Critical Path – vet Project Team's analysis; review of Outage performance.

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Initial Project Assessment

Darlington Nuclear Refurbishment Project

ONTARIO POWER GENERATION

Burns & McDonnell
Modus Strategic Solutions

August 13, 2013

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1. Executive Summary

On February 25, 2013 Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") were retained by Ontario Power Generation ("OPG") to provide External Oversight of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project"). As part of our services, BMcD/Modus provides the following Project Assessment of the DR Project in which we examine the DR Project's current status; evaluate the methodology the DR Project team ("DR Team") is employing for planning and executing the work; review and assess the DR Project's risks and challenges; and, provide certain recommendations where applicable for the DR Team and OPG's management to consider.

The DR Project is a complex undertaking for any utility. Fortunately, OPG is positioned to be the beneficiary of lessons learned from a number of critical past projects, most notably the Pickering A Unit 4/1 Return to Service ("PARTS"), as well as the prior CANDU life extension refurbishments that have been executed at Bruce Power, Point Lepreau and Wolsong. In fact, Wolsong provides the reference plant that is being utilized by the SNC-Lavalin Nuclear, Inc./AECON Construction Group, Inc. Joint Venture ("SNC/Aecon") for purposes of formulating its estimate for the retube and feeder replacement ("RFR") work. For these reasons, BMcD/Modus has focused significant attention in this Independent Project Assessment ("Project Assessment") on the DR Team's incorporation of appropriate lessons learned and operational experience ("OPEX") into the DR Project's plan. In any event, the DR Project has many "first of a kind" aspects which must be taken into account in the planning and execution phases.

Based on our observations to date, BMcD/Modus believes the DR Project is appropriately advanced at this time to support its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015. However, the DR Team needs to effectively and efficiently manage a number of significant risks in order to achieve the necessary level of definition and project maturity required for the RQE.

The following is a brief summary of our observations regarding the DR Project's current and most significant challenges and risks.

- **Project Management Roles, Responsibilities and Readiness:** Thus far in the DR Project's development, the team has been working on developing the component projects (RFR, Turbine Generator, Balance of Plant and the like) as separate, individual projects. This approach is appropriate during the planning phase in order to ready each Project Bundle for execution. However, the challenge for the DR Team will be to shift from the "silo" mentality to operating as an integrated Project. Moreover, the choice of using a significantly different project delivery method (multiple Engineer, Procure and Construct ("EPC") contractors) than OPG has utilized on past capital projects means the DR Team has to define the processes, level of staffing and qualifications necessary for effectively managing the work.

  The DR Team may experience some challenges in integrating and operating as a single, integrated, oversight management team. In our experience, the DR Team's current growing pains are commonly experienced by owners who engage in large EPC contracts for the first time. OPG's oversight of the Detailed Engineering and Planning & Assessing phases pose perhaps the most significant near-term risks, as these functions have typically been performed in-house by OPG on past projects. Moreover, OPG's most vital role during the Execution Phase will be to manage and coordinate the work of the multiple EPC contractors, a condition that typically provides a ready

source of change orders, delays and commercial disputes on projects of this type. Now that the scoping work is nearly complete, the challenge for the DR Team will be to migrate toward integration of the work into one unified Program—and such integration should occur as soon as possible.

The DR Team also needs to ensure that it has individuals with the expertise to manage the Execution Phase. Thus the DR Team should be looking to add those individuals who will be responsible for the construction of the DR Project sooner rather than later and integrate them into the Project planning process. It is important that the DR Team require the EPC Contractors do this as well.

- **Scope Definition and Budget/Schedule Status:** On March 5, 2010, Management identified the following DR Project's goals to the Board: (1) replacement of life-limiting components (such as pressure tubes) to allow OPG to operate the units for an additional 30 years, and; (2) replacement of components most effectively done in an extended outage.[1] Management assured the OPG Board of Directors Nuclear Oversight Committee ("NOC") that the DR Project had processes in place to control scope growth via the Project's Scope Review Board, which will "ensure that appropriate reviews (technical and financial) are being performed to ensure that scope is appropriate and minimized to the extent feasible to avoid increasing the complexity of the project and impacting the project's critical path."[2]

  The DR Project's scope was derived from a deliberate process that included review of over 1400 separate Darlington Scope Requests ("DSRs") that were generated primarily by the Station and Project Engineering. These DSRs were reviewed and vetted, and ultimately were presented to the Project's Scope Review Board for disposition. The Project Team was mindful of OPEX from PARTS and intentionally took an expansive view of project scope, with the later intention of reducing that scope through a series of critical challenges, all of which were anticipated by the DR Project's processes.

  In 2009, the DR Project's point estimate was $7.724 B with a publically-announced range of $6B to $10B.[3] The DR Project's most current budget assessment, the 2013 Business Plan (as of 3rd Quarter 2012), identified a projected Project cost of $9.273 B, reflecting growth of $1.548 B, or 20%.[4] Direct work scope considerations within the Project's bundles accounted for $421 M of this growth although the largest overall cost growth contributor is OPG's indirect management costs, which increased by $626 M, or 72% over the 2009 budget. A driver for the increase in overhead cost was a decision by OPG to have the DR Project carry the costs for the Operations & Maintenance workers associated with the units being refurbished for the duration of the DR Project. In addition, there has been some ongoing internal debate regarding the scope of the DR Project in light of the Station's high standing with WANO, which may has driven some of the desire to increase scope.

  Coinciding with the start of BMcD/Modus's engagement and changes in the DR Project's executive leadership, the DR Team recognized that the velocity of the scope additions and other management costs had the potential to adversely impact the DR Team's ability to execute the Project within the

[1] Update on Darlington Refurbishment Project (March 5, 2010) at p. 1 ("Background").
[2] Update on Darlington Refurbishment Project (May 18, 2010) at p. 2.
[3] DGNS Refurbishment Estimate Analysis (April 25, 2013) at p. 3.
[4] *Id.*

anticipated schedule and budget estimates. Key members of the DR Team were assigned to revisit the DR Project's approved scope with the intent of optimizing the Project's size. These reviews are ongoing at this time with decisions by the Scope Review Board and executive management pending. This "scrubbing" of the scope is timely, appropriate and necessary, and should result in greater confidence in the execution schedule and overall project costs. However, the DR Team must also take appropriate care to ensure that items not included in the Project's scope but are nevertheless needed (in some manner) for the DNGS stations' future operation and performance are captured in future O&M and Capital planning and are not dropped. Moreover, the DR Team must take a critical look at the Project's indirect costs in order to ensure that the associated management team has the proper skill-sets and is right-sized for its role on the Project.

The DR Team is also preparing different planning scenarios intended to achieve greater schedule certainty with less overall risk. The DR Team has adopted new planning assumptions for the 2014 Business Plan budget forecast that model elimination of the scheduled overlap of the execution phase of each unit, and in particular, isolating the performance of Unit 2. Given the past history of CANDU mid-life refurbishments, this appears to be a reasonable strategic decision.

- **Engineering Status:** Engineering for the RFR and Turbine Generator Projects are under EPC contracts that are each advancing with the contractors performing the detailed design work. The remainder of the engineering effort is currently focused on developing the requirements needed for procuring the rest of the DR Project's scope, and in particular, the Balance of Plant ("BOP"). In order for the RQE to be reliable, detailed engineering must be sufficiently progressed by the 2nd Quarter of 2015 for the DR Team to develop Class 2 cost estimates (cost estimates that are deemed to meet the criterion of the Association for the Advancement of Cost Engineering ("AACE") cost estimating standards).[5] Per the AACE standards[6], to achieve a high quality Class 2 Estimate, detailed engineering needs to be between 30% and 75% complete overall in order to realistically determine contingency. The DR Team is mindful of the need to complete sufficient detailed engineering and Planning & Assessing prior to RQE. This goal will require significant work and some changes to procurement method, as discussed below.

  The DR Project is currently developing engineering packages known as Modification Design Packages ("MDPs") for work not yet contracted (mostly for BOP work) that are precursors to detailed design. OPG has contracted with two external Owner Support Services ("OSS") vendors, AMEC and WorleyParsons, to augment its staff and develop the MDPs. OPG's engineering team has recognized the potential schedule problems and is attempting to expedite and optimize the efficiency of the MDP preparations as well as start the EPC contractors on detailed design packages. Additional modifications to the procurement process, such as earlier releases of smaller scoping packages, will be required to optimize the schedule and accelerate the beginning of detailed engineering.

  As a part of its initial assessment of the DR Project's engineering capabilities, BMcD/Modus has also reviewed: the structure and depth of the OPG engineering organization; processes and procedures;

[5] AACE Class estimates, Class 5 through Class 2, are referred to herein as the "Class X Estimate".

[6] AACE International Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) at p. 2; AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011) at p.2.

metrics for tracking work; and proposed methods for managing the OSS vendors. We have provided some comments and observations directly to the DR Engineering Team regarding optimizing the work flows and the development of Project metrics, and we have witnessed some improvements since the start of our engagement. There has been proper management focus on the issues that are unique to engineering. We will continue to monitor this critical work from a program management perspective as the engineering functions migrate from supporting procurement to project execution.

- **Project Controls:** The primary and associated subset of controls that the DR Team is establishing for tracking the planning and execution of the work are each in various stages of development. The following is a brief summary of the primary performance measurement tools the DR Team is currently developing:
    - Budget Development: The DR Team has a reasonably detailed game plan developed for achieving RQE and is generally following that plan. The current operative budget (2013 Business Plan) was developed on the basis of embryonic project definition and the range of uncertainty associated with that estimate was at no better than Class 5 level. The DR Team is currently in the process of developing its 2014 Business Plan, which is due to be released in the 4th Quarter 2013. There are a number of moving parts that could influence cost and schedule development over the next several months, including final determination of scope, optimization of the contracting strategy, the potential "unlapping" of Unit 2, staffing needs, and the like. The Project Controls Team is attempting to increase the level of rigor in the 2014 Business Plan development and this is a work in progress. We would expect the team to significantly ramp-up the level and quality of effort in conjunction with next year's 2015 Business Plan, as more knowledge about the Project develops. Ramping up the effort will provide higher confidence in the Project prior to RQE.
    - Project Schedule Development and Methodology: The OPG Project Controls team has developed a "Coordination & Control Schedule" ("C&C Schedule") that tracks the schedule activities at a milestone-based level. Although this tool should be sufficient for the Definition Phase, it is our understanding that the current process indicates that the C&C Schedule will be used through the completion of the Project. We believe that the C&C Schedule may prove to be too cumbersome once the Project moves to the Execution Phase. It is our opinion that the DR Project will ultimately be best served by a single, integrated Level 3 schedule that includes all activities for daily, weekly and monthly project management.
    - Cost and Earned Value Tracking: The DR Project is establishing new systems for tracking and projecting costs as well as tracking earned value (Proliance). The Project Controls Team planned to have these systems in place by spring of 2013 but implementation has proven more difficult than initially planned. In our experience, implementing such systems is frequently problematic, and OPG is doing so at a time when the DR Project is rapidly maturing. Until Proliance is functioning, the DR Team will continue to utilize manually-based controls for tracking costs. BMcD/Modus will continue to monitor the development of these systems and provide input and observations in regard to selected and reasonable "dipstick" checks concerning data fidelity and the like.

- Risk Management. The DR Team is in the process of improving its risk management program. The existing program with some contemplated modifications is generally consistent with what we have seen in the industry at-large. The Project's risk database has been populated by the individual Project and Functional groups and the DR Team has established certain forums (i.e. the Risk Oversight Committee) for evaluating related inputs. However, while the work to date represents a good start, there is significant development work remaining for the DR Team so as to be in a position to ultimately and reasonably address risk and risk mitigation:
    - Risk identification and associated scoring needs to be consistent on how individual risks are identified, evaluated, mitigated and monetized;
    - Per OPG internal procedures,[7] project contingency is to be based in large part on the project risk register. Therefore, it is critical that the risk team properly manage the risk register so as to ensure contingency is properly quantified;
    - The risk database is currently populated with large numbers of items that within the industry at large would ordinarily be viewed as management concerns as opposed to innate risks associated with the work;
    - The RADAR system that the DR Team uses to collect risks is cumbersome and does not interface with other databases—efforts to streamline the above have been very slow;
    - There needs to be some focus on the identification of potential "opportunities" that can be managed within the Risk Program.
    - Management should review its staffing and leadership of the Risk team to ensure that an effective, world class, sufficiently staffed and properly experienced team is in place.
- Electronic Data Management System ("EDMS"): Similar to Proliance, development of the EDMS is lagging behind the DR Team's intended implementation schedule. This, too, is not unexpected, but nevertheless must be cured as soon as possible. The EDMS is supposed to be available in the 3rd Quarter 2013. This system is a critical tool for managing the work of the contractors on-site and dealing with the considerable volume of information that is typically generated by a project of this magnitude.

Going-forward, BMcD/Modus recommends OPG consider re-unifying the Project Controls team under one umbrella. In order to maintain the necessary independence, Project Controls personnel should have a direct and singular reporting line to a central Director, and that individual should report directly to the SVP of Darlington Refurbishment.

- **Commercial Development**: OPG has entered into an EPC contract for the Definition Phase of the RFR Project (this includes Project Planning, construction of the Mock-Up facility, and engineering of the Tooling), Engineering and Supply of the Turbine Generator equipment, and intends to enter into several more EPC contracts for much of the remaining work. OPG's intended methodology for contracting the work is one that shifts certain performance risks to multiple EPC vendors for

[7] Nuclear Refurbishment Contingency Development and Management, N-MAN-00120-10001-RISK-05-R000 (July 19, 2012) at p. 4.

individual scopes of work that nonetheless leaves OPG as the overall manager and coordinator of these multiple EPCs. There are no contractual terms that serve to relieve all of the owner's risk, and no contractual penalties intent on causing contractors pain for a failed project that can ever fully compensate an owner for the consequences of such failure. As a result, the DR Team needs to embrace the proactive management of the contractors, which requires the team to effectively and transparently engage the contractors and hold them accountable for their performance, and to manage the interfaces between the various contractors so as to minimize potential disruption, all on an active nuclear site. While OPG has in place a good oversight plan, the key will be the actual execution. As a result, this item bears continuing and close monitoring.

- **Retube and Reactor Feeder Replacement**: The DR Team has devoted significant focus and financial investment in the RFR work, which comprises the DR Project's single-most important evolution and its most significant risk. The commercial agreement with SNC/Aecon establishes a methodology for developing a high-confidence performance schedule and cost estimate for the RFR work's performance that anticipates the submission and acceptance of four iterations of the Project's cost estimate, each with an increasing level of detail and certainty. The first two (Class 4 and 5 estimates) iterations focused on developing a Basis of Estimate that considers OPEX from prior refurbishment projects, and establishes Wolsong as its reference plant in regard to establishing work durations and sequencing. The remaining cost estimate iterations (Class 3 and 2 Estimates) will focus on SNC/Aecon's estimate specifically for Darlington. The Class 3 Estimate is intended to reflect SNC/Aecon's detailed work packages for the DR Project and the Class 2 Estimate will represent the final target price agreement with all risk/reward contingency identified.

  However, progress to date in adequately preparing and vetting the RFR estimates has been mixed.

  - SNC/Aecon's Class 5 Estimate approval was delayed by 6 months due to an apparent miscommunication between SNC/Aecon and OPG's RFR team. The team worked to recover the time lost by advancing the successor Class 4 Estimate, which OPG approved 1 month early on March 21, 2013. From our review of SNC/Aecon's Class 4 Estimate, it appears that the team has optimized the estimate of an as-built reference plant. However, the current estimate does not reveal significant improvements or maturity related to the quality of costs carried in the Class 4 Estimate as compared to that in the Class 5 Estimate upon which it was based.
  - Moreover, the current RFR Class 4 Estimate is not commensurate with AACE's Standards of Practice. In some ways, the RFR Class 4 Estimate exceeds what is normally considered at Class 4 although the RFR Class 4 does not account for the DR Project's engineering definition or contingency. Per its contract with OPG, SNC/Aecon is not required to monetize risk until it prepares and submits the Class 2 cost iteration in May 2015. As a result, until RQE is derived, the overall DR Project cost estimate's largest component is progressing on a separate definition path which is not best practice in nature.

  Significant work remains for SNC/Aecon to complete its work plan and associated cost estimate so as to meet the DR Project's standards. Additionally, there is very little room for lost time in the development of the Class 3 Estimate. The DR Team is advised to consider revisiting the method of identifying and monetizing RFR's risks as the overall cost estimate progresses so as to increase confidence in SNC/Aecon's cost estimate and reduce the potential for last-minute surprises emanating from the contractor.

- **Balance of Plant:** The work that comprises the DR Project's BOP scope is varied and split roughly in half between NSSS and conventional plant work. As of the 2013 Business Plan, this scope consists of ~200 DSRs that have been estimated to cost approximately $503M. These include Core Scope, Non-Core Scope and all contingent items. By its nature, BOP work carries significant risk because it includes work on multiple systems in myriad locations and requires a wide range of craft workers. BOP work coordination is frequently a significant management challenge on a refurbishment project such as this one.

From the outset of our engagement, we have been concerned that the DR Team's intended plan for procuring the BOP was time-challenged, had too many different and unnecessary steps, and could ultimately over-complicate the DR Project if the scope and scale were not right-sized. As noted, Engineering, with the help of seconded staff from the OSS vendors, is developing MDRs for procurement of the BOP work. The DR Team's original plan was to package-up the MDRs into two large bundles (NSSS and Conventional) and put those out for bid between the two Extended Services Master Services Agreement ("ESMSA") vendors, ES Fox and Black & McDonald. Because of the pace of the MDR preparation, these bundles would not be aggregated for this bidding process until well into 2014. As a result, the vendors could not start detailed design and preparation of construction work packages to complete this work in time for OPG to develop a mature, detailed Class 2 Estimate relating to BOP cost in time for derivation of the RQE. The consequence of this would be that the RQE would either be late, or would be of a lower-quality than promised, with the cost estimates, schedules and execution plans for the work having less certainty. This in turn would, obviously, require greater contingency and present significant risk to the actual execution of the work.

The DR Team's leadership is currently examining an alternate method for procuring the BOP work. Since the ESMSA vendors' contracts have already been procured under a competitive process and each is qualified for the work, competitively bidding this work would likely not yield a significant price difference and would, in our view, cost the Project 6-12 months of valuable schedule time. The DR Team is investigating methods to flow work the to the ESMSA contractors in smaller packages, in order to eliminate the time originally planned for bundling these packages together and for procurement, bid evaluation, selection and contract negotiation. This would allow the ESMSA vendors to get started now on detailed design instead of waiting until 2014. The DR Team is also looking at practical ways to integrate the ESMSA's design partners in the process as early as possible in order to begin detailed design. Our experience shows that this is the most prudent approach to the BOP work on a project of this type.

Finally, the team is evaluating the current BOP scope review to ensure that what is included in the DR Project meets the intent of the DR Team's commitments, and will be eliminating certain work that does not have to be performed in the DR Project. Each of these measures will help get BOP on track, and all of the above will be needed so as to keep the BOP detailed design off the critical path and improve the chance that the team will have a solid plan and estimate for BOP work in time for adoption of the RQE. In our experience, the method of releasing smaller bundles of BOP work as they become ready is the most prudent and effective means of reducing the risks inherent with BOP work, and in this case, because the ESMSA agreements are in place, would likely be the lowest cost option due to the schedule savings and risk avoidance.

- **OPG Critical Path Activities:** OPG is responsible for planning, directing and executing the work leading up to and after the completion of the RFR work. During the Vault Preparation period (from breaker open to the start of SNC/Aecon's work), OPG is responsible for defuelling and draining all of the systems, and OPG regains the lead in critical path activities in the start-up and commissioning phases. In all, the DR Team estimates that OPG will control the critical path 25% of the time (243 of 968 total days) of the breaker-to-breaker unit duration[8]. Many of the work items in OPG's scope have been performed before; however, some of the work, like defuelling, have never been performed at DNGS or by OPG and will be on the critical path. In addition, DNGS has unique challenges due to the fact the fueling machines that are needed to support the DR Project are also needed to maintain operations of the operating units. The DR Team is very aware of these risks and has made adjustments to the plan, most notably with refurbishment of the fueling machines prior to the opening of the Unit 2 breaker. The team is planning to continue to refine its schedule and sequence of events.

II. Work Plan And Methodology

In accordance with Schedule 1.1(x) - Scope of Services to the Agreement between Ontario Power Generation ("OPG") and BMcD/Modus for Independent External Oversight Services for the DR Project dated February 25, 2013 (the "Agreement"), BMcD/Modus has developed a recommended Work Plan for the term of its two-year engagement. This plan was presented to the Nuclear Oversight Committee on May 14, 2013. At that time, BMcD/Modus was given authority to proceed with the development of an Initial Project Assessment of the DR Project. BMcD/Modus's Project Assessment is intended to address significant aspects of the DR Project planning and set-up and provide a status baseline as of the time of the report that BMcD/Modus will use to measure the DR Team's progress in future reports. This report will provide the results of our Project Assessment.

In order to develop our Project Assessment, BMcD/Modus has reviewed key project documents, interviewed OPG's key personnel and attended regular and special meetings, including the following:

- **Project Planning**: BMcD/Modus has embedded within the DR Team and has:
  - Attended both regular and special meetings with the DR Team to determine status of project's planning, development and integration of processes and tools, schedule development, contracting strategy and assess prominent risks specific to each project;
  - Reviewed key planning materials and summaries.
- **Processes and Procedures:** We have reviewed the Project Execution Plan and associated Project Management Processes and Procedures regarding their application to the DR Project and how they would be viewed in light of industry best practices.
- **Engineering: BMcD/Modus attended and initiated meetings with the Engineering team to determine their approach, status, standards and plan for completing both short term (procurement focused activities) and long term (support of the Execution Phase). In addition, BMcD/Modus:**
  - Assessed the DR Team's methods for tracking and documenting the status of critical design evolutions to ensure that selected metrics are providing an accurate gauge of engineering progress;

[8] DNGS RFR – Execution Phase Estimate Progression (June 21, 2013).

- Reviewed metrics for tracking engineering deliverables;
- Reviewed management of external OSS vendors;
- Provided suggestions, as necessary, to streamline the management of engineering, planning, assessing and procurement;
- Evaluated whether the DR Team has actually incorporated lessons learned and OPEX into its project scope, and suggest other lessons learned from our team's experience that may be applicable;
- Sampled general quality of engineering deliverables submitted by EPC Contractors and reviewed OPG's review and approval process;
- Reviewed the plan to complete detailed engineering supportive of the adoption date of the RQE, which is essential to reducing the potential vulnerability to changes in price and schedule during the Execution Phase.

- **Determined Status/Progress of Scoping Activities:** BMcD/Modus has reviewed the DR Team's process for tracking and maturing scope, including:
  - Reviewing the DR Team's activities and results of scope definition and reviews, including observing and vetting of Gate Review processes.
  - Sampling of work product to determine methodology for scope rationalization;
  - Review of key documents in support of project scope definition, including commitments to BOD and variance reporting.

- **<u>Reviewed and Assessed OPG's Cost Control Systems and the Program Budget</u>:**
  - Project Estimating
    - Reviewed and assessed the Gate Processes and related estimating of work orders;
    - Reviewed project estimating approach and sampled estimating work product from a form, format and process perspective;
    - Reviewed RFR vendor estimates for work for compliance to OPG's standards and best industry practices.
  - Reviewed and assessed the contracts, systems, processes and procedures the DR Team has in place for commercial conduct, including:
    - Change Management;
    - Notice and Notification of Changes in Scope;
    - Contract Change Orders;
    - Contract Payments.
  - Program Budget:
    - Reviewed the DR Team's processes and methodology for phased development of cost estimates and project schedule leading to the RQE.
    - Evaluated the DR Team's approach to preparing and maintaining the Baseline Schedule and Project Budget, and identified any approaches that might depart from industry-best practice and offer suggestions, as appropriate, regarding the tools and techniques that might be available to improve the overall process.
    - Reviewed and assessed the DR Team's current methodology for determining contingency for the Project.
    - Performed detailed review and vetting of aspects of the DR Project's 2013 Business Plan budget, including a "deep dive" into the details of the RFR Project's estimate.

- Assessed development of project earned value system (Proliance)

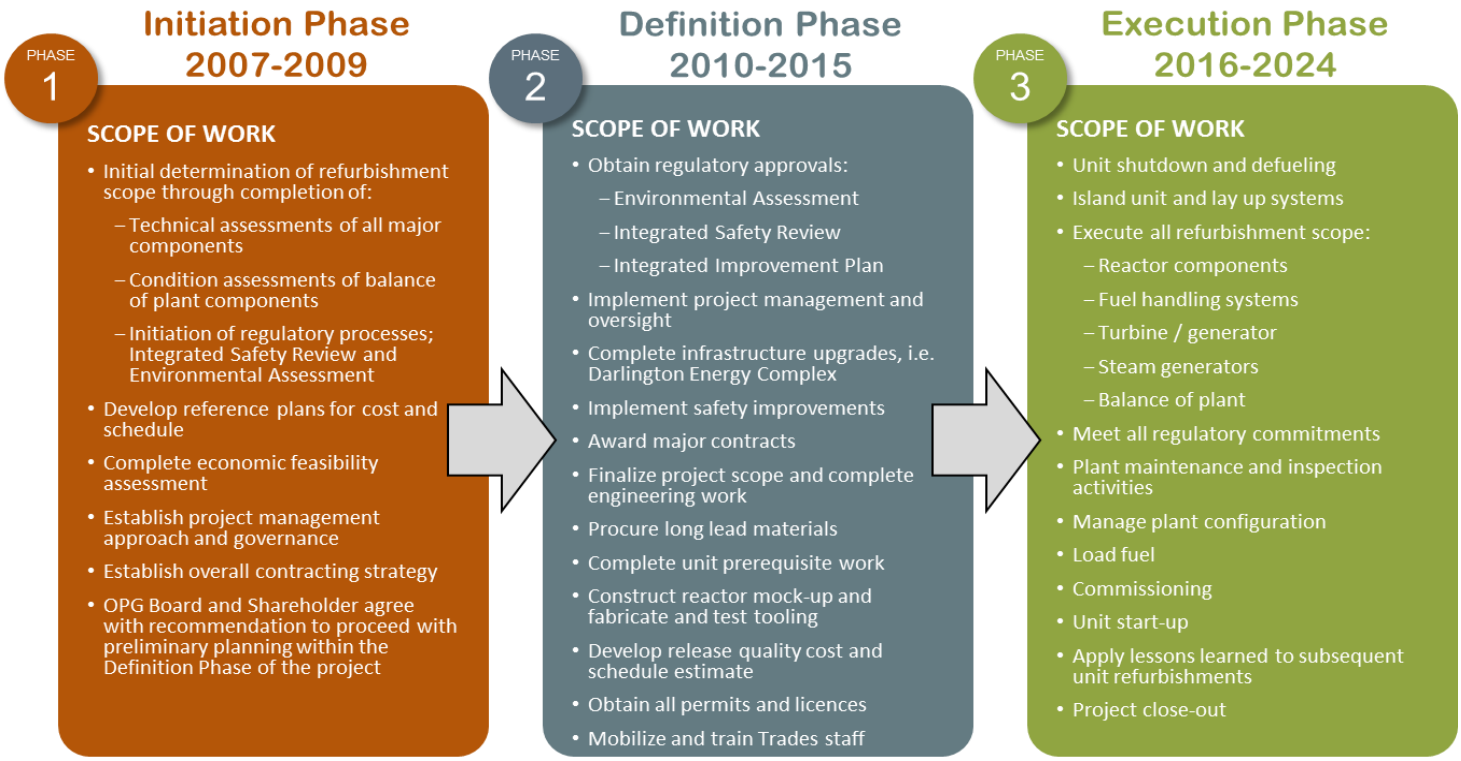
- **Schedule Assessment:** BMcD/Modus reviewed the DR Team's utilization of scheduling techniques and "rules" in order to evaluate whether there is:
  - Clarity of critical path(s) and sub-critical path(s) for monitoring performance;
  - Proper alignment within the cost system and documented support of the Project estimate;
  - Adherence to proper scheduling practices for integration of P6 enterprise schedule as well as contractors' submission of baseline and updates to the Project Schedule;
  - Proper schedule integration among all projects and subprojects.
  - Review of current status of the DR Team's C&C Schedule.
- **Organization**: BMcD/Modus has identified the risk associated with the role OPG is playing on the DR Project.
  - Reviewed and assessed OPG's ability to provide the appropriate level of project oversight to the Project's EPC contractors without directing the contractors' means, methods and procedures;
  - Reviewed the current and planned staffing levels and generally assessed the team's capabilities;
  - Assessed OPG's ongoing challenges in adapting to a construction project environment and utilizing an integrated P6 schedule instead of using Passport for work management.
- **Contracting Strategy and Contract Terms**:
  - Reviewed Commercial Strategy to determine whether OPG is proceeding on a reasonable path based upon industry experience and practice.
  - Reviewed the RFP process and recommend ways in which the RFP development process can be streamlined, particularly with the BOP Scope.
  - Reviewed Contracts as they are negotiated to determine if OPG has adequately assessed contracting risks.
  - Observed Gate process to identify how commercial risks are being presented and understanding process for allocation of budget/contingency.
- **OPEX and Risk Management:**
  - Assessed the DR Team's processes for establishing and updating the risk management system and reporting emanating from that system:
  - Risk scoring and identification;
  - Risk mitigation and avoidance strategies;
  - Related strategies for same;
  - Contingency development and,
  - Training of DR Team on use of Risk Management tools.
  - OPEX:
    - Reviewed timing and method of OPEX incorporation;
    - Determined whether OPEX is being reasonably incorporated during the planning stage of contractor work by OPG and contractors prior to RQE;
    - Inspected SNC/Aecon Plan on implementation OPEX.

Attachment "A" is listing of the documents BMcD/Modus reviewed in preparation of this Project Assessment.

III. Project Overview

A. Project History

The Darlington Nuclear units are currently predicted to reach their nominal end of service lives in 2019 to 2020. However, various factors from Darlington operations could result in the units reaching the end of life earlier or later than the present predictions indicate. In June 2006, the Ontario Government directed OPG to begin feasibility studies regarding the refurbishment of the Darlington Nuclear plants in order to extend their service lives. In late 2007, OPG commenced "Phase I" of the DR Project called the "Initiation Phase" in order to determine the preliminary scope of work for the Darlington Refurbishment project and to perform an economic feasibility assessment. Phase I was completed in 2009. OPG is currently in "Phase 2", or the "Definition Phase", which will continue until "Phase 3" called the "Execution Phase" begins in 2016. The three phases are detailed as follows:



Source: DR Project Team

OPG has chosen to manage the Darlington Refurbishment as a "Program". According to Project Management Institute ("PMI"), "A Program is a group of related projects managed in a coordinated manner to obtain benefits and control NOT available from managing them individually."[9] OPG's stated overall commercial strategy for the Program is premised on OPG acting as the General Contractor and Program Manager for the full Program. Within the Program, there are seven discrete Projects, each with its own project management team (including functions that are matrixed, such as engineers, commercial managers and project controls leads). The seven Projects (also known as "Project Bundles") encompass the following scopes of work:

- Retube and Feeder Replacement

[9] The Standard for Program Management, 2nd Ed.

- Islanding
- Fuel Handling/Defuelling
- Turbine Generator Maintenance and Controls Upgrade
- Boiler and Auxiliary Systems (Steam Generator Lancing)
- Shutdown, Layup and Services
- Balance of Plant

As of the date of this Project Assessment, the DR Team's major activities revolve around: (1) overseeing SNC/Aecon's development of the RFR Mock-up, detailed engineering and the Execution Phase plan and RQE project estimate; (2) completing procurement of the remaining scopes of work, including the BOP and Fuel Handling, which constitute a significant portion of the work; (3) identifying, and in some cases paring down, the scope of the work that will be performed within the DR Project; (4) preparing for the outages that will proceed the start of Unit 2's refurbishment; (5) developing the Project's schedule and budget for the RQE deadline. In this Project Assessment, BMcD/Modus has focused on these and other areas of risk.

B. Project Management Development

OPG's ability to successfully plan and execute the DR Project will be due in large part on the DR Team. Therefore, our Project Assessment must necessarily include some preliminary observations regarding the DR Team. As of the date of this Project Assessment, the DR Team has 233 individuals in the following areas[10]:

OPG Staff	**Headcount**
SVP – NR	2
Engineering	107
Planning & Controls	42
Management Systems Oversight	7
Execution and Construction Planning	41
Operations & Maintenance	34

In addition, there is ongoing involvement and assistance provided from the Projects & Modifications and Station organizations as well as staff from other business units (OBUs) that are matrixed into the DR Project. The DR Team has been established with the responsibility of assessing, making recommendations to OPG's Senior Management with respect to the feasibility of refurbishing the Darlington units, developing the scope, schedule and estimate for the Refurbishment Program, and providing overall program oversight on the execution of all activities associated with refurbishment, including:

- Assessing the technical feasibility of refurbishing Darlington and operating it for an additional 30 years of post-refurbishment operations;
- Making recommendations as to the lead time required to be prepared to refurbish each unit,
- Defining the refurbishment scope;

[10] Program Status Report for Period Ending June 2013 at p. 16.

- Executing project planning, including the development of contract management strategies, cost estimates, schedules, a full risk assessment, and a release quality estimate for the Project;
- Managing the refurbishment pre-outage planning and preparation activities;
- Provision of overall program oversight on all execution and commissioning activities; and
- Performing Project Closeout.[11]

The DR Team's focus to date has been on the planning of the DR Project. We recommend the DR Team accelerate its plans to staff its construction and execution organization and integrate those individuals into the DR Team. At this point in the Project's maturity (and in particular the RFR project), constructability reviews will be essential for further development of the Project's Schedule, comprehensive work packages and detailed engineering. Additionally, it is likely that changes will emerge based on the constructability reviews, and the longer the DR Team has to adjust, the better. Getting the right personnel involved with reviewing and developing plans and processes up-front can prevent most (but certainly not all) of the late, high impact issues. OPG needs to insist that the EPC contractors build their Execution Phase organization as well.

1. OPG's Oversight Role

OPG's current contracting strategy, which will be discussed in more detail below, is dependent on the use of several Engineer, Procure and Construct, or "EPC", contractors. OPG will take on the role of General Contractor and Program Manager, with the responsibility of contractor oversight and coordination. This is a risk laden role. This contracting strategy represents a considerable change in approach from OPG's prior Large Capital Projects. The following matrix identifies how this approach differs from OPG's approach to PARTS Unit 1:

Project Component	**Responsible Party**	
	PARTS Unit 1	**DR Project**
Scope Definition	OPG	OPG with assistance from external vendors
Procurement Engineering	OPG	OPG managing outside vendors
Detailed Engineering	OPG	EPC Contractors
Planning & Assessing	OPG	EPC Contractors
Construction	Contractors managed by OPG Construction Management	EPC Contractors with OPG as the Construction/Program Manager
Start-up and Commissioning	OPG	OPG

While the use of the EPC model for large capital projects is common in the industry at-large, it is more prevalent for owners to use a single contractor to perform all of the work. Here, OPG will have several EPC contractors performing discrete scopes of work that will require management and coordination by the DR Team. Furthermore, in our experience, the EPC model can have significant challenges for any organization. Our team has observed some of the typical growing pains on the DR Project that come with such a transition. It will require time for the DR Team to adapt to its roles and responsibilities under this new governance.

There is a "sweet spot" that all owners must find when engaged in EPC contracting for large capital expansion or refurbishing projects. Owners frequently assume that EPC contracts by their nature distribute all of the risk

[11] *See* Darlington Refurbishment Project Charter, D-PCH-09701-10000 R001 (June 15, 2009) at p.1.

to the contractors and therefore the owner proceeds to only passively engaged in the work. At the other extreme, there are owners who micromanage the work to the point that their invasiveness is tantamount to dictating means and methods to the contractors which usually ends in nothing short of disaster. Both of the above management styles have significant cost and schedule risks for owners, and generally lead to disappointing outcomes – finding the right balance is crucial. Additionally, the DR Project has an added layer of complexity since DR Team will be responsible for managing and coordinating several EPC contractors at the same time—all of which will be competing for the same space, labor and the owner's time and attention. The DR Team has recognized that its new "oversight" role will be a challenge and its performance in the Definition and Execution Phases will have to be carefully and continuously monitored. We will continue to review the DR Team's performance on this issue as more contracts are executed.

2. DR Team Leadership

Shortly after beginning our role on the Project in late February 2013, OPG announced that Albert Sweetnam, the EVP of the Refurbishment Project had left the company. Through May 2013, interim management of the Project was assumed by Wayne Robbins, the Chief Nuclear Officer. There were no other changes to the DR Team during this time. BMcD/Modus observed no measurable ill effects from the former EVP's departure.

In late May 2013, Bill Robinson rejoined the DR Project as the Sr. Vice President of Nuclear Projects after a short term as a project consultant. Robinson's experience includes: leading the rescue of the Pickering A Return to Service of Unit 4 from significant cost and schedule overruns; management of the successful PARTS Unit 1 Project; leading a seconded team from OPG at Point Lepreau; and early development of the DR Project. His leadership should prove beneficial in the planning stages of the DR Project.

Dietmar Reiner is currently the SVP of Nuclear Refurbishment. Mr. Reiner has an excellent grasp of the Project's strategy and accomplishments, and is keenly aware of the amount of work in front of the DR Team. He also appears to have the support of his team of direct reports and has instituted goals within the team related to transparency and effective communication.

3. Processes

The DR Team continues to develop and refine the management processes necessary for the Project, many of which are discussed herein. The DR Team has developed, and continues to develop a plethora of process and procedure documents and guidelines—perhaps too many. The risks of having too many processes include needlessly creating work (which requires more people that add cost) and conditions for non-adherence. Additionally, it is our observation that many of the procedures are not fully integrated (within a particular group itself or to other groups within the DR Project), with accurate annotations to reference documents. Currently, the DR Team does not have a matrix or even a complete list of all of the processes, procedures, standards, guidelines, manuals and the like that have been developed for the DR Project. The DR Team has recently embarked on cataloging and re-doing some of the procedures and this, presumably, may clear the air, correct what needs to be corrected and impart clarity to the remaining. The existing Management Systems Oversight group should be able to provide necessary support in this regard. Throughout this Project Assessment we will provide our view of the development of the Project management processes to date and their relative effectiveness, given the current status of the DR Project.

C. Scope Definition

An important early indicator of continued success is the DR Team's adaptability to right-size and control project scope in order to meet the commitments to the Board of Directors ("BOD"), the Shareholder and the

public. Between the years 2009 to 2012, the DR Project's overall budget has grown by ~$1.5B (2012 dollars) which is equivalent to ~20% of initial budget. The current point-estimate of ~$9.3B ($2012 dollars) in the 2013 Business Plan is approaching the upper boundary of the budgeted range of ~$10.8B ($2012) latest approved by the BOD. This total increase represents in large part scope growth of the DR Project. There are many reasons for this growth, including:

- OPEX, in particular from PARTS, which had significant cost overruns and schedule delays due to lack of scope definition at that project's outset has led the DR Team to conservatively identify a broad range of potential refurbishment scope;
- In the scope identification process, there appears to have been a tendency to increase scope to maintain the Station's WANO standing as well as over-commit to regulatory-driven modifications;
- As the scope of the Project has become more in-focus, the size of the Project Team has grown to match the effort represented;
- OPG decided to shift the OPS & Maintenance cost for each unit's operators to the DR Project while under refurbishment, which further added to the overhead costs.

The DR Team's SVPs have a firm understanding that, going forward, if scope is not effectively managed (and in some cases significantly reduced), OPG's management will be hard-pressed to deliver the DR Project at an acceptable cost. Below we discuss the progression of the DR Project's cost estimate, assess the current DR Team effort to examine and vet scope, and provide other recommendations for OPG to consider.

1. Budget and Scope History

BMcD/Modus's starting point in reviewing the DR Project's scope was to review the evolution of Management's representations to the BOD. The following summarizes the presentations that Management has given to the BOD regarding the evolution of the DR Project's budget and associated scope:

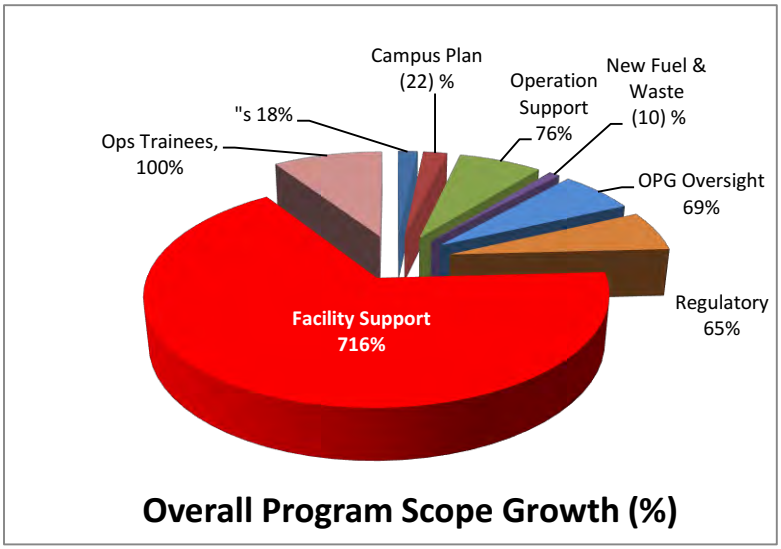
- On November 18, 2008, the BOD was presented an initial "medium confidence" cost estimate of ~$4.9B including a 20% contingency. At that time, the basis of the cost estimate included a 2007 Pickering B Assessment; industry studies; and considerations emanating from OPG's own operating experience (OPEX).[12]
- In year 2009, Rev 3 of the cost estimate was developed by the Project Control Team which totaled ~$7.7B[13].
- On March 5, 2010, Management committed to the BOD that the DR Project's scope would be limited to: (1) replace life-limiting components (such as pressure tubes) to allow OPG to operate the units for an additional 30 years, and; (2) replacement of components most effectively done in an extended outage. Management assured the NOC that the DR Project had processes in place to control scope growth via the Scope Review Board, which will "ensure that appropriate reviews (technical and financial) are being performed to ensure that scope is appropriate and minimized to the extent feasible to avoid increasing the complexity of the project and impacting the project's critical path."[14]

[12] Report for Submission to Nuclear Generation Projects Committee (November 18, 2008) at p. 8.
[13] Report for Submission to Nuclear Generation Projects Committee (November 17, 2009) at p. 1.
[14] Update on Darlington Refurbishment Project (March 5, 2010) at p. 1.

- On November 17, 2011, the BOD was presented with a cost estimate that was characterized as remaining in the range of ~$6.3B to ~$10.5B[15] Additionally, the DR Team's 2012 Business Plan estimate was ~$8.7B.
- On November 15, 2012 management presented its 2013 Business Plan cost estimate with a high confidence amount of ~$9.3B in 2012 dollars, thus including escalation, which remained less than $10B in 2009$. There were additional details and explanation of variances within the materials presented with the 2013 Business Plan.[16]

Based on files made available, variances and explanations of overall Program scope growth between 2009 and 2012 are summarized below:[17]

- Operations Support grew by $386M or 76% based on required human resource profile considerations, all as prepared by Operations and Maintenance Organization.
- OPG project management projections grew by $443M or 69% based on enhanced definitions and refined organizational characteristics of each department. Currently, the project management estimate is ~20% of total direct costs.
- Regulatory expenses grew by $71M or 65%, primarily due to CNSC fees.



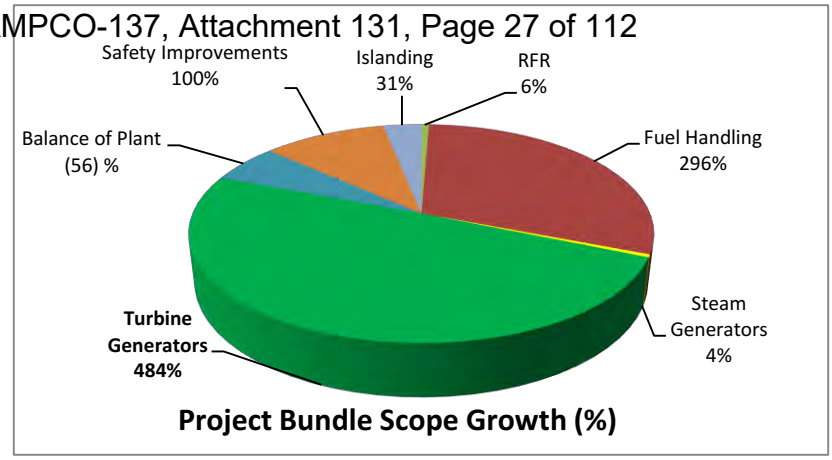
Overall Program Scope Growth (%)

- Facility Support grew by $86M or 716%. Projected costs were reflective of corporate real estate (CRED) support costs at the Darlington Energy Center (DEC) along with business trade union (BTU) costs to maintain site facilities.
- Operation Training grew by $27M or 100%.
- Project Bundles grew by $568M or 18% overall, resulting from enhanced work definition; increased maturity; increased scope of the Turbine Generator Project and addition of safety improvement opportunity (SIO) projects.
- Campus Plan costs decreased by $146M or 22% due to improved scope clarity.
- New fuel and Waste work decreased by $34M or 10% due also to improved scope clarity.

The variances between the 2012 and 2013 Business Plans for the Project Bundles which comprise the bulk of direct costs are summarized below:

[15] Update on the Darlington Refurbishment Project Economics (November 17, 2011) at p. B-1.
[16] Update on the Darlington Refurbishment Project Economics (November 15, 2012) at p. 3.
[17] See DNGS Refurbishment Estimate Analysis (April 25, 2013) at p. 4.

- The RFR scope grew by $154M or 6% via improved definition and development of a more refined cost estimate.
- The Fuel Handling scope increased by $125M or 296% based on detailed review of Fuel Handling – Component Condition Assessment and continued scope clarification.
- The Steam Generator scope grew by $7M or 4% due to a revised cost estimate.



Project Bundle Scope Growth (%)

- The Turbine Generator scope grew by $287M or 484% due to the addition of the turbine control system and general scope finalization.
- BOP work reduced by $207M or 56% due to significant validation of work scope placed elsewhere in the program.
- Safety Improvement work increased by $175M or 100% due to the addition of SIO's.
- Islanding work grew by $27M or 31% due to scope clarification and the development of associated cost estimates.

Overall, a variance review indicates that the larger cost increases as measured between the 2012 and 2013 Business Plans resided in the Functional groups, not the Project Bundles. This suggests that any attempt by the DR Team or Management to reduce scope must also involve a re-look of the corresponding Functional group costs as well.

2. Scope Review Process by DR Team

As noted, the DR Team is currently vetting the approved project scope. The following summarizes the process the team is using to rationalize the scope and right-size the DR Project.

a. Process for Scope Determination

The DR Project's governance for scope review establishes the following Primary Objectives:

- Successful refurbishment of Darlington Station life-limiting components in order to allow Darlington to operate for 30 years beyond the current predicted end of service life.
- The Refurbishment Project will maintain and return the unit in the condition in which it is turned over.
- A successful refurbishment project requires delivery of all core and approved non-core scope within the high confidence timeline and budget established in the RQE and as documented in the Project Business Case Summary.
- Project cost and schedule as well as post-refurbishment performance will come under extreme scrutiny due to the high profile nature of this project and its impact on OPG's reputation.

- Where scope is approved by Scope Review Board, Nuclear Refurbishment may recommend inclusion of the scope and execution in a pre-refurbishment station outage.

The stated goal of this process is to "ensure that the proposed additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts."[18]

The DR Project's scope was developed from review and vetting of 1,409 DSRs that were generated by the Station and Refurbishment Engineering. Based on OPEX from past refurbishments, including PARTS Unit 4, the team adopted an intentionally expansive view of potential scope inclusion so as to consider all options and avoid later surprises and/or scope additions that could adversely impact the DR Project's success.

The process used to date for defining scope was based in part on accepting and classifying "Core" versus "Non-Core" scope. "Core Scope" is "work that must be done to achieve the Primary Objective" including (1) Regulatory; (2) Station Life Limiting Components; (3) Component Upgrades that can only be done in an extended outage; (4) Programmatic Work necessary to maintain the plant's license; (5) Pre-requisites; and (6) Facilities and Infrastructure to support the DR Project. Non-core scope is defined as work that "Will be performed in the refurbishment period if it has no impact on the Projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period."[19] The Scope Review Board has been given the role of approving, deferring or rejecting the scope items based on multiple criteria.

b. Scope Status as of the 2013 Business Plan

The 2013 Business Plan's scope definition and maturity level within each Bundle varies considerably. The following summarizes the monetized value of the DR Project's DSRs for each of the Bundle in the 2013 Business Plan.[20]

Project Bundle	Number of DSRs	2013 Business Plan ($000)
BOP	208	503,381
Campus Plan Infrastructure	23	234,566
Campus Plan Inside	10	75,569
Campus Plan Outside	17	252,198
Engineering Projects	42	203,443
Fuel Handling	76	237,963
In-Station Infrastructure	14	47,639
RFR	17	2,463,611
Safety Improvement Opportunities	3	103,000
Steam Generators	12	190,780
Shut Down/Layup	26	48,552
Turbine Generator	79	501,286
Unit Islanding	29	125,156

[18] Darlington Nuclear Refurbishment Program-Scope Control NK38-INS-09701-10001-R004 (December 12, 2012) at p. 4.
[19] *Id.,* p.8
[20] Scope Review as of June 20, 2013 at Table 1.

Project Bundle	Number of DSRs	2013 Business Plan ($000)
Other	3	300
Total	**559**	**4,987,444**

The DR Team anticipates that it will generate additional DSRs that will need to be dispositioned and may add to the total end scope. Outside of discovery work that cannot be anticipated until the unit is under construction, the DR Team expects that additional DSRs will largely come from three sources:

- Component Condition Assessments ("CCA's"): The DR Team determined that many of the condition assessments performed in the developing the DSRs were incomplete. Project Engineering is currently re-evaluating the CCAs that appear to have shortcomings. It is not currently expected that these CCAs will yield a significant number of additional DSRs although this process needs to be continuously and closely monitored, and the interim results need visibility.
- Regulatory Requirements: There are certain regulatory issues that will require additional DSRs and/or modifications to existing DSRs. Most notable are additional requirements for fire protection work that was not initially anticipated. These additions are being assessed at this time.
- Scope Defining Inspections: The DR Project will be performing ~40 separate scope defining inspections during the upcoming pre-project outages. While the plan for the Project includes contingent scope and associated budget, there is a risk regarding the work scope that could be generated until these inspections are completed.

Based on our review of the development of the scope, it appears that OPG's methodology has cast a wide net for identifying all of the possible scope that could be included in the Project. The DR Team has developed effective metrics for bringing focus and attention to scope identification status and maturity via its "Health of Scope" ("HOS") reporting. These HOS reports highlight the life of a DSR until it is dispositioned. These metrics have been very helpful in bringing focus to the scope that lacks maturity and requires action.

The challenge for the DR Team now is to weed out the work scope that is not essentially done in refurbishment and ultimately define scope that is balanced to the original commitments to the BOD, the Shareholder and CNSC. Adding unnecessary work not only increases the Project's cost but aggravates complexity and risk. Reasonably balancing the scope with complexity, risk, schedule and budget concerns has the added benefit of allowing the DR Team to focus on the critical path RFR work which has been problematic in prior mid-life refurbishments.

As a result, the DR Team is currently reviewing the previously approved DSRs and bucketing them into one of three categories:

Must Refurbish in DR Project	Possible Deferral to Station for Life-cycle Management	Remove from Scope
•Life limited components •Regulatory commitments •Drained/Defuel State •Refurbishment Support •Sustaining scope – 30 year replacements	•Station improvements with positive payback •Sustaining Scope that can be done outside of DR Project •Sustaining Scope – Manage as part of Life-Cycle Management •Sustaining Scope – Service Equipment, can be done online or during normal station outage •Station Support •Station Improvements – Likely payback	•Work not needed for ISR •Inspections determine scope is unnecessary •Work should be done under functional work program •DSR is for purchase of Capital Spares •Work with no relationship to Refurbishment •Work that must be done in VBO •Station Improvements – Payback Unlikely •Clean-up – work superseded

In our experience, removing scope that was once nominally "in" a project is often a difficult proposition. The DR Team has engaged in two separate reviews, one conducted by key members of the team using the above considerations and a second "cold eye" review by Paul Pasquet, who is reviewing the scope in light of the necessary regulatory commitments. As of the time of this Report, these reviews are ongoing with the intent to present separate recommendations to the Scope Review Board for final review and disposition prior to the DR Team's 2014 Business Plan presentation. BMcD/Modus has examined these ongoing processes, reviewed interim conclusions (to the extent those are available) and interviewed the principals involved, from which we can conclude that this effort is robust and likely to produce significant recommendations in reducing the Project's scope.

3. Conclusions – Scope Status and Review

Since the inception of our engagement, BMcD/Modus has observed the DR Team's increased focus on scope and all the related considerations. We have noted the direction and increased focus provided by the DR Team's leadership. Assuming that the result of this effort is supported by a favorable economic analysis, BMcD/Modus believes these efforts are likely to result in a more achievable project plan with reduced overall risk. The following considerations should be kept in mind as the DR Team prepares its recommendations:

- Cost controls that the DR Team has put in place need to be followed in the future or scope creep will again threaten the success of the DR Project.
- Decisions regarding scope of the DR Project should be made as quickly as practicable so as to avoid the team expending effort on scope that will not be performed in the Project. Currently, Project Engineering is under stress to complete the procurement engineering work associated with undefined DSRs. If the DR Team can winnow down the scope as intended, such changes will reduce this pressure and make the final scoping effort more manageable and increased the likelihood of timely preparation of these packages.
- The remaining scope risks, including those resulting from future scope-defining inspections, need to be tracked in a transparent manner for the BOD so that there are no surprises.
- The results of this review need to be recorded in the AIDA database for future reference for rate proceedings and configuration management.

IV. Functional Group Status

A. Engineering

At the outset of our engagement, BMcD/Modus found the DR Project's engineering in a state of flux. The OPG Engineering Team was in the process of instituting new procedures and developing the organization needed to fulfill all of its necessary functions, its metrics and tracking methods of engineering product were in the embryonic stage, and it appeared that engineering was significantly stressed and behind schedule. However, the Engineering Team's performance indicators did not reflect this stress. Over the last several months, we have noted improvements in both reporting and production, though there are many challenges remaining in both areas. In this assessment, we have focused on defining the roles OPG's engineering will play, the current areas of focus, and recommendations for improvements for upcoming phases.

1. Overview of Engineering Roles and Responsibilities

The Engineering Team (with its sub-parts Nuclear Safety, Design Engineering, Component Engineering, Engineering Projects and Reactor Engineering) is the largest of the DR Project's Functional Groups and fulfills a number of significant and evolving functions during the Project's lifecycle. Because OPG has chosen an EPC model, detailed engineering will be provided by the EPC contractors. However, OPG's Engineering Team retains responsibility for:

- Defining project requirements and design elements through development of the Design Modification Packages ("MDP");
- Identification of owner supplied long lead materials;
- Design authority approvals;
- Design completion assurance;
- Construction Completion Declaration
- Commissioning;
- Available for Service;
- DSR Closure.[21]

Currently, the Engineering Team's focus is on preparing procurement-related MDPs that are essential for defining OPG's requirements for the remaining scopes of work. This is an OPG-led function, though the Engineering Team is supplementing its efforts with the OSS Vendors, WorleyParsons and AMEC, in order to achieve a higher level of throughput. Once this phase completes, the Engineering Team will retreat into an oversight role in which its primary function will be to review and approve EPC design documents. OPG will take the lead again as the work moves out of the Execution Phase and into Commissioning. These myriad functions will require the Engineering Team to constantly review the mix of people and their specialties within the team. Management is currently evaluating the structure of the Engineering Team to meet these challenges.

Because OPG and the various EPC vendors each have responsibility for aspects of the design at various stages, answering the seemingly straightforward question of the DR Project's engineering status is a very complex equation. Nonetheless, as discussed below, the Engineering Team should endeavor to improve its reporting

[21] Darlington Refurbishment Project Unit 2 Major Work Streams (undated).

and metrics so that management and the BOD have a better and more precise handle on the status of the DR Project's engineering definition as the DR Project progresses.

2. Procurement Engineering - MDP Process

Since the majority of the Engineering Team's current efforts revolve around the MDP activities, BMcD/Modus has reviewed this process, progress and issues. The OPEX that the Engineering Team has gathered from the MDR/MDP process needs to be considered as the DR Project's design advances.

a. Developing MDRs

As noted, the DR Project's scope was assessed based on a wide variety of plant CCAs, life cycle management reports, system health reports, engineering backlogs and regulatory requirements in order to develop approximately 1400 DSRs. These DSRs were then evaluated to determine if the resulting scope of work would be a Maintenance Work Order, an equivalency evaluation, a Non-Identical Component Replacement or a Modification. If the disposition requires a modification, a Modification Design Requirement ("MDR"), Modification Outline and Conceptual Design Report are developed in accordance with the existing Engineering Change Control ("ECC") process. These evaluations of the DSRs netted 117 MDRs for engineering evaluation.[22]

According to OPG procedures, Engineering must prepare MDRs for the following purposes:

- New or existing Structures, Systems and Components;
- Engineered tooling;
- Permanent or temporary additions to existing facilities; and
- Permanently or temporarily re-defining a system design basis.[23]

In accordance with OPG's ECC process, the actual development of each MDR requires Engineering to review and account for such elements as:

- Nuclear Safety Design, Functional and Performance Requirements
- Interfacing Systems
- Design Limits and Strengths and Seismic Requirements
- Design Constraints and Constructability
- Environmental Qualification/Aging Considerations and Reliability Requirements
- Maintainability/Operability/Human Factor Requirements
- Periodic Inspection Requirements
- Safety Requirements
- Commissioning Requirements
- Standards and Codes
- Comparison with Similar Systems at Other Generating Stations

Initially, OPG planned to prepare the MDR packages with in-house, internal resources. However, OPG could not complete the volume of work and the number of MDRs required without additional engineering help. The

[22] Preparation of Needs Document N-GUID-00700-10002-R001 (2013) at p. 13; Modification Process N-PROC-MP-0090-R009 (2013)at p. 41 , Engineering Change Control, N·PROG-MP-0001 (2013).
[23] Preparation of Modification Design Requirements, N-INS-00700-10007-R001 (2013) at p.3.

Engineering Team therefore contracted with the OSS vendors to complete the MDP development as augmented staff workers under OPG to support the RQE milestone. This, however, has led to increased costs for the development of the MDRs.[24]

b. MDR/MDP Status and Metrics

Despite the fact that the OSS vendors have now been engaged, Engineering is still struggling to meet the schedule for MDP development. In June 2013, OPG's Nuclear Oversight ("NO") group conducted a performance-based audit of the MDR/MDP and Design Quality Oversight process, the objective of which was to determine if the development of MDRs and associated MDP documents comply with governance, and to audit the Engineering team's organization. NO identified the schedule instability for the OSS Vendors work, noting that compliance with the MDR completion dates was "difficult to determine" because of the changing dates and metrics used for tracking engineering work.[25] While the then-current schedule showed engineering essentially on track, NO determined that the OSS vendors were trending well behind in the development of the MDR packages based on a December 31, 2012 schedule labelled as the "baseline." In all, of the 37 remaining MDRs, 19 were scheduled to be complete by June 30, 2013 per the original baseline schedule; though as of the end of June, only one MDR was complete. NO also found additional quality and accountability issues in the OPG Engineering Team's management of the vendor. These audit findings are being addressed by Engineering.

Engineering has ramped up its efforts in developing metrics, though these are still in the embryonic stage. The weekly engineering meeting with the team and the OSS vendors has increasingly focused on schedule performance and project "need" dates. There have been improvements in the reporting by the OSS vendors, though there is still noise within the earned value rules and counting of design products.

3. Engineering Quality Programs

The Engineering quality program is currently focused on oversight of the EPC vendor in-line with the original implementation model. Since very few of the projects have progressed past the procurement phase, the effectiveness of the quality oversight model implementation has yet to be proven.

OPEX from early implementation of the EPC model on the Campus Plan modification activities has led the Engineering Quality group to look into its methods of oversight activities of the OSS vendors and the MDP development process. Recent actions to address these quality issues include: a Self-Assessment,[26] a Nuclear Oversight Audit Report,[27] and a Common Cause Analysis regarding the quality of design engineering deliverables received from the OSS vendors.[28]

As part of the Common Cause Analysis, fifty-five SCRs were reviewed to determine the bases of the quality issues. The results were broken down into the following categories:

[24] *See* SCR N-2013-01589.

[25] Nuclear Oversight Audit Report – Darlington Refurbishment – Modification Design Requirements and Design Quality Oversight, OPGN NO-2013-005 T6.

[26] *See* SA NO13-00005.

[27] *See* OPGN NO-2013-005 T6.

[28] *See* Common Cause Analysis SCR N-2013-02294 (June 21, 2013) at p. 6.

SCR Category	# of SCRs	Findings
Quality of Product	27	Human performance error Issues; Lack of rigor during verification; Staff not sufficiently trained/qualified
Delays in Deliverables	16	Original schedule errors; resource availability
Procedure Adherence	13	Lack of understanding; Execution Mistakes
Expectations	5	Poor Communications

The conclusion from this Common Cause Analysis identified two themes related to MDP quality:[29]

- Human performance issues during the preparation and issuance of the design products; and
- Communication issues between OPG staff and the OSS Vendors.

Actions being taken to address the issues identified above are:

- Pursue opportunities to co-locate OPG and OSS vendor engineers at either the DEC or vendor facilities to improve communications;
- Get vendor engineering staff registered in the OPG TIMS system as qualified engineers;
- Refresher training for OSS staff with regard to OPG's ECC process; and
- Team building activities[30]

These issues are indicative of a team that is getting organized on the fly and under duress. The Engineering Team's leadership is taking this OPEX into account and is reshaping the organization, which should result in improvements. The BMcD/Modus team will continue to monitor the OSS and EPC vendors engineering services in these areas as additional MDP packages and EPC detailed design work products become available for review. In addition, we will monitor the Engineering Team's quality processes at the Program level to assess the DR Team's ability to ensure adequate oversight of the upcoming detailed engineering phase.

4. Additional Observations and Recommendations

However its progress is measured, the DR Project's engineering effort is still in a very early phase. Engineering's current activities in developing the procurement packages are projected to continue well into 2014, and the team will have to adapt to monitoring the EPC's detailed design work that is underway. The current rationalization of scope and potential scope expansion from CCAs and regulatory scope will have an impact (both positive and negative) on the Engineering Team's work effort. Moreover, OPG will need to settle into an essentially new role of providing oversight of the detailed design process performed entirely by others.

For these reasons, BMcD/Modus believes it is essential for the Engineering Team to continue to refine its metrics, including earned value and schedule adherence. The reliability and quality of RQE will depend on the DR Team's ability to understand with confidence the Project's underlying level of engineering maturity. Currently, in part due to the fragmented distribution of the engineering activities between OPG, the OSS vendors and the EPC vendors, there is no metric that measures the integrated engineering effort (OPG + OSS

[29] *Id.* at p. 6.
[30] *Id.*at pp.8-10.

Vendor + EPC Vendor) such that the true status of the overall engineering effort is visible and can be understood.

There have been improvements over the last several weeks in the Engineering Team's metrics because the team is relying less on showing progress via work-down curves tracking completion milestones and more on interim key performance indicators such as SPI/CPI. In addition, the metrics better reflect the "need" dates from the various projects. There are still improvements needed and noise to wring out of the data, though the metrics are much accurate now than at the outset of our engagement. As the Project's C&C Schedule matures, we would expect that all of teams' metrics will be schedule-focused.

We have some additional high-level observations:

- As noted and discussed at length in the BOP section, OPG needs to examine a different delivery method for BOP work, one that allows the EPC vendors to begin detailed design as soon as possible. In conjunction with this change, the Engineering Team should review its processes to eliminate or reduce redundancy and the burdensome nature of elements of the MDR package development. One potential solution would be to limit the work by the OSS vendors and transfer some of these requirements to the EPC, so long as OPG's requirements are robustly detailed and established in accordance with ECC.
- The Engineering Team needs to review its and the other OPG groups' turn-around time for design approvals. There have been OPG-caused delays in approval of the OSS vendors' work, and the team needs to eliminate such constrictions where possible. The team should consider expanding its ball-in-court metrics to incorporate more granularity and visibility of the choke points in the chain.
- On the subject of engineering quality, BMcD/Modus recommends that an audit program be utilized to confirm that the EPC engineering vendors are adhering to their own QA/QC programs and that specific OPG quality requirements have been incorporated into the engineering practices utilized by these vendors (e.g.: Requirements Traceability Matrix).
- The Engineering Team should continue to evaluate the methods it will use for overseeing the development of detailed engineering by the EPC vendors. The OPEX from the Campus Plan work is informative in this regard and should be studied carefully.
- Developing comprehensive work packages is another function that has been exported to the EPC vendors. The Engineering Team will need to have sufficient resources available to handle questions and Requests for Information ("RFIs") from these vendors.

As the engineering effort continues, BMcD/Modus will provide both status updates and additional recommendations.

B. Commercial/Contracting Strategy

1. Process

OPG has chosen to use a combination of the multiple-prime and EPC project delivery methods. Here, each EPC "prime" contract equates to a Project within the DR Program. Each EPC prime contractor is responsible for coordinating and delivering the work covered by its particular scope of work (i.e. a Project or some portion

of a Project), but is not responsible for the entire Program.[31] Instead, OPG will take on the role of the Program Manager.

Under OPG's procedures, the Nuclear Commercial Development ("NCD") group coordinates an analysis with each Project Team and relevant stakeholders to develop a "Contracting Strategy" for each major work package. "A comprehensive contracting strategy takes into consideration factors such as the nature and scope of the work, the Supplier marketplace, potential longer term or broader commercial arrangements and results in a recommendation of the procurement approach, contract structure, pricing mechanism and the style and type of management to be adopted for the subsequent contract."[32]

Although each Project Team must perform a separate evaluation to determine the best contracting strategy, OPG has stated a strong preference for the EPC or hybrid versions of the EPC project delivery model, whereby a single contractor will perform the detailed engineering, equipment procurement and construction and installation work for a particular scope of work. OPG's key rationales for this choice are:

- This model gives OPG one point of contact (i.e. fewer interfaces and hand-offs for which the owner would be responsible to coordinate) and is "easier" to monitor and coordinate. From OPG's perspective, this also gives "one point of accountability" for complete delivery.
- This model can provide cost and schedule certainty to the owner prior to commencement of the execution/construction phase. This aligns with the DR Project's goal of having a high-level of definition for RQE.
- This model will enable OPG to concentrate its resources and efforts on rigorous project management and contractor oversight, which will be crucial to the DR Project's success.
- This model aligns with OPG's core business and overall future business direction, including staffing. [33]

Where applicable and relevant, we will discuss individual Project contracting strategies below. At this time, only contracts for the engineering and supply for Defuelling, RFR Definition Phase work (including development of the Tooling, construction of the Mock-Up and pre-construction estimate and schedule development), and the equipment supply and technical services contract for the Turbine Generators have been awarded and fully negotiated. The Execution Phase agreement for the RFR work has technically not yet been awarded (though it is anticipated that this work will be awarded to SNC/AECON upon agreement of the Target Price); and the final Target Price for this agreement will be subject to the ongoing RFR estimate development required by the Definition Phase contract.

Additionally, the ESMSA Contracts for the two intended BOP contractors have been negotiated and pre-Refurbishment work under these agreements is ongoing, although no Execution Phase work has been awarded to date. These contracts were awarded on the basis of competitive bid process, and the terms and conditions of these agreements were established for the purpose of simplifying future awards of the BOP work. The BOP section of this report provides additional detail regarding the commercial considerations in these contracts.

[31] The Campus Plan Projects have been excluded from the scope of the DR Commercial Strategy since they are being managed by Projects & Modifications, rather than the DR Team.

[32] See Program Contract Management Plan, NK38-PLAN-09701-1067- R000 (January 31, 2013) at p.5.

[33] See Darlington Refurbishment Program Commercial Strategy, NK38-REP-00150-10001-R001 (October 1, 2012) at p.11.

As with any commercial strategy for a large capital project, there are risks associated with the multi-prime EPC model chosen by OPG for the DR Project. Many of these risks have been recognized and are being monitored by OPG, though they must be discussed on an ongoing basis as realization of some of these risks will impact the success or failure of the DR Project.

- With the multi-prime management approach, Owner's traditionally hire construction managers or program managers to coordinate the EPC contractors' work, and owner's engineers to review program compliance. OPG has chosen to fill these roles, and its success will be dependent its ability to employ a strong, capable and experienced construction management team that is able to effectively coordinate and track the work of such a large, complex project. We would also recommend that the DR Team integrate key construction management individuals into the DR Project Team as early as possible in the Definition Phase.
- OPG's preferred EPC contracting strategy is a new project delivery model introduced for the DR Project. It is also different from that used by OPG's vendors on past projects. Business cultural differences between OPG and vendors' management philosophies will have to be closely managed.
- The RFR contract dwarfs the other major project scopes, and there is a tendency to think of SNC/Aecon as the Project's full-wrap EPC contractor. This is not the case, and management needs to devote attention to the other projects to optimize adjacent project coordination and minimize interferences.
- The ESMSA vendors' performance and OPG's management of the vendors' work on the current Campus Plan scope has been mixed. OPEX from the D20 Storage Facility includes evidence of failures on both OPG's and the vendor's part to recognize that key details were missing from that project's definition which led to unrealistic schedule and readiness expectations[34]. The DR Team should examine these lessons learned going forward.
- The Program/Project approach has the risk of creating "silos" between the Project teams. Although each of the major Project Bundles are self-contained units, the Program must be managed by OPG as a whole, with a single, integrated schedule, cost control system and risk management approach.

Developing a contracting strategy for such a large project has to include a number of key variables. Some contracting approaches are more risky for the owner than others. Some are unsuitable for certain situations. Some strategies work for some owner organizations but do not work for others because the strategy depends on the owner's strengths. There is evidence that OPG took these major considerations into account in deciding on the contracting strategy it is following. However, this strategy will require some significant changes to OPG's prior large capital project mindset, and while growing pains are expected, the Project's success will be largely determined by OPG's willingness to embrace the role and recognize and control the risks associated with the chosen method.

C. Project Controls

OPG's Project Controls team is responsible for essential functions of Schedule, Budget, Risk Management and Document Control. The following is our assessment of the development of each of these key elements to date.

[34] D20 Storage and Drum Handling Project: Modification Planning Lessons Learned Report, D-LLD-38000-1001 (March 4, 2013)

1. Project Controls Team and Structure

After Engineering, the DR Project's Project Controls team is the next largest functional group on the Project, and given the broad range of responsibilities the team has been given, this appears to be entirely appropriate. Project Controls is supporting the project-led approach with a core functional team and matrixed resources that have been embedded within the various Project Bundles. This was done to assist the Bundles in developing their respective schedules and budgets, though the efficacy of this model will likely wane as the Project continues to mature.

Going-forward, BMcD/Modus recommends OPG clarify the reporting lines of authority for Project Controls matrixed staff. Project Controls as essentially an independent function and those charged with that function are tasked with holding project managers accountable to integrated schedule, budget and risk standards. As an example, in the budget process, it is expected that certain puts and takes will occur between the Project Bundles. Project Controls needs to be the first-line-of-defense of the budget and broker these budget shifts with only the Project's overall best interests in mind. The matrixed Project Controls staff could be put in an uncomfortable position, having to work essentially for two bosses. In order to maintain the necessary independence, Project Controls personnel should have a direct and singular reporting line to a central Director, and that individual should report directly to the project's executive.

2. Schedule Development

a. Process and Methodology

The DR Team has chosen a method for developing the Project's schedule that is unique in the industry at large. In accordance with the Program Schedule Management Plan[35]:

> The (C&C Schedule) level 2 schedule covers the scope of work by Phase, Unit USI, and Type of work and contains full Critical Path Method (CPM) logic. It is referred to as the C&C schedule, or, Control and Co-ordination schedule, as this is the schedule which will be used, at the Phase and Unit level, to track the overall schedule status of the Program. It will be updated and controlled by OPG and based on the Contractors detailed Level 3 Schedules.[36]

In essence, the DR Team intends to use the Level 2 C&C Schedule as an integrated "look" of the schedule using Level 2 detail that mirrors (or hammocks) the level 3 detail that the contractors are developing for work execution. In order to update and further develop the C&C Schedule, OPG's Schedule Team intends to summarize the contractors' level 3 schedule into a separate level 2 that contains an adequate number of activities with realistic activity durations to clearly show the sequence and logic in performing all projects, within the Program, at the Phase and Unit level, in a systematic manner. It will include all interfaces between OPG and contractor, and/or between contractors."[37] Notably, under this plan, the Level 3 detailed schedules from the contractors and respective work groups will not be integrated but only summarized at the milestone level. The eight[38] project bundles will each develop, maintain and update eight separate schedules with no interface logic ties between areas or bundles. The DR Team currently anticipates the C&C Schedule will

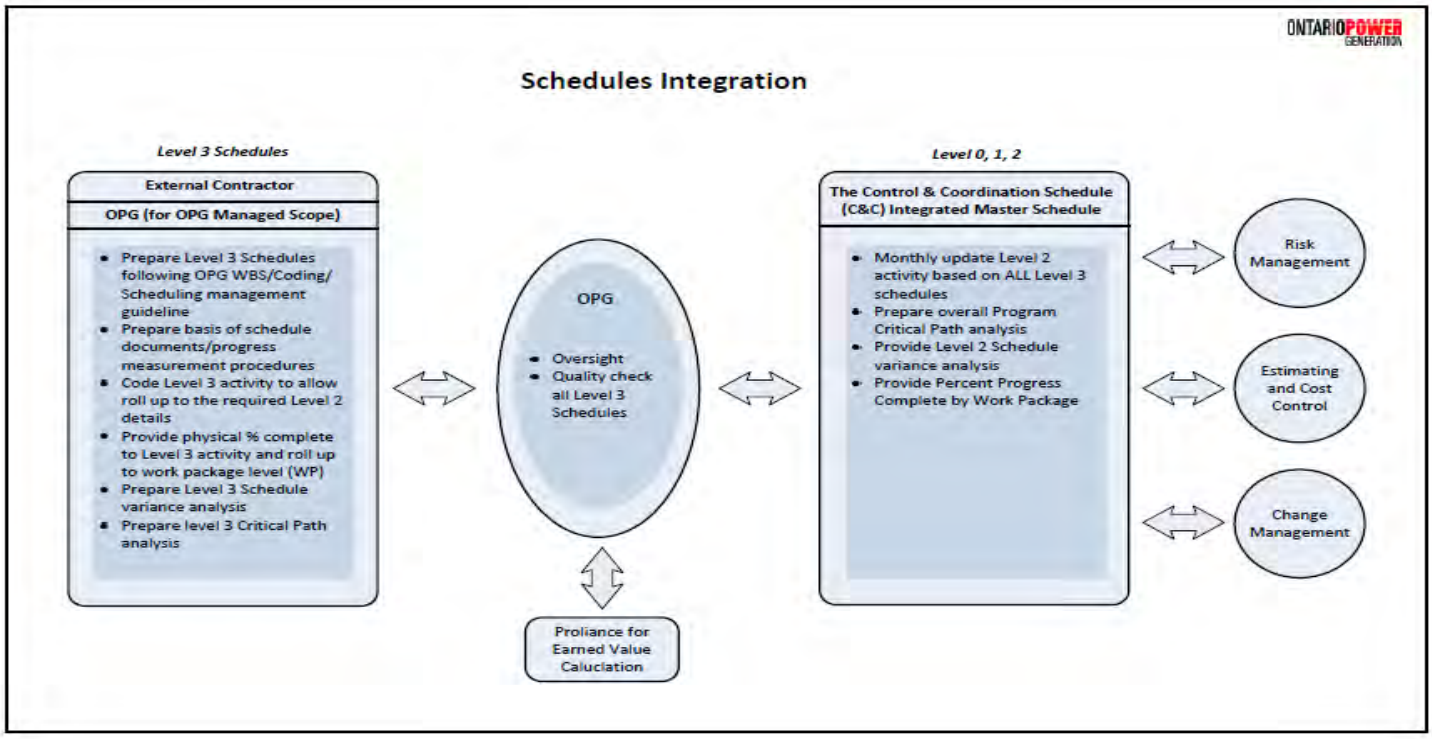
[35] NK38-PLAN-09701-10067 (January 31, 2013).
[36] Program Schedule Management Plan, NK38-PLAN-09701-10067-0004-R001 (March 27, 2013) at p.4.
[37] *Id.*
[38] For scheduling purposes, some of the SIO work is in a separate bundle.

consist of 5,000 tasks/activities in the Level 2 format, whereas the level 3 schedule, when developed, will consist of ~50,000 tasks/activities.

As articulated by the Project Team, the key drivers behind this unique methodology are:

- To allow for coordination of schedule activities at the summary milestone level. This is based on the Project Team's preference to manage the interfaces between the contractors and work groups at a higher, less granular level;
- To address OPEX from prior capital projects suggesting that the Project Team needs to manage the Project in a manner different from a conventional maintenance outage;
- To support OPG's desire for the exclusive ability to manage both overall and individual milestones that determine the contractors' schedule start dates, finish dates and float using the C&C Schedule.

OPG's *Program Schedule Management Plan* provides the procedure for developing the C&C Schedule from the Level 3 detailed schedule.[39] The diagram below identifies the flow of information from the Level 3 detailed schedules to the Level 2, C&C Schedule:



Some of OPG's processes follow typical scheduling practices: each bundle will have and update individual detailed Level 3 schedules with integrated Work Breakdown Structures ("WBS"); and assessment of critical paths and status updates will be based on an assessment of physical percent completion. These processes generally conform to frequent industry practices. Moreover, each Project Bundle will be responsible for updating its schedule to show its progress, and OPG will receive and coordinate the interfaces between the

[39] *Id.* at pp. 4-5.

Project Bundles through establishing and maintaining project milestones and touch points contained in the Level 3 Schedule.

While the C&C Schedule will work for the Definition Phase, it is our understanding that the DR Team intends to use the C&C Schedule as its prime schedule management tool through the Execution Phase. However, OPG's intended approach varies from what is typically seen in the industry for project execution in several important respects. By the Project Team's design, there will be no single integrated Level 3 schedule on the Project during the Planning or Execution Phases. Under this plan, instead of enmeshing these eight Project Bundle schedules, OPG has created the Level 2 C&C Schedule which "covers the scope of work by Phase, Unit USI, and Type of work and contains the full Critical Path Method (CPM) logic" and interface points. The DR Team's intent is that the C&C Schedule "will be updated and controlled by OPG and **based on** the Contractors detailed Level 3 Schedules." As shown in the diagram above, in order to monitor schedule progress, BMcD/Modus believes that this will cause OPG to monitor the eight separate Level 3 schedules and summarize the information into the C&C Schedule, as well as capture and record any changes to each bundle's schedule durations, adjacencies and logic (including the critical path). Typically, this level of integration is done electronically via an agreed automated roll-up of the schedule's Level 3 activities into a higher level 2 format. Such a Level 2 Schedule is typically not a stand-alone, calculating schedule, but merely a roll-up of the detailed Level 3 integrated, calculating schedule.

Maintaining a single Level 3 integrated, calculating detailed schedule network in P6 is standard in the industry because it readily provides the level of information needed for day-to-day management of the projects' work. The AACE's Recommended Practice 37R-06, which OPG's Schedule Management Plan uses as a reference document, states that Level 3 is the "first level that a meaningful critical path network can be displayed and the CPM schedule can be used to monitor and manage (control) the overall project work. Level 3 is a good level for the overall project control schedule since it is neither too summarized nor too detailed."[40] AACE recommends that the Level 3 schedule network "reflect the interfaces between key workgroups, disciplines, or crafts involved in the execution of the stage." BMcD/Modus agrees with and endorses AACE's conclusions. In our experience, a schedule for a project of this complexity needs a detailed logic network that is unconstrained and able to freely and readily calculate the critical path and sub-critical paths. As a result of our experience and widespread industry practice, we are skeptical that OPG's efforts at maintaining, updating and administrating the level 2 C&C Schedule will provide the management tool necessary for successfully coordinating and controlling the Execution Phase of the work.

b. Status of Schedule Development

The DR Team is currently developing the C&C Schedule by populating the detailed schedule network. The Project Information Management System ("PIMS") milestones for schedule development are: (1) Level 3 Schedule, "Revision A", April 15, 2014; (2) Level 3 Schedule, "Revision B", which will form the basis for the RQE, is scheduled to be completed in May 15, 2015; and (3) Final Level 3 Integrated Schedule, April 15, 2016.

The interim C&C Schedule was the basis of the presentation to the Refurbishment Project Executive Team ("RPET") on July 19, 2013. The following is an assessment of the current status of each of the Bundle components of the schedule, based on a review of the materials that were prepared for that presentation:

[40] AACE International Recommended Practice No. 37R-06 Schedule Levels of Detail—As Applied in Engineering, Procurement and Construction (March 20, 2010) at p.2.

C&C Schedule Status as of July 19, 2013	
Project Bundle	**Current Status**
RFR	Level 3 is resource loaded with contractor staff needs, though there is a concern with contractor staffing to meet the work load in the Fall 2013. Program milestones for 'mock-up construction complete' are misaligned with the contract (by 61 days), with a CCF to be processed. RFR is currently evaluating inter-project ties and inserting outage milestones into the schedule. The RFR team was challenged to evaluate the number of activities with excessive float (600+ days) though the RFR team believes this float is realistic due to early performance of certain work. In addition, RFR will need to examine multiple activities with 500+ days of duration.
BOP	The schedule is currently reflecting pressure from MDR's for scoping, which are showing 89 days late. This may be due to logic ties rather than lack of progress and if so, will be corrected. However, as will be discussed in the BOP section, there is a significant risk that the current schedule logic will not support on-time completion of BOP detailed engineering. In addition, the schedule currently reflects that several inspection preparations are running behind schedule, though the BOP team assures that recovery plans are in place and as-planned completion dates are expected to be maintained.
Fuel Handling	The schedule for Fuel Handling is being revised to reflect the award of the Defuelling contract as well as certain changes that management has directed to move work forward, before the start of the DR Project's Execution Phase.
Turbine Generator	This bundle's schedule is not well developed at this time, as activity definition, sequencing and interface ties all require work. The current preliminary engineering activities are riding the data date with no rationale. The team reported that the RFP negotiations are impacting the schedule at this time.
Steam Generators	This schedule reflects the current maturity level, which is in the pre-contract phase.
Shutdown/Layup	New level 2 schedule was completed at the end of July and will be used as the target. The strategy is to use the existing ESMSA contracts and vendors for the work. The plans to support this procurement strategy are reflected in the target schedule.
Functional Group	**Current Status**
Operations & Maintenance	Much of the current work is to support project needs yet the activities are not tied (integrated) with the downstream project activities, consequently large amounts of float are shown. Significant O&M work that is required for the projects does not show up on the O&M C&C Schedule, which reflects an interface issue with coding and layout at level 2.
Licensing	Licensing schedule is organized by each project, activities are supposed to be extracted from the project schedules. This schedule needs further refinement from presentation layout to the definition of licensing activities for it to be a usable C&C schedule.

C&C Schedule Status as of July 19, 2013	
Nuclear Safety	There were a number of flaws noted with activity dates, % complete, float, descriptions, among other things. The activities are very short term focused, level of effort type activities. This schedule also needs further refinement for it to be a usable C&C schedule.

In the C&C Schedule meetings held during the week of July 15 2013, the Project Controls Team identified that schedule adherence and variance will be monitored against this version (July) of the level 2 schedule. There was a concern noted that the schedule fragnets from OPEX on other projects are not being used to guide the logic and durations of schedule activities, the schedules are being developed from scratch. We noted a distinct difference between Functional and Project groups with the approach and degree of schedule development. The Functional groups in general have much more work ahead in their schedule development, with the Project Bundles being much further along. The current iteration of the Project schedule will be used to drive and measure the Definition Phase for the next 10 months. All schedule performance metrics will use this schedule as the interim baseline for measurement at the milestone level. As the Project Bundles mature, the schedule will continue to be populated with additional Level 3 schedules.

c. Summary of Risks

Whereas the C&C Schedule is an adequate tool for the Definition Phase of the Project, BMcD/Modus is concerned with the schedule development plan that OPG is pursuing for the DR Project's Execution Phase. The following are some of these concerns:

- OPG intends that its C&C Schedule be its depiction of the interfaces between the eight Level 3 Project Bundle schedules, as described. At a minimum, this approach appears to shift significant burden onto OPG's Project Controls department to update the C&C Schedule to match the Level 3 schedules received from the contractors. This approach creates a risk that the C&C Schedule and the eight Level 3 schedules will not be fully aligned and manipulation of data will most likely be a daily issue as between OPG and its contractors. Moreover, the contractors may not accept the C&C Schedule as the Project's baseline schedule, which would create difficult issues when analyzing potential impacts and mitigation of delays and coordination problems.
- OPG's intent with the C&C Schedule is to give the contractors sufficient latitude to develop and "own" their respective schedules, and reduce the amount of interference (unintentional or otherwise) from OPG. However, in our view, the contracts executed to date do not present clear and unambiguous rules to hold contractors accountable in schedule development. The contracts rely on the parties reaching mutual agreement on the schedule which is a concept fraught with risk and difficult to achieve under the best of circumstances, and one which could ultimately result in the DR Project never having a baseline schedule. The contracts also reference AACE standards rather than identify specific requirements; however, there is a potential for confusion regarding OPG's exact requirements, as not all sections of these AACE standards are applicable and these standards are intended to be used as guidelines in the first place not requirements or obligations that OPG can enforce as the per OPG's Schedule Plan. OPG should consider revisiting its scheduling requirements for the contractors and clearly spell those out in all (current and future) contracts so that these standards are understood and dispositioned upfront and not held over for later mutual agreement.

- OPG's ability to obtain a sufficiently detailed Level 3 schedule from each contractor will depend on the amount of oversight the OPG team applies at a very early stage of development. As an example, the RFR contract requires SNC/Aecon and OPG to have a meeting of the minds on the schedule before it is accepted. OPG will have to similarly engage each contractor and police the schedule updates to ensure none are using techniques that could give OPG's management a false read of the Project's progress.

- As noted, OPG plans to limit the transparency of an integrated schedule in order to manage contractor float. While we recognize the importance of an owner maintaining proper float management when multiple prime contractors are working side-by-side, we do not believe that this is a sufficient reason for not having a fully integrated Level 3 schedule tool for coordinating and controlling the work. As an example, OPG will not be able to hold a "Plan of the Day" meeting with all contractors present because OPG intends to restrict viewing of the overall schedule. Moreover, to the extent that there are touch points between the contractors, and there will be many, OPG will have a difficult management task of communicating separately and individually with each party – even the best in the industry avoid this scenario. In our experience, limiting the transparency of the schedule risks the value of the schedule as an essential planning and communication tool needed to hold the contractors accountable.

- The level of resources OPG needs to maintain the C&C Schedule may be significantly underestimated. Our concern is that OPG will be utilizing resources in summarizing the detailed schedule that would be better focused on vetting of the contractors' schedule input.

- In the event a Project delay occurs in one of the eight bundles requiring a delay mitigation analysis, such analysis would need to use the Level 3 Detailed Schedule. However, if the Level 3 Schedule is not updated with interface logic, such an analysis would prove problematic at best. It would be very difficult if not impossible to perform an effective and convincing delay analysis using the Level 2 Summary Schedule, which was not developed by the contractors but is an owner controlled and developed document, all for the purposes to prove or disprove a delay claim.

In summary, BMcD/Modus sees significant risks associated with the plan for tracking the schedule using the currently adopted process, and we are skeptical that the end-product OPG intends to create will be a useful tool, let alone offset these potential risks.

d. Summary of Recommendations—Schedule

Based on the above observations, BMcD/Modus recommends the Project Team consider the following path forward with respect to the schedule:

- OPG's Project Controls team should continue populating the Level 2 C&C Schedule in the same manner with each Project Bundle submitting progressively more detailed Level 3 Schedules through RQE;

- OPG's Project Controls team should develop distinct rules for contractors to follow in the development of their level 3 schedules and have these rules clearly imbedded in all of the contracts;

- Continue using the C&C Schedule as a planning tool and as a tool for OPG management to measure the DR Project's status, critical path, and forecasted completion dates, through the current phase of project development until the Level 3 Detailed Schedule is completed;

- Continue developing the touch-points and milestones at Level 2 as the basis for the planning process;

- Once the detailed Level 3 schedule inputs from the contractors are sufficiently mature, OPG should revisit the issue of integrating the schedules from each Project Bundle into a single CPM network using the Level 3 Detailed Schedule;

- OPG should vet the internal resource requirement and model the amount of such that it will need for tracking and managing the schedule under both scenarios. The upcoming 2014 Business Planning review will be important for establishing the level of effort and resources needed for schedule development and maintenance; and

- OPG may choose to continue updating of the C&C Schedule, both as an interim Level 2 Schedule and as tool for OPG management to measure the Project's status, critical path, and forecasted completion dates if doing so provides OPG's management with a useful tool.

In summary, we are of the view that OPG is needlessly exposing itself to extra time, cost and management difficulties in proceeding along its contemplated course of scheduling after RQE. In this deviation from widespread industry practice, we doubt that the action will result in the Project Control tool necessary for tracking the work during the Execution Phase of the DR Project. We recommend that OPG consider developing a fully integrated level 3 schedule using progressive elaboration of the detail as the contractors' plans mature and automatically roll-up of the level 3 detail to the level 2 and summary schedules for management and reporting.

3. Budget Process and Status

a. Processes and Methodology for Cost Management

BMcD/Modus has reviewed the primary processes, procedures, manuals and guidelines for budgeting and cost controls and found that the intent of these processes to generally comport with industry standards. However, the DR Team should review these documents for consistency and integration. The following summarizes our review of the more significant concerns related to the DR Project's cost control processes.

i. Contingency

On June 26, 2013, the DR Team issued a "major" revision to its Contingency Development and Management Guide.[41] The revision was issued as work was starting on the 2014 Business Plan Business Plan estimate so that proper guidance could be provided to the Project Teams in developing each of their contingencies. According to the DR Team, Contingency Development and Management should be guided by the following principles:

a) Uncertainty and risks in projects is a certainty – project managers are expected to identify discrete risks and be provided with the budgets to manage risks.

b) There should be at least two classifications of funds to manage executive expectations, uncertainty and risks: One to manage identified and documented "known unknowns", and one to manage "unknown unknowns".

c) Risk management must be a living and iterative process requiring frequent monitoring and control as project circumstances are always changing

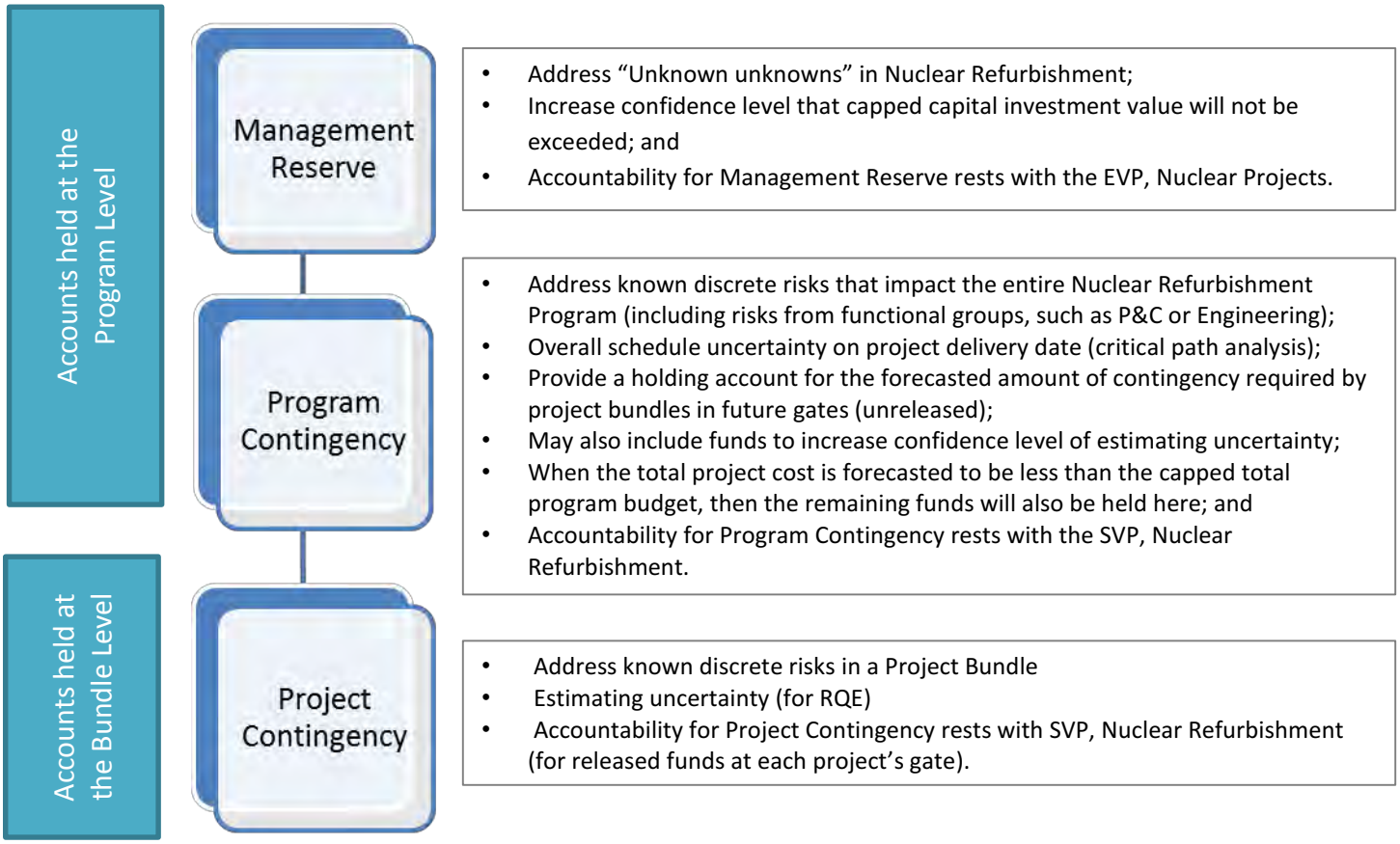
[41] Nuclear Refurbishment – Contingency Development and Management Guide, N-MAN-00120-10001 Risk-05 R001 (June 26, 2013).

d) Contingency development should be based on a justifiable risks, properly documented and determined using an approved process

e) Contingency usage must be justifiable, properly documented, and requested via an approved process that allows for proper reviews and levels of approval

f) Contingency or Management Reserve approvers must understand the impact of this usage on the remaining risks on the Project and as well on the overall program.[42]

Based upon these principles, the DR Team has established three contingency pools from which contingency funds may be drawn: 1) Project Contingency; 2) Program Contingency; and 3) Management Reserve. Below is an illustration of the purpose, scope and accountability for each type of contingency:



In determining the appropriate amount of contingency, the guideline recommends the use of a probabilistic approach, or Monte Carlo simulation method, which is the industry standard for mega projects. However, a probabilistic approach depends upon the organization having a comprehensive and reliable risk assessment and risk management program. As a result, the quality and effectiveness of OPG's Risk Management Program is very important for overall cost control.

As we will discuss in more detail below, based upon our review of the operative procedures and guidelines as well as interviews with the Project Managers and the Risk Section Manager, the Risk Management Program is

[42] Gary Rose, "Strategic Direction for Nuclear Refurbishment Contingency Development and Management" (undated).

comprehensive and well within industry standard. However, we have concerns regarding its execution, including risk identification and the updating, scoring, maintenance and management of the risk register, all of which need to be closely integrated. Making OPG's risk register the foundation of the Project contingency analysis potentially transfers quantifying risk and the exercise of estimating contingency not only away from the cost estimating function, but from the contractor to the owner. As yet, we have not had a chance to fully review how the items in the risk register are monetized and how contingency is actually calculated; the opportunity to do so will come with our vetting of the 2014 Business Plan budget process.

ii. Gate Review Process

The Gate Review process is intended to ensure that all work is rigorously defined and adequately vetted at a series of gates which correspond to relative maturity of that sub-project.[43] The ultimate goal, as described by the DR Team, is for all work to meet the standards of Gate 3 prior to approval of funding for execution; further, that all work on the DR Project will be at the requisite level for Gate 3 approval by the RQE date.[44]

Based on our review of the estimating, contingency and gate review processes, the Gate Reviews appears to be adequate for use if all associated paradigms are identified and adhered to. As an example, the Gate Review Board has continuously rejected the Gate 2 submission from the Turbine Generator Team for its lack of completeness and failure to meet the Project's standards. We would recommend RPET to use this as a living example for holding the DR Team accountable as the requirements of the gate reviews increase and more projects will be advancing to Gate 3.

The Gate Review process is consistent with that seen in the industry at large. Nonetheless, as noted in this report, BMcD/Modus has particular concerns regarding the BOP scope's readiness for Gate 3 by October 2015. This has less to do with the gate process than the current schedule and pace of scope definition evident within the BOP work.

iii. Cost Management and Project Reporting

The implementation of Proliance, which the DR Team intends to be the primary tool for reporting earned value, has been delayed and is currently only in the embryonic stages of its development. As a result, we have not yet been able to evaluate it as an effective project tool. Only one Project Bundle RFR, has an earned value process that is up and running and system bugs are still being worked out. Three other projects—BOP, Defuelling, and Turbine Generator—have reportedly been readied for import into the earned value system. However, there is evidence that the Turbine Generator team is not on board with or committed to the earned value process or, more basically, even to Proliance.

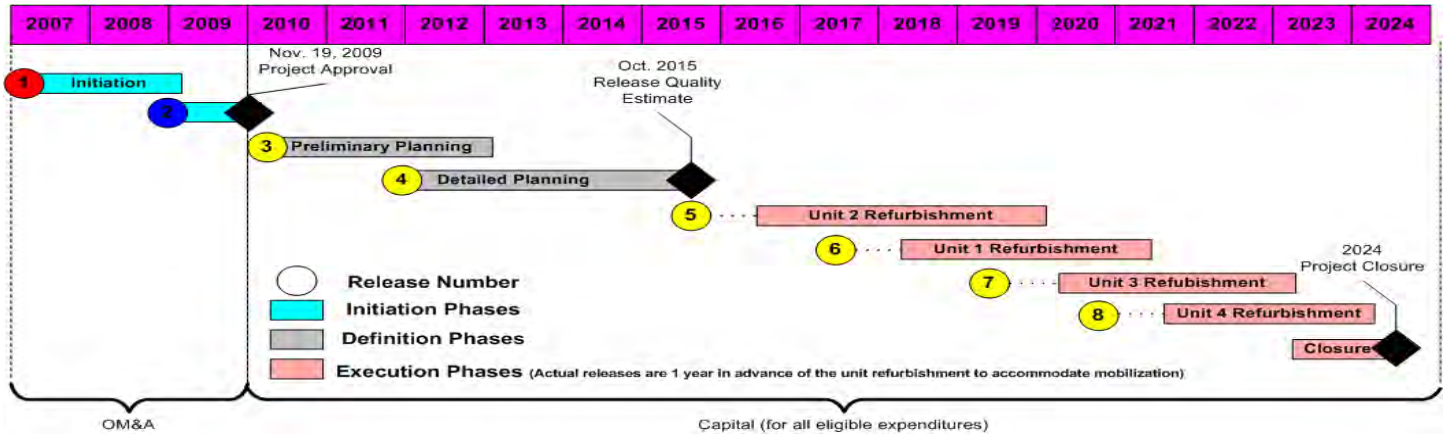
It should also be noted that based on our industry experience with clients employing similar systems to Proliance, it will most likely take months or quarters to get the earned value system up, running and purged of reporting noise. Therefore, it could be some time before OPG receives any meaningful data out of Proliance.

b. Review of 2013 Business Plan

The current DR Project cost estimate is in the form of the 2013 Business Plan which the DR Team presented to the BOD for approval in the 4th Quarter of 2012. This Business Plan was the most recent in a series of yearly

[43] Nuclear Projects Gated Process, N-MAN-00120-10001-GRB-R000 (November 28, 2012).
[44] Darlington Program Update, February 27, 2013, at p. 71.

funding requests, the purpose of which is to provide the Board with an update on the status on the DR Project and to request approval of the revised overall release strategy and funding to proceed to Detailed Planning within the Definition Phase of the Project as identified below:



This release strategy provides the BOD with built-in "off ramps" in the event the DR Project's economics cannot be supported, and requires the DR Team to provide the BOD with yearly requests for Definition Phase funding.

The base assumptions embedded in the 2013 Business Plan are as follows[45]:

- First unit Refurbishment Start date – October 2016
- Duration of Refurbishment (4 units) – 36 months each, 88 months total
- Estimate shown is in overnight $2012M (excluding interest and escalation)
- Estimate is based on scope approved by the Scope Review Board, contractor cost, and OPG costs
- As contracts are awarded and contractor estimates are refined, the Project estimate is updated
- Contingency is based on an assessment of cost estimate uncertainty (price, quantity, productivity) as well as an assessment of discrete project risks
- Refurbishment will perform oversight of EPC vendors and will operate the unit during the refurbishment period.

The Project Bundle estimates underlying the 2013 Business Plan (exclusive of BOP) were characterized as Class 5, and there is evidence of scope (and scope bucketing) uncertainty in the comments adjoining the estimate's line items. The estimates for the Functional Groups were drawn from high-to-medium level staffing plans for each of these groups. As noted in the earlier discussion of Scope, the Functional Groups' plans changed from the 2012 to the 2013 Business Plan, reflecting a larger Execution Team with greater External Oversight, Project Controls and Engineering costs[46].

[45] *Id*. at p. 18.
[46] Id. at p. 17.

c. 2014 Business Plan

i. Revised Planning Assumptions

On June 4, 2013 OPG's Senior Management determined that the DR Team needed to analyze for planning purposes a potential alternative schedule scenario in which:

- Unit 2's Execution Phase would begin as originally planned October 2016
- Unit 1's Execution Phase would begin after the commencement of Unit 2
- Units 1, 3 and 4 construction would overlap by 19 and 17 months
- The total Refurbishment Project window would be 108 months

The drivers behind this new set of planning assumptions include reducing the complexity and risk of performance in as many ways as reasonable and allowing OPG to fully integrate lessons learned from the first Unit into the execution of the remaining Units. As of the time of this Report, the DR Team is engaged in its 2014 Business Plan review in which the team plans to reflect the result of this evaluation. It is our understanding that this work will continue into the 3rd Quarter of 2013 and culminate in a recommendation to the BOD to be presented during the October 2013 BOD meeting. We will continue to monitor this effort to its conclusion.

BMcD/Modus recommends the following in tandem and/or support of this decision:

- When presenting information to the BOD, OPG management must adequately document, present and otherwise explain the nature of its cost estimates and appropriately characterize the same before the BOD, all in a transparent manner. The BOD would benefit from the DR Team developing new and meaningful metrics that trace and meaningfully report on scope, cost and planning variances going-forward.
- It is our understanding that the DR Team intends to segregate the estimated variances in the 2014 Business Plan estimate that were caused by scope increase/decrease from those emanating from the revised planning assumptions. This will be helpful but the Project Teams and Functional groups must be supportive.
- In keeping with the revised planning assumptions, the DR Team is training a critical eye on BOP scope. As discussed elsewhere in this Report, the DR Team should examine a different project delivery method than originally planned in order to optimize the BOP schedule, in particular the schedule for developing detailed engineering and construction work packages that will form the basis of Class 2 estimates needed for RQE.
- It is likely that if approved, the revised planning assumptions will result in some commercial reworking of the JV Agreement with SNC/Aecon. If Unit 2 is performed as a stand-alone without overlap, there will be some budgetary puts and takes that will likely impact the target price. BMcD/Modus recommends that OPG use this opportunity to consider amending the JV Agreement to incorporate other changes that could result in greater transparency, cooperation and risk reduction in the RFR project.

ii. Basis of Estimate

BMcD/Modus has sampled some of the preliminary materials that are currently being assembled in support of the 2014 Business Plan reviews. Based on this in-flight review, it appears that the vast majority (64%) of the individual estimates that will make-up the 2014 Business Plan are still characterized as Class 5, while 19% are at Class 4 including RFR, which we discuss in detail in the related section. Seventeen percent (17%) of the DSRs have not been estimated to date. Based on this information, it would not appear that the level of maturity has greatly increased from the 2013 Business Plan to the 2014 Business Plan.

iii. Process

The 2014 Business Plan assessment will not be a full re-examination of the DR Project's underlying cost estimates. While at this stage, given the DR Project's overall maturity, this refresh of costs is appropriate, we nevertheless recommend that the DR Team engage in more rigorous effort in connection with next year's 2015 Business Plan cost assessment as a pre-cursor to release of the RQE. Because of the expected leap in clarity in regard to project definition over the next several months, the DR Team should be tasked with considerably narrowing the uncertainty cost band around project cost – there is no reason to delay this to the timing of the of the RQE release.

d. Recommendations—Estimating and Budgeting

In summary, while the DR Team has made reasonably good strides toward establishing cost controls and driving compliance and accountability from a process perspective, there are some areas (scope definition, contingency development and management) where improvements can be made. The following are selected recommendations in this regard:

- The DR Project's estimating process needs to more closely adhere to AACE guidelines, and do so with greater uniformity. Since RFR is the test case for the other project cost estimates, the team needs to ensure that adequate vetting of the RFR estimate is accomplished as the cost estimate moves toward the RFR Class 3.

- The Risk Register needs to be streamlined and otherwise vetted including how and why some categories of risks are translated into contingency.

- Estimating and risk management functions need to be better aligned with regard to deriving contingency.

- Proliance needs to be implemented as soon as possible to ensure the cost and schedule management systems and reporting are aligned and in sync. This is critical to ensure data fidelity as the bundles move through the gate review process and move toward RQE and execution.

- The number, mapping and consistency of the various cost control processes and procedures should be reviewed by the DR Team, with an eye toward simplifying and streamlining such procedures.

In developing and characterizing its cost estimates and contingency, management reserves and allowances, OPG needs to adhere to unified and consistent definitions. In the absence of clarity, the organization will almost certainly continue to use the terms in interchangeable manners and thus run afoul of good practice. OPG has chosen AACE for reference guidelines and it needs to align to them in all cases, both internally and in contractor operations. As we discuss in the section related to RFR, inconsistent application of processes can

lead to unnecessary confusion and thus a misunderstanding at the management level with respect to the rigor behind the cost estimates presented to it.

4. Risk Management/Lessons Learned/OPEX/AIDA

a. Status of the Programs

The DR Team has established its Risk Management Program which is generally consistent with those commonly encountered on other projects and complies with published literature such as the Project Management Book of Knowledge ("PMBOK")[47]. The Risk Management Program focuses on the key elements of: (1) Risk identification; (2) Likelihood of Occurrence; (3) Impact; (4) Mitigation and (5) Monitoring. To date, the DR Team has focused on the following activities:

- Developing written procedures[48] derived from corporate documents[49] and establishing a risk management organization infrastructure;
- Creating a central risk register to assemble and document identified risks, results of assessments, response plans (mitigation activities) and status. The risk register is an Access database called RADAR (**R**isk **A**ssessment **D**atabase and **R**egister), which is maintained by a small Risk Group that is part of the Project Infrastructure section of the Refurbishment Planning and Controls organization;

- Initiating a Risk Oversight Committee ("ROC") comprised of RPET and various subject-matter experts that meets at least quarterly to provide oversight of program and project risk management activities.

On a separate path, SNC/Aecon and the OPG RFR Project Team are developing and vetting their own risk register as part of the RFR estimating process. Development of this RFR risk register is required under the specific terms of the JV Agreement and is based in large part on the OPEX and lessons learned from prior refurbishments. It will be used for monetizing a component of SNC/Aecon's target price for the Work.

OPEX and lessons learned are key sources of input for identifying risks within the Risk Management Program. To make full use of the OPEX from past refurbishments, the DR Project has established a formal process and procedure[50] to capture and communicate OPEX and lessons learned that assist in identifying and managing the risks.

In addition to the Risk, OPEX and lessons learned programs, the DR Team also has established a formal program for ensuring that assumptions, actions and decisions associated with the refurbishment are properly

[47] PMBOK is published by the Project Management Institute.
[48] Nuclear Refurbishment Risk Management, N-MAN-00120-10001-RISK-04-R000 (July 25, 2012), Nuclear Projects Risk Management Process, N-MAN-00120-10001-RISK-R001 (November 22, 2012).
[49] Darlington Refurbishment Risk Management Plan NK38-PLAN-09701-10067; Project Risk Management Standard, OPG-STD-0062.
[50] Darlington Refurbishment Lessons Learned And OPEX Management, N-MAN-00120-10001- RISK-06 (July 19, 2012).

assessed and that follow-up actions are documented and managed[51]. This information is collected and recorded in the Assumptions, Issues, Decisions and Actions ("AIDA") database, which is maintained by the Risk Group. The purposes for recording significant assumptions and decisions include: "To Exhibit prudence and oversight in the decision making process and in the validation of key assumptions impacting NR"; and "To maintain an auditable trail for future review and reference."[52]

To mitigate cost and schedule risks, the DR Team has established a Contingency Program[53] which provides for developing contingency from quantitative and qualitative analysis of risks residing in the Risk Registers and in functional area business planning. A more detailed analysis of the Contingency Program is discussed in Section IV.C.2.a.i.

b. Processes and Methodology

The process that the DR Team is using for developing the source data, analysis and presentation of risks is generally consistent with that observed in the industry at large although there are some issues with the quality of the information that DR Team needs to correct. Below we describe the component parts of the Risk Management Program.

i. Risk Scoring Process

The DR Team has populated the Risk Management Program's databases through facilitated brainstorming sessions, individual input and review of OPEX and lessons learned from other projects. The Risk Group aggregates and reports specific risks in individual projects or department RADAR files. High level "global" risks that have the potential to impact the viability of the whole Refurbishment Program are included in a Program Risk Register. Each Program risk is "scored" by assigning a number to reflect the probability of occurrence based upon the following rating system:

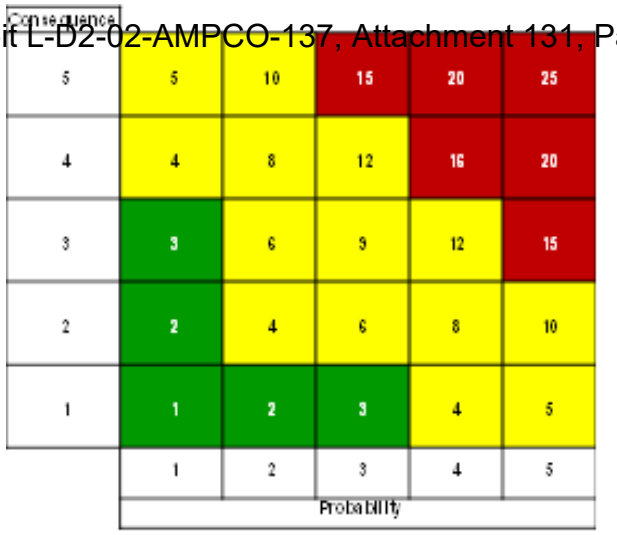
Probability Rating ->	1	2	3	4	5
Qualitative	Improbable	Unlikely	Possible	Likely	Probable
Quantitative	< 10%	10% - 30%	30% - 70%	70% - 90%	>90%

In addition, the consequence of each risk is "scored" relative to its potential impact on cost as depicted in the table below.

Impact Rating ->	1	2	3	4	5
Qualitative	Minimal	Minor	Notable	Substantial	Major
Quantitative (Cost)	< $5M	$5M - $50M	$50M - $200M	$200M - $500M	>$500M

Similar ratings are developed for schedule impact and risk manageability (i.e. ability to mitigate or control the risks). Different rating scales may apply to the individual Project Bundles and Functional groups. The final individual Risk score is determined by multiplying the probability of occurrence by the highest of the impact ratings for cost, schedule or manageability. The "heat map" below is a graphical representation of the probability and impact combinations that yield a risk score. The color coding depicts the severity of the risk relative to likelihood and impact.

[51] Nuclear Refurbishment Assumptions and Decisions Management, N-MAN-00120-10001 RISK-07 (March 5, 2013).
[52] *Id.*
[53] Nuclear Refurbishment – Contingency Development and Management, N-MAN-00120-10001 RISK-05 R001 (June 26, 2012).



EPC contractors supporting the DR Project must also prepare a Risk Management Plan for identifying and managing contractor related risks. Scoring of risks can be somewhat subjective as risk tolerance can vary from person to person. In our review of the various Project risk registers, we have observed wide variances in scoring practices. This may lead to difficulty by the management team to accurately identify and assign the proper amount of contingency necessary to cover these risks.

ii. RADAR and OPEX Databases

The DR Team developed the RADAR database to be the central depository of OPEX and lessons learned from external sources to OPG (e.g. the CANDU Owners Group, Bruce, the Institute for Nuclear Power Operations ("INPO")) or within OPG (e.g. Pickering, Operations & Maintenance, and the DR Project itself). A refurbishment OPEX management database is maintained by the DR Project's Program OPEX Single Point of Contact ("SPOC") in the Refurbishment Planning and Controls Risk Group. The OPEX SPOC gathers and screens OPEX and lessons learned items, enters the information into the database and distributes the new entries to the local departments and projects. Responsible departments and projects then assess applicability and respond to the OPEX SPOC regarding how the item will be addressed. The OPEX SPOC issues a quarterly OPEX/Lessons Learned Summary Report to document quarterly Lessons Learned and actions planned or taken to address significant items.

iii. AIDA Database

The DR Team has established the AIDA database as storehouse of all of the DR Project's major assumptions and decisions. This database is intended to support OPG's future rate proceedings as well as be an adjunct to the plant's configuration management.

All of the DR Project's significant assumptions are supposed to be entered into the AIDA database by submittal of a prescribed form to the DR Project Planning & Controls Risk Group. A similar process is used for significant decisions. However, the decision entry process ("Decision Record and Analysis Summary" – DRAS) requires a benefit-cost analysis and progressive approvals based on the potential impact of the decision. The DR Project Planning & Controls Risk Group is responsible for providing oversight and support throughout the assumption and decision management program. Action items that arise from meetings or individual submittals are entered in the actions database, which is also processed and maintained by the DR Project Planning & Controls

Risk Group. As noted below, the DR Team has not fully updated AIDA, which compromises its overall usefulness for its intended purposes.

c. Summary of Observations

A sound Risk Management Program is critical to the success of a complex project such as the DR Project. The DR Project intends its Risk Management Program to function along such lines. The DR Project's reporting to the BOD and management has been focused on risk identification. While there are good aspects of the DR Project's Risk Management and associated programs, they have not yet been developed to reach their full potential for supporting project objectives. In part, this is due to the maturity level of the DR Project program. A number of the concerns raised herein have been recognized by the DR Project Risk Group and selected action is underway. However, curative actions need attention at this time. The following issues are presented:

- **Risk Identification and Scoring Issues**: Many of the identified risks are really "concerns" stemming from potential inadequate management and thus serve to only clutter the Risk Register – contingency should not be added for poor management, rather, better management should be added. For example, Program Risk No. 300: "The risk is that the Campus Plan schedule may not be fully integrated with the Refurb schedule". Within the industry, the above would only be seen as a risk resulting from poor management, and not an innate work risk. Cluttering the register with false risks is energy consuming and serves no productive purpose. In addition, there is evidence of wide ranging ambiguity and inconsistency in the risk titles and descriptions which leads to uncertainty in understanding the risk that may in turn lead to misplaced mitigations.

  Moreover, the rules that the DR Team are using exhibit a broad range of probability (30% - 70%) and could mask serious differences in likelihood of occurrence scoring. A risk with a probability of 31% is given the same score as one with a probability of 69%. While the risk analysis process in not precise, the opportunity exists to inappropriately score a risk in this broad range.

- **Tools for Risk Management Program**: The software systems used for Risk Management and related programs (i.e. RADAR, AIDA, OPEX) are cumbersome with limited capabilities and do not interface well or cross reference with each other. This limits effectiveness as a management tool and causes inefficient use of personnel time. Efforts by the IT group to improve this critical system are essential at this time.

  There are a number of shortcomings in the various databases that the Risk Group is tasked with maintaining. For example, the AIDA database is conceptually an excellent tool that should help OPG immeasurably in future rate proceedings. However, our pulsing of AIDA's content identified a number of significant gaps in the information that has been stored within the database. In addition, we noted a number of entries of questionable value (e.g. numerous entries state "the assumption is that identified criteria with regards to (an event) will be met"). Also, many of the entries border on events that should be considered "risks;" however, there is no indication that a corresponding risk was created in the Risk Register.

  The OPEX and Lessons Learned program is good, but the OPEX database is not fully integrated with RADAR and AIDA database. This disconnect could cause important OPEX and lessons learned issues to be lost or ineffectively tracked. The DR Project Risk Group's plan for creating an integrated, user friendly and accessible system will remedy this.

- **Opportunities**: A good Risk Management Program also attempts to identify "opportunities" and provide for a proactive response to improve the likelihood of the "opportunity" occurring. No such opportunities have been observed in the DR Project RM Program, suggesting that latent opportunities may be out there.

- **Contingency**: The DR Team is currently implementing a revised contingency process. However, properly implementing and managing the program will be a challenge, considering the above concerns regarding resources in the DR Project Risk Group, training, risk definition ambiguity and RADAR database capabilities. Performing stochastic analyses to calculate contingency is appropriate. However, it is a complex process that could yield inconsistent results. The issues identified herein need resolution in order for the stochastic modeling that will form contingency recommendations to be accurate and consistent.

- **Lack of Metrics**: The Risk Management and associated programs have a less than desirable number of meaningful metrics to provide management with a sense of the maturity or fidelity of the underlying the data and the DR Project's performance.

- **Staffing and Leadership:** The Refurbishment Planning and Controls Risk Group is lean and staffed with capable but relatively inexperienced individuals - several staff are Co-ops or interns. The DR Project's philosophy appears to be for the individual projects and departments to perform the majority of Risk Management duties and related work, while the central Risk Group serves only an administrative, support and oversight role. This creates a condition that at the end of the day, risk management is viewed as a collateral duty of project or department personnel which dilutes and diminishes the attention focused on risk management efforts, given other duties of such entities. A recent self-assessment of the DR Project Risk Management program concluded that *"Darlington lacks the resources to achieve the desired dynamic risk culture"*. Despite that conclusion, the accompanying recommendation advocates no curative action.

  In a related note, training for Risk Management and related programs is occurring in an ad hoc manner, and the resultant issues addressed in this report reflect its ineffectiveness.

d. BMcD/Modus Recommendations—Risk Management Program

Based on the above observations, BMcD/Modus recommends that the Project Team consider the following with respect to the Risk Management and associated programs:

- ***Provide Direction on Risk Scoring and Evaluation***: The DR Team should decide whether all Risk Registers "concerns" that rely on existing management processes should be considered innate "risks" with associated analyses, mitigation actions and tracking. The team should also consider whether the definition of risk should include a phrase such as: "…for which there is no management structure of process to address". The team should vet all DR Project's Risk Registers and identify those entries which fail to rise to the level of a true risk and consider removing such items as appropriate by closing the risk or transferring it to an action item list.

  The team should seek to eliminate ambiguity in risk descriptions, prepare and distribute a short instruction for responsible risk owners to review and revise their risk descriptions. Alternatively, the team should consider assigning several technical writers to review risk descriptions and interface with the responsible risk owners to clarify the descriptions. Also, to avoid inconsistencies and to preclude "gaming", contingency derivations should be performed across all areas by a qualified centralized

group with adequate resources and detailed procedural requirements. Finally, the team should consider revising probability scoring to include specific points rather than ranges (e.g. 10%, 30%, 50%, 70% and 90%).

- ***Address Leadership Issues***: Many of the concerns raised in this section of the report would likely be addressed by appointing or hiring a strong, experienced, and assertive central Risk Program Coordinator with an established track record of success, endorsed by senior management. The risk manager should have well-defined responsibilities (e.g. oversee RM, OPEX, AIDA activities on a day-to-day basis, proactively advocate the documentation of decisions, assumptions, lessons learned, etc., eliminate ambiguity and inaccuracies of database entries, facilitate consistency in risk analysis/scoring and in contingency development, conduct training, etc.). Also, the DR Team should consider performing a staffing analysis to ensure that the Risk Group is right-sized with the appropriate skill sets.

  OPG should also consider elevating the Risk Group in the DR Project organization to give it more stature and to demonstrate that senior management considers Risk Management, OPEX Management, Decision and Assumption Programs to be serious and extremely important elements of a successful Nuclear Refurbishment.

- ***Expedite the IT organization's efforts with the Various Databases:*** The DR Project needs IT support to develop the needed Risk/OPEX/AIDA software systems pursuant to the recommendations of the Risk Group.

- ***Address AIDA Database Gaps:*** The DR Team should clearly define the requirements of the AIDA Database, review the existing database for conformance with such requirements, and revise the database as required.

- ***Training Gaps***: The DR Team should consider developing and executing a comprehensive Risk, OPEX and AIDA training program. This training would foster an understanding and acceptance of the importance of these programs, stimulate proactive participation and encourage the identification of opportunities in the Risk Registers. Once effective training is initiated, consideration should be given to establishing an internal communication program to keep people informed and to sustain appropriate employee interest and participation.

- ***Metrics and Trend Charts:*** The DR Team should review (and develop or re-develop) appropriate metrics to effectively track various elements of the risk management program.

V. Major Project Bundles

A. Retube and Feeder Replacement

The DR Project's largest single cost component is the Retube and Feeder Replacement ("RFR") project, which comprises the Project's critical path and represents the largest risk to the Project's overall execution. OPG is the fourth utility to perform a mid-life refurbishment of CANDU reactors, and all of the prior unit refurbishments have experienced a number of significant delays, cost overruns and/or performance issues. Thus, understanding the risks and lessons learned from these prior projects is an essential part of developing the RFR cost estimates.

The RFR project is organized into three phases:

(1) Definition Phase: pre-outage work beginning February 1, 2012 and to be completed before the first plant outage in 2016. It also includes the development of specialized tooling and the design and construction of a reactor mock-up for training purposes, prior to refurbishment.

(2) Execution Phase: actual specialized fieldwork associated with each of the station's four reactors, including the removal and replacement of 480 pressure tubes, calandria tubes, 960 end fittings; and 960 feeder pipes the reactor components and includes training and tool maintenance for each of the four DNGS units; and

(3) *Commissioning Phase*: plant commissioning and support as required and directed by OPG.

On March 1, 2012, OPG awarded the RFR contract to SNC/ Aecon (the "JV Agreement"). The JV Agreement is for the Definition Phase of the RFR Project that will be performed from 2013 to mid-2016. The current value of the SNL/Aecon contract is estimated at over $600 million. Once the Definition Phase is completed, OPG and SNC/Aecon will determine the cost to complete the Execution and Commissioning Phase work and if such cost is acceptable, OPG will award the remaining contract work for the Execution Phase.

1. RFR Cost Estimates

The JV Agreement requires SNC/Aecon to develop a series of progressive cost estimates based on AACE *cost estimate Classification System* for the Execution Phase. Per the JV Agreement, the timeline for developing and submitting the progressive cost estimates spans a period of about three years beginning on August 1, 2012. Submission of each progressively classed cost estimate (i.e., Class 4, 3 and 2) is contractually due on June 15 of each year, starting in 2013. The final Class 2 Estimate is intended to form the basis of SNC/Aecon's Parget Price for the Execution Phase.

The intent for the progressively classed cost estimates is to absorb all lessons learned through mining-out OPEX along with other information developed during the Project's Definition Phase, all as it becomes available, validated and approved by OPG. The JV Agreement established as part of this progression of estimates a process whereby the successive classes of estimates proceeding to the final Class 2 Estimate specifically exclude consideration of contingency. The JV Agreement at 3.5 states, "Every Execution Phase cost estimate prepared in accordance with this Agreement will not include any contingency amount." However, the JV Agreement also states that the estimates at every level will follow AACE guidelines, and those guidelines include calculation of contingency.

The parties' intent in the JV Agreement is to use the risk register to help develop and manage the Target Cost. OPG and SNC/Aecon will mutually determine and agree on the risks to be included on the risk register. Once there is an agreement, the Target Cost can only be increased for those risks that were identified (unless the risk is an excusable event). As we previously discussed, the procedure dictated by the JV Agreement actually conflicts with the AACE guidelines as well as the processes established by the DR Team for scope and cost "gating."

Nonetheless, as with all cost estimates for the DR Project, as the knowledge that forms the basis of the estimate matures, the RFR Team must present the resulting revised estimate under the DR Project's Gate Process. The intent of this process is to ensure that all important aspects of the estimate under scrutiny have been adequately vetted before proceeding further.

2. BMcD/Modus Review of RFR Cost Estimates

BMcD/Modus has examined the two RFR estimates to date to evaluate: (1) the efficacy of the vetting process for the DR Project's most significant scope of work; (2) the status of the RFR's estimate and how it should viewed by OPG's Management; and, (3) draw broader conclusions regarding the methodology the DR Team has established for review, vetting and challenging estimates in general. To more fully understand the methodology and procedures used for development of the Class 5 and Class 4 Estimates, BMcD/Modus has met with the key members of the OPG RFR estimating team.

In conjunction with its oversight responsibilities, BMcD/Modus has reviewed various OPG's procedural and process documents, certain PowerPoint presentations and the cost estimates. A list of these documents appears in Exhibit A.

a. Basis of Estimate – Class 5

SNC/Aecon's Class 5 Estimate was initially submitted on August 1, 2012 in accordance with its Project Estimating Plan.[54] OPG observed considerable shortcomings in this initial estimate submission. Most notably, OPG found that contrary to the contractually prescribed methodology for developing the cost estimate, SNC/Aecon embedded several prohibited cost items, such as contingency and overhead within the base cost estimate. As a result, OPG rejected SNC/Aecon's initial Class 5 Estimate. The total of the rejected Class 5 Estimate was $2.841 B, which OPG determined to be "too high".

As identified in the Estimating Plan, which reflects the current understanding between the parties for the development of the estimates, the root causes of the disconnect between SNC/Aecon and OPG were:

- The detailed basis of estimate were not agreed upon before SNC/Aecon started;
- The original Estimating Plan was too high level;
- SNC/Aecon did not clearly understand the basis for OPG's intended estimating process;
- SNC/Aecon's estimating resources changed, resulting in lost continuity;
- Inadequate and untimely collaboration over details in the estimate.[55]

The remedy for these early process failures was the parties agreed that "schedule and estimate [for the successive estimating packages] to be prepared as ***ideal without risks, contingency & factors per the Agreement***."[56] The basis for the next iteration of the Class 5 Estimate was a Process Flow Diagram ("PFD") that was derived entirely from OPEX and largely from Wolsong, which was then reviewed and monetized based on the associated level of effort. "In the Class 5 Estimate the critical path activity durations were established on adjusted OPEX durations, based on a percentage average adjustment representing 'ideal' productivity for all [Direct Field Labor or "DFL"] activities equally applied, without contingencies or allowances."[57] The only adjustments to the DFL categories were to adjust the size, scale and to some extent the work rules that represented the difference between Wolsong and Darlington at a very high level.

SNC/Aecon submitted the revised Class 5 Estimate on December 21, 2012. The revised Class 5 was $1.512 B. Within the industry, the approved Class 5 Estimate would be considered appropriate in defining the reference

[54] DNGS RFR Project—Project Estimating Plan 509407-0000-00000-33IM-0001 R3 (March 21, 2013).
[55] *Id.* at p. 18.
[56] *Id.*
[57] *Id.* at p. 17.

plant for an estimate of this type. The modifications to the process produced what was intended by the JV Agreement—a jumping off point for estimating this work, based on OPEX and in consideration of process improvements that should come from the repetitive nature of this work.

b. Basis of Cost Estimate – Class 4

The goal for the Class 4 Estimate was for SNC/Aecon to state and OPG to validate the primary costs consisting of vault DFL and the Owner Specified Materials ("OSM"). SNC/Aecon presented an estimate based on "individual OPEX validations" with "100% of all DFL activities on the PFD critical path series. . .analyzed and validated assuming ideal productivity without contingencies or allowances for unforeseen disruptions."[58] In other words, the Class 4 Estimate was intended to be a validated, perfect-world reference plant with all risks wrung-out. Each DFL activity on the Project's critical path for the Class 4 Estimate was individually validated, as opposed to the Class 5 Estimate procedure wherein only an average adjustment factor was used, based on OPEX sampling. The vetting of the above described activities was memorialized in specific estimating reports called *Mini-Estimate Reports*.

As stated, each of the Class 5 and Class 4 Estimates utilized information from previous OPG projects (OPEX), *looking backwards*. The primary outside referenced project used for the Basis of Estimate ("BOE") was Wolsong Unit 1 (2009-2011) OPEX. Below are select estimate considerations:

- OPEX information has been adjusted for quantities and assumed optimum shift work hours and other patterns.
- In the estimate, all work is deemed executed under *ideal* conditions and thus actual *poor productivity* has been excised (based on a review of OPEX information).
- All contingencies and risks have been removed from the estimate.
- OPEX data from the Bruce Restart project and Point Lepreau has been used, as appropriate, when no other data is available.
- OPEX information has been adjusted to reflect existing Ontario Labor Agreements.
- Generally, DFL parallel path activities (i.e., non-critical) have not been robustly re-assessed but have been minimally reviewed so as to determine if they have *gone critical* as a result of CP duration changes made when moving to Class 4 from Class 3.
- Percentage allocation for support services, training and Project Management Team ("PMT") labor have been carried forward based on the Class 5 Estimate.

Utilization of the above methodology has resulted in a project estimate modeled under *best theoretical* performance conditions. However, the Class 4 Estimate was essentially devoid of more refined cost estimates specifically for Darlington that include productivity factors and contingency identification.

[58] *Id.*

i. Cost Estimate Variance Analysis

The monetary changes noted from the approved Class 5 to Class 4 Estimate were minor: these variances total ~$139.6M or 9.23% growth from the Class 5 Estimate amount. The most significant difference from Class 5 to Class 4 Estimate were changes to the work day ("WD") durations for critical path work activities in the vault, as summarized below in Table A:

Table A - Critical Path Summary and Variance

Vault Summary Series	Class 5 Durations (WD)	Class 4 Durations (WD)	Variance (WD)	Basis for Variance
Pre-Requirements	32	92	60	40 WDs added to SNC/Aecon schedule for bulkhead installation; 6 WDs added for PHT work; 14 WDs reconciliation of critical path
Feeder Removal	44	55	11	13 WD added for one parallel task (Feeder Cabinet Removal) changed to critical path; 3 WD added for a new critical path task - Feeder Monorail; -5 WD deleted for reduction of Feeder Removal activity.
Fuel Channel Removal	219	223.5	4.5	Re-evaluation of OPEX related to critical path activities.
Inspection	75	82	7	Re-evaluation of OPEX related to critical path activities
Feeder Installation	97	79	-18	Re-evaluation of OPEX related to critical path activities
Fuel Channel Installation	138	138	0	No changes
Post-Requirements	18	63	45	20 WD added due to the addition of bulkhead removal. 26 WD added due to new execution strategies for four critical activities. -1 WD reduced due to re-evaluation of OPEX related to critical path activities.
TOTAL	623	732.5	109.5	

From a cost perspective, the impacts of these revisions were as follows:

- Bulkhead activities and associated cost in both the Pre-Requirement phase and Post-Requirement phase are now included in Class 4 Estimate whereas these costs were not included as scope in the Class 5 cost estimate ($73.2M or ~4.84%). OPG has shifted this scope from the Islanding Project to RFR, and thus does not represent a major impact to the overall DR Project's budget.
- Escalation to 2013 dollars is included in the Class 4 Estimate ($38.4M or 2.54%) per the JV Agreement.
- Other miscellaneous changes ($29.9M or ~1.85%):
    - OSM decreased based on actual vendor feedback and quotations.
    - Feeder installation duration/hours were significantly reduced as a result of more detailed analysis when compared to the Class 5 Estimate.
    - Tool decontamination and packaging increased in Class 4 level
    - Non-Destructive Examination, Phased Array Testing and Shielding scope was added to the Class 5 Estimate.
    - Letter of Credit costs increased due to a calculation error in the Class 5 Estimate.

The relatively minor change to the cost estimate from Class 5 to Class 4 reflects the parties' goal to perform "100% validation" of the critical path PFD activities that are the foundation of the estimate. It is not clear as to why this work was deferred to the Class 4 Estimate, and the production of the estimates one-after-the-other indicates that this was a continuous effort that may not have justified two separate deliverables or classifications. The variance between the estimates is not reflective of any real increased level of project definition, at least according to AACE Recommended Practices. The most significant change between the two estimates, the bulkhead scope ($73.2M), was a part of the DR Project, but the scope was shifted to SNC/Aecon after release of the Class 5 Estimate.

BMcD/Modus does not question that SNC/Aecon's estimate is nevertheless better as a result of this validation. However, both OPG and SNC/Aecon should seek to define and classify future estimates with greater precision and traceability to the established processes for the DR Project. If the parties proceed as anticipated in the JV Agreement, this issue will be cured with the Class 3 Estimate, which will be premised more on the specific definition of SNC/Aecon's DR Project Execution Plan and less on the theoretical model that is the heart of the Class 4 Estimate.

ii. Estimate Quality Assurance

The Class 4 Estimate was developed in accordance with SNC/Aecon's Project Quality Assurance Plan. The OPG Estimate Quality Assurance process includes selection of qualified estimating team members who have hands-on experience with CANDU RFR refurbishment beyond available OPEX information. From our review, it appears that the team included or otherwise drew upon Subject Matter Experts with relevant expertise for the purposes of consulting with and advising the OPG estimators. Another level of oversight was provided by SNC/Aecon's Review Team for the purposes of validation of OPEX information and also to ensure complete in-depth scope coverage in the estimates. The cost estimate was also reviewed by a cold-eye Peer Review Team to catch any errors or omissions that SNC/Aecon's Team members may have over looked.

In our view, the OPG cost estimate team exhibits a reasonable composition of talents including experience mix. However, as is true with most nuclear refurbishments, the DR Team will be constantly challenged as the Project progresses.

In order to test the quality of the estimate, BMcD/Modus randomly sampled several line items of cost in the Class 4 Estimate. As a result of this sampling, we found some minor inconsistencies, such that the OPG team should consider assigning a quality resource to scrub estimate sheets for errant inclusions or exclusions, as well as perform quality checks on spreadsheet formulae and the like so as to end up with the most reliable work product reasonable. This is industry best practice particularly on projects involving repetitive work.

iii. Observations Regarding the RFR Estimates

As noted above, we do not believe that the current SNC/Aecon estimate does not comply with the standard definition of a Class 4 Estimate as such definition is used by AACE, or the industry at large. SNC/Aecon's Class 4 Estimate is based almost entirely on a scale-up of a reference plant (Wolsong) with all known or perceived imperfections removed (an issue itself subject to considerable ambiguity). In developing this "perfect" theoretical estimate, SNC/Aecon and OPG intentionally (and in accordance with the JV Agreement) overlooked central considerations of the AACE guidelines identify for classification of estimates, as summarized below:

- ***The Class 5 through Class 3 Estimates do not include contingencies amounts.*** Per AACE Recommended Practice 18R-97, the expected (+/-) accuracy ranges for Class 1 through Class 5 cost estimates have meaning only after application of contingency (typically at a 50% level of confidence).[59]

- ***Project maturation was not considered in the Class 4 Estimate.*** Per AACE Recommended Practice 18R-97, and in line with industry practice, the maturity level of project definition is the primary determinant of an estimate class – maturity level generally comprises engineering percent complete. For example, in a Class 5 Estimate, the expected level of project definition (as measured by engineering) would range between 0 to 1% of total engineering being complete. For example, a key deliverable for measuring engineering percent complete would be number of completed block flow diagrams. Similarly, for a Class 4 Estimate, the expected level of project definition would range from 1% to 15% of total engineering complete and key design deliverables would include a number of completed block schematics, process flow diagrams (PDFs) for main process systems and preliminary engineered process and equipment lists.

- ***That SNC/Aecon and OPG did not follow AACE for the Class 4 Estimate is intentional, as the JV Agreement's language would preclude classification of these estimates within AACE.*** OPG Management should recognize that this very large and significant portion of the DR Project is being measured, estimated and monetized in a manner that is different from the other scopes of work on the Project. However, as noted, this is by contractual design, as SNC/Aecon is not obligated to provide monetized input regarding the items in the Risk Register until the conclusion of the target price negotiations, which is scheduled for May 2015.

- ***The development of a "perfect" reference plant comes freighted with ambiguity.*** To the uninformed observer, SNC/Aecon's Class 4 Estimate could appear to represent a model for the best possible

[59] AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011) at p. 2.

outcome (aka optimal performance) for the DR Project. However, the current Class 4 Estimate actually represents a model of "perfect" performance that the DR Team believes is unrealistic to expect in the real world at any location, even perhaps Wolsong. Further, the "reference plant" is actually not Wolsong (which, to date, represents the most successful RFR project from a schedule standpoint) but a modified Wolsong absent approximately 19% of its as-built durations, then scaled-up to match the Darlington parameters. Thus, OPG may well be subject to managing the Project to a wholly unrealistic mile post.

- ***Ultimately, BMcD/Modus recommends that OPG focus on the value derived from the Class 4 Estimates not on whether it meets AACE's definition of a Class 4 Estimate***. The RFR work is different from many major construction scopes whereas the AACE classification is ordinarily applied to work that is largely repetitive and akin to a manufacturing process in which tooling, reliability and assembly-line precision is required. Developing an estimate that summarizes the best possible performance of such an operation has significant value.

OPG should be extremely cautious in regard to characterizing its current estimate as being anything other than *current best efforts toward compliance with the AACE estimate classification scheme*. The current estimate nevertheless has great value and should be viewed as a useful benchmark as OPG progresses to an AACE Class 3 Estimate where the cost estimating work product must shine, no excuses allowed.

d. Class 3 Estimate Progression

The starting point for development of the Class 3 Estimate is the Class 4 Estimate and the Project Estimating Plan. From this point forward, the Class 3 Estimate will be *looking forward* utilizing well-defined Process Flow Diagrams (PFDs), preliminary Construction Work Packages and applicable N-Procedures that are unique to the DR Project and based on SNC/Aecon's view of constructability. This methodology change could result in task-based duration and man-hours variances; indeed, it could result in improvements from greater knowledge and improvements to the tooling that will be tested in the mock-up. The Class 3 estimate's efficacy will determined by the completeness and availability of detail within the design, procurement, mock-up facility and tool testing work efforts, all of which will facilitate progress to the requisite depth and accuracy.

Any developing variances (to the extent existing) will be logged and vetted within the Class 3 Estimate progression cycle. The Class 3 Estimate will be structured as an integrated program to allow for further progression to Class 2 Estimate. OPG expects that the Class 3 Estimate will reflect the SNC/Aecon's estimate of 100% "wrench time" based on the maturation of the DR Project's design and the proving-out of the tool set in the mock-up. SNC/Aecon and OPG will further review certain mitigation strategies and actions to reduce risks in the Execution Phase which will be monetized in the Class 2 Estimate.

As stated previously, the Class 3 Estimate will use the Class 4 Estimate as the basis for further development and some important activities and aspects of that effort will include:

- The establishment and maturation of key inputs that will drive the estimate (e.g., Process Flow Diagrams, Engineering and Construction Work Package development and Risk Register).

- A review of the experience and OPEX during the Class 5 and Class 4 Estimate work effort and adjustment of processes and methodology, as appropriate, for continued development of the Class 3 Estimate.

- Compliance with the next level of AACE estimate classification requirements as further underscored by OPG procedural documents.

- Identification of major variances as between the Class 4 and Class 3 Estimates.

- Examination, reassessment and refinement of the Risk Register associated with the Class 3 Estimate.

These steps are anticipated by the JV Agreement and should result in a further-refined estimate.

3. Risk Program and Contingency Development for Target Cost

The Risk Register plays a very important role in the development of the Target Cost for the Execution Phase of the Project. As discussed above, it is not anticipated that the RFR Contractor's Execution Phase estimate will include contingency until submission of the Class 2 Estimate. The contingency amount will be determined using a probabilistic approach based in large part upon identification of risks on the contractor's risk register. The JV Agreement sets forth the following requirements for the development of SNC/Aecon's development of the Risk Register:

> Prior to the submission of each such Submittal, during the preparation of the relevant Risk Register, OPG and the Contractor will work cooperatively towards achieving OPG approval of a final Risk Register by the date specified in the Definition Phase Milestone Schedule. Contractor will develop such Risk Register through a series of workshops that will be facilitated by OPG's authorized representative or an independent third party.
>
> The risk analysis workshops will follow the following methodology:
>
> (a) Holistic risk analysis;
> (b) Schedule risk analysis;
> (c) Cost risk analysis; and
> (d) Independent third party review.[60]

Additionally, it appears that the final risk register is subject to agreement between the EPC Contractor and OPG. The importance of the risk register is laid out by Section 3.5(g) of the Contract:

> (g) **Effect of Agreement on the Risk Register**. Once OPG and the Contractor reach agreement on the Risk Register, no Amendment will be made to the Execution Phase Milestone Schedule, the Execution Phase Target Cost, the Submittal Schedule, the Execution Phase Target Schedule or the Execution Phase Fixed Fee to address a risk that arises during the Execution Phase and that is not identified on the Risk Register attached as Exhibit 3.5(g) (other than risks related to excusable delays as set out in section 5.2(a), or a change in Applicable Laws as described in section 4.4, or as otherwise set out in an approved Project Change Directive or an Amendment). However, OPG will compensate the Contractor for Reimbursable Costs incurred for any Work required to address any such risks that have an impact on the Execution Phase Work and that were not identified on the final Risk Register.

[60] RFR EPC Contract at Exhibit 3.5, Section 14.

SNC/Aecon is progressively refining its Risk Register as the EPC cost estimate progresses through the various AACE estimate classifications. As of May 1, 2013, the Risk Register contained some 329 identified risks. In the further development from Class 5 to Class 4, SNC/Aecon and OPG analyzed 169 (51%) of these initial risks, while 44 (13%) were not analyzed. In addition, the parties agreed to add 116 (31%) additional risks to the register. Of significance, the Risk Register contains non-productive work activities that SNC/Aecon identified from OPEX and stripped from the Reference Plant in Class 4. SNC/Aecon has not fully developed its Risk Register (nor does it have an obligation to do so at this time) to allow OPG to begin vetting the necessary contingency. OPG should consider accelerating the pace at which SNC/Aecon monetizes the Risk Register so that OPG can apply appropriate contingency at the project level sooner than the JV Agreement anticipates.

4. Recommendations – RFR Cost Estimate

Based on our review of the progression of RFR estimates to date and our understanding of the DR Project's next steps, BMcD/Modus has drawn the following conclusions:

- AACE Classifications: Going forward, OPG should seek to clarify the guidelines used for establishing the RFR's BOE which are inconsistent with the terms of the JV Agreement. The primary estimating guidance for SNC/Aecon consists of:

    - AACE Recommended Practice Number 34R-05 - Basis of Estimate with an accuracy band of -30% to +50%.
    - OPG Instruction N-INS-00400-10001 R01 "Estimate Developing"
    - Exhibit 3.5 of the SNC JV Agreement

    However, as defined by the JV Agreement, the Class 3 Estimate will not include contingency of any sort and as a result, the associated AACE accuracy bands will not be applicable. From a process standpoint, OPG should seek to clarify the application and appropriate use of these various standards and guidelines in the Class 3 Estimate so as to avoid potential confusion, inconsistency and communication problems during the next phase of the RFR estimate development.

- Metrics for Estimating Progress: The DR Team should strongly consider implementing meaningful metrics that are simple and user-friendly in order to effectively and realistically monitor progression of SNC/Aecon's Class 4 to Class 3 estimate during the next 12 months. Such metrics can track the progression of the estimate in lock-step with the overall maturation of the RFR project, which will have the associated benefit of providing management with key health indicators. One example would be to measure engineering progress by using planned vs. completed drawings in various categories (e.g., P&IDs) on a monthly basis. Another example might be to use work down curves for Engineering and Construction Work Package development.

- Monetizing SNC/Aecon's Project Management Costs: A major outlying cost to be determined in the Class 3 Estimate is SNC/Aecon's management and overhead costs. In Section 1.1.3 of Appendix D-10 of the Class 4 Estimate, the Specific Cost Estimating Report indicates that the percentage cost add-on for foremen management and supervising foreman management and PMT remained unchanged from the Class 5 Estimate. No new information was presented, such as monetization of an organizational chart to support a progression to a Class 4 Estimate. As SNC/Aecon most likely has historical experience suitable for use in meaningfully quantifying these cost items, the earlier the look at it, the better. With respect to SNC/Aecon's Support Services, in Section 1.1.2 of Appendix D-11, of the Class 4 Estimate, the Specific Cost Estimating Report shows that the percentage cost add-on for Support Services (SS)

remained unchanged from Class 5 Estimate. No new information has been presented to suggest a meaningful progression. Again, SNC/Aecon should have historical experience to use and progress the estimate in this regard.

- RFR Risk Register: Considerable work remains in identifying and monetizing risks in the Risk Register specific to the RFR work.
    - The OPG estimating group should be used as a resource to help vet the monetizing of risks as performed by SNC/Aecon. By comparing the SNC/Aecon's assessments to its own, the OPG team will be better equipped to make informed decisions on the reliability of the SNC/Aecon contingency work product.
    - The Execution Phase Risk Register for the Class 4 Estimate contains 329 identified risks at various levels such as low, medium, high and very high. The list is too long and appears redundant yet will most likely grow with the passage of time. As stated elsewhere, for a project of this complexity and importance, OPG should consider bringing on board an experienced risk manager with a solid construction background so as to best manage the Risk Register.
    - As noted, OPG should consider revisiting the contractual scheme that currently prevents SNC/Aecon from monetizing risks until the creation of the Class 2 Estimate and the target price.

5. RFR Schedule and Plan Optimization

a. RFR Schedule Status

RFR's overall schedule development is significantly ahead of the other Project Bundle Teams, particularly in the evolution of the detailed level 3 schedule. The RFR team is involved daily with SNC/Aecon's detailed schedule and monitors development and update progress against the milestones and level 2 activities weekly. Nonetheless, as noted, there are some issues with the RFR's status in the schedule that need to be addressed, including a number of activities with excessive float (600+ days) though the RFR team believes this float is realistic due to early performance of certain work. In addition, RFR will need to examine multiple activities with 500+ days of duration.

Since RFR is on the critical path, it is good that its schedule is farther ahead so that the bugs can be worked out well in advance. Because this team is so far ahead of the others in the planning and schedule development area, the RFR team has encountered technical schedule formation issues that the other teams have not yet encountered. In some cases, Project Controls has not been made aware of some of these issues and is busy establishing rules and criteria for overall project planning and schedule development. These rules do not always address the problems encountered early by the RFR team and are sometimes contradictory to the direction already chosen by this team. As a result the RFR team has to rework previously developed schedules, formats and/or codes. The most affected area of development thus far has been the summary level 2 schedule for RFR. More attention needs to be given to the RFR schedule team's handling of these issues as they are true indications of future project issues.

Some conflict has developed between the RFR Bundle Team and the OPG Project Management Team (and potentially some of the other Bundle Teams) due to this misalignment of progress and not just in the area of scheduling. This conflict is mainly due to the somewhat isolated nature of the teams in the area of project management and schedule development. This is not unusual early in the life of mega-projects like the DR

Project. Because the individual scopes of work are so large and unique that they warrant individual bundle teams, it is the nature of these groups to focus on and attack their scopes somewhat independently. However, we see the issues that have developed with the schedule maturation as further evidence that the DR Team needs to break down silos and move to a unified Program approach.

b. Planning Opportunities

Now that SNC/Aecon has developed the reference plant work plan that forms the basis of its estimate, the team's attention will be focused on developing the specific plan for the DR Project. In doing so, SNC/Aecon and the OPG RFR team should maintain one eye on the OPEX from Wolsong and Lepreau while looking for ways to optimize the plan to move the planning assumptions from *best achieved* to *best achievable* plan. As an example, in our review of the Wolsong OPEX and how it was used in formulating the Class 4 Estimate's BOE, it appears SNC/Aecon has not accounted for the likely productivity improvements OPG will achieve from the revised volume reduction strategy.

From our team's OPEX (Wolsong, Pickering and other relatable plants), there are certain improvements that we believe the team should consider, including:

- In the fuel channel removal, SNC/Aecon should consider a process improvement over Wolsong and remove channels from both sides of the reactor. Doing so could improve the critical path by as much 8-9 days and could lessen overall dose.
- There are certain tool fixes that CANDU Energy made due to performance issues at Wolsong; we will be interested in seeing how these fixes result in better tool performance from the start of the work.
- Distinguishing the Wolsong OPEX from volume reduction from the newly minted plan from SNC/Aecon to see if adequate time and risk has been squeezed from the plan.

As SNC/Aecon's plan is further fleshed-out, we will examine the revised plan for time duration, manpower and manhours for the individual components of the work against the as-built from past refurbishments. In addition, BMcD/Modus has other recommendations for OPG to consider, including:

- Requiring SNC/Aecon to add CANDU Energy personnel who were particularly helpful and effective in the Wolsong project.
- Having a team from OPG working shoulder-to-shoulder with CANDU Energy and tool supply subcontractors in learning the operation of the tools, which we believe will aid OPG in decision-making during the Execution Phase.
- Obtain and rationalize the complete set of Wolsong and other stations' OPEX through the CANDU Owners' Group.
- Begin challenging SNC/Aecon regarding its bandwidth to support multiple refurbishments at once in light of its past performance and likelihood of Bruce Power deciding to go forward.

B. Balance of Plant

Balance of Plant ("BOP") scope for the DR Project consists of DSR's for plant modifications of the following plant areas and systems:

- Pre-refurbishment Work

- Safety & Control Systems
- Reactor Component Systems
- Conventional Systems
- Common Systems
- Special Programs.

For the Execution Phase, the BOP team is working to combine DSRs into these systems to the extent possible. In addition, much of this work is considered "contingent scope" and the necessity of its performance will depend on the outcome of scope defining inspections that will be carried out during upcoming outages. Therefore, as is often the case in refurbishment projects, the scope that comprises the BOP is the most difficult to plan, which can lead to problematic schedule and cost estimate issues.

The DR Team attempted to anticipate the typical issues with BOP in its contracting model, though some of the initial assumptions it made are not materializing. There is a significant risk that absent changes, the BOP work—and in particular, detailed engineering work performed by the EPC contractors—will not advance quickly enough to provide management with a high-quality estimate at RQE.

As a result, the DR Team is currently investigating methods for improving the schedule for BOP scope definition, which in turn should yield a higher quality plan and RQE. However, doing so may require a significant change in the planned project procurement and delivery method. The following summarizes the strategy, status of the BOP work, and recommendations for improvements, many of which are currently being pursued by the DR Team.

1. Current Contracting Strategy

As memorialized in DR Team's Contracting Strategy for Balance of Plant the BOP Team "determined that the preferred approach for [BOP work] is to collate as much bulk work as possible to best leverage existing Extended Services Master Service Agreements ("ESMSA") and Engineer, Procure, Construct ("EPC") concepts, and to separate out specialized work by exception for alternative sourcing strategies."[61] By implementing this strategy, the DR Team seeks to simplify the BOP procurement approach for an "inherently complex collection of work that doesn't fit well into existing DR projects" and minimize the risk inherent in OPG integrating a large number of separate but inter-related packages of plant system work.[62] The ESMSA contractors are ES Fox and Black & McDonald. These contractors were chosen through an RFP process which allowed OPG to negotiate both the contract terms and the rates in a competitive environment. There are no major differences in either the contract terms and conditions or the rates of the two ESMSA contractors.

After reviewing multiple options for executing this strategy, the DR Team decided to bulk BOP work into two major EPC packages made up of multiple DSRs: (1) nuclear side system work ("NSSS") and ii) conventional side system work. Scoping of the work is occurring via development of MDR/MDP packages by Project Engineering and the OSS vendors. The BOP Team's intent is to bid the work between the ESMSA vendors on a "Secondary Compete" basis. The Secondary Compete is intended to identify which of the vendors is most qualified for the work, and the possibility exists for only one vendor to emerge with the

[61] *See* Contracting Strategy for Balance of Plant, NK38-REP-09701-10102 (March 19, 2013) at p. 4.
[62] *Id.*

entire BOP scope. The BOP Team rejected the option of bidding each individual system in smaller packages due to OPEX that such a method could increase field execution rub points and integration issues and put OPG in the position of having greater management and oversight of the work.

The DR Team's evaluation also considered whether to open competition beyond the ESMSA vendors, though the team concluded that the utilizing the existing vendors had a number of advantages: (1) contracts were already in place based on an open, competitive negotiation; (2) the work under the BOP contracts would be similar in type to the work that the ESMSA contracts were intended to control; and (3) an open bid competition would require significantly more scope definition from OPG than time permits.

The DR Team recognized there were certain risks with this contracting strategy, among which are:

- Because of the scope definition timeframes, the BOP work was already behind the other projects. The DR Team's strategy was premised on "bidding the work via ESMSA secondary compete once scope reaches 70% has been developed" rather than waiting for completed scope definition from the OSS vendors.
- The ESMSA's Terms & Conditions ("T's & C's") existing master agreements were fully negotiated, but there was a risk identified that these contracts "may not be sufficient to address the needs and risks for the BOP project scope of work to be done during refurbishment execution outage." The DR Team is planning on approaching the vendors to see if this is the case.
- The DR Team is concerned that the ESMSA contractors' capability bandwidth may not be large enough, and the team has identified a risk that the vendors may need additional competent resources.
- Labour relations remain a risk as there are still items subject to CPA decisions.
- The DR Team appears to understand that there is a risk of owner interference due to "the large volume of plant system work and the continuing development of project scope."

From a purely strategic basis, OPG's concepts for the BOP model fit within that frequently seen in the industry for such work. However, BMcD/Modus has a significant concern that there is an assumption that enough time exists in the schedule for OPG to: (1) wait to bundle the scope into two large packages of work before even starting the procurement process, which will take some 8-12 months based on current progress; (2) engage in a Secondary Compete between two vendors whose pricing is the same and who have areas of specialty which are likely to dictate which vendor will perform a particular scope of work; and, (3) develop detailed engineering and comprehensive work packages with enough definition to develop a Class 2 Estimate in time for the RQE.

2. Scope, Engineering and Schedule Status

Two major factors are complicating the confidence with the BOP work at this time: (1) scope is still a moving target; and (2) an optimistic, very tight plan for scope definition and procurement of BOP work is currently at risk.

a. Current Scope and Possible Reductions

The work that comprises the DR Project's BOP scope is varied and split roughly in half between NSSS and conventional plant work. As of the 2013 Business Plan, this scope consisted of ~200 DSRs that have been estimated to cost approximately $503M. It should be noted that the BOP line item for the 2013 Business

Plan reflects a total of only $161M with a reduction from the 2012 Business Plan of $207M[63]. This "reduction" was actually a scope shift to the Turbine Generator Bundle, and the remaining BOP scope was in other categories (SIOs and Contingent scope, among others).

In part because BOP is a basket of disparate scopes, it has been subject to increases since the Project's outset. Based on interviews with the members of the DR Team, the BOP work has expanded to its current state for a number of reasons, including: (1) DSRs were approved for work that should have been considered Life Cycle Management; (2) DSRs were erroneously tagged as Core Scope; and (3) Sustaining Scope definitions were expanded to include items that are outside of the DR Project's commitments.

There is increasing concern that the BOP scope had grown to such an extent that it was threatening the DR Project's viability. The result of the observed scope creep, as expressed in the Darlington Refurbishment Independent Scope Review is, "the volume of scope is contributing to an increasing risk to OPG's ability to successfully refurbish the Darlington units, in terms of cost and schedule. The volume of work will add complexity to the Refurbishment project which may not be necessary, when considering the life-cycle management program at Darlington, i.e. some work may be best performed online or in an outage, managed by the station with utilization of Portfolio funds as required, before or after the refurbishment outage period."[64]

The DR Team's review of BOP scope is ongoing at this time. We discuss this review in more detail in Section III.C.2, above. However, we do note here that the review has already netted tangible results. As an example, the BOP team has recently studied the valve program and identified an 80% reduction in the number of valves the team was anticipating replacing.[65] It is likely that the team will reduce the BOP scope overall, which will serve to enhance the chances of the DR Project's success.

b. Schedule Status

The PIMS Milestone Schedule from January 2012 indicated that detailed design for major components of BOP work would extend well into 2015-6, which is inconsistent with the DR Team's RQE goal. The C&C Schedule's iterations have shown some improvement over those dates; however, in April 2013, the C&C Schedule showed MDR preparation for BOP scopes of work was likely to occur through 2013 and into the 1st Quarter of 2013, and procurement activities into late 2014.

In addition, the BOP's actual progress is running late against this extremely tight plan. BOP has missed three major milestones needed for defining its scope due to process-related issues.[66] Current projections (as of June 30th) in the C&C Schedule show as many as 89 MDR packages are running later than expected, and that 18 of 40 MDPs needed for BOP procurement were completed. The BOP Project Team has recognized that the current progress with MDR/MDP packages is a significant risk "to support EPC contracting timelines for BOP, leading to schedule delays or the need to proceed with RFPs at risk."[67] Moreover, the future scope-defining inspections are looming and could create more scope revisions. To

[63] DNGS Refurbishment Estimate Analysis (April 25, 2013) at p. 4.
[64] Terms of Reference Darlington Refurbishment Independent Scope Review, NK38-REF-09701-10004-R000 (May 23, 2013) at p. 2.
[65] *See* NK38-CORR-09701-0465000 (May 28, 2013).
[66] *See* Program Status Report for period ending June 2013 at p. 61.
[67] *Id.*at p. 62.

date, 166 of 355 planned scope defining work orders are completed.[68] The BOP Project Team identified "The risk is that BOP scope defining inspections are not completed or completed late resulting in the inability to finalize scope and subsequent delays to awarding EPC contracts."[69]

3. Observations and Risks

By its nature, BOP work carries inherent risks which the DR Team attempted to mitigate with its strategic model. However, the BOP schedule has matured and we are concerned that the scoping work is not moving at a pace necessary to carry out the original plan. In particular, BMcD/Modus sees a significant likelihood that the BOP work will not mature to the extent necessary in time for a high quality estimate at RQE. The most problematic areas and consequences are as follows:

- It does not appear that there is enough time to wait for the MDRs to be finished (even at the 70% level) for bundling of the work into two large BOP packages and enter into a planned Secondary Compete process. The schedule is further tightening due to the later completion of the MDR packages, and the procurement process, even if streamlined, adds 3-6 months to an already tight schedule.

- Even if there were such competition, the outcome is largely known at this time, as the one major difference between the ESMSA vendors is that one, ES Fox, has engineering partners (Hatch and Sargent & Lundy) who have a deep bench for performing NSSS design, while the other, Black & McDonald, is more experienced with conventional systems. Since the contracts were recently and thoroughly negotiated, it is unlikely that OPG would be able to drive a significantly better monetary bargain from either vendor than the one currently in place and offset the cost and time associated with such a competition. Therefore, the scope could be effectively split right now between the two ESMSA vendors. From recent discussions with members of the DR Team, the vendors themselves are accustomed to direct assignment of scope, so long as it is equitable. The split between NSSS and Conventional Scope appears to allow for such a split.

- Because BOP scope is still a moving target, it is entirely likely that even if the scope were "bundled" it would only change again, up or down, and even deductive change orders can be costly and problematic. If bundling the scope is intended to improve the quality of the ESMSA vendors' plans and estimates for performance, scope uncertainty will negate such an advantage; thus, waiting for the scope to be bundled only delays the start of the detailed design of packages that are sitting on the shelf, some of which are there now.

There are also performance-related concerns that should be examined and mitigated, including:

- There have been questions regarding the ability of the two ESMSA vendors to handle the amount of work that could come from the BOP contracts. This would present an additional reason for avoiding a Secondary Compete process, as it is unlikely OPG would be comfortable with one vendor having a monopoly of the BOP scope. If the work is equitably split between the two vendors, neither vendor would have work that should stretch their capacity.

[68] *Id.*
[69] *Id.*at p. 60.

- There have been questions raised regarding both the contractors' performance on the Campus Plan work and the ESMSA contracts' terms and conditions. These are valid questions, though both vendors have performed larger projects for OPG in the past with success. The DR Team should hone in on the reasons for any suboptimal performance and work out any barriers to success on the broader DR Project scopes, as necessary.

- The nature of BOP work requires schedule and physical coordination between the BOP and the other EPC contractors. OPG needs to recognize its role in this regard of coordinating this work so that interference is limited.

4. Recommendations—Balance of Plant

The biggest risks to the BOP work right now are scope and schedule. To mitigate the schedule issues, OPG should consider a different contracting approach that would jumpstart the detailed design of the BOP packages; also, consider reducing the scope of those packages to the absolute minimum needed to meet the DR Project's commitments. As part of this strategic refocus, the primary drivers for a revised strategy should be: (1) meeting schedule commitments; (2) reducing potential interference to the RFR contract, and (3) creating flexibility to handle emergent work, schedule perturbations, scope shifting and scope revisions. Without this level of focus on the schedule, it is very likely that the DR Team's commitment to present a high-quality estimate at RQE, at least for the BOP work, will not be met.

As a result, BMcD/Modus recommends that OPG take all reasonable efforts to increase schedule certainty for the BOP work by awarding and assigning smaller packages of the work on a qualifications-based criteria with cost-plus contract terms as soon as reasonable. In this model, the ESMSA could be assigned or awarded projects before the OSS vendor has completed the MDP package for a given modification. This scenario allows for efficiency gains for the ESMSA engineers, who could be involved at an earlier stage of development, which could reduce the re-performance of engineering effort and increase the constructability of the selected modification solution. This structure also allows for easier shifting of packages between the vendors (or other entities) if contractor bandwidth remains a risk. Moreover, if the 2014 Business Plan revised planning assumptions are adopted, the BOP work schedule will have to be the most fluid and allow time for discovery work.

To the extent that there is concern over the cost, OPG could consider using the final as-built price and schedule from Unit 2 to fix or target price more elements of the contract for the later units. By this point, the majority of performance risks will be known and the scope for the remaining units will presumably be substantially identified, allowing for much earlier and more robust planning.

The most pressing problem with the BOP work is the start of detailed engineering necessary for providing management requisite confidence in connection with the RQE. Without changes to the current procurement strategy, this problem will almost certainly manifest itself in a lower quality estimate at RQE than intended. This will cause the DR Team to request greater contingency and have less confidence in the Execution Plan for the work. In our experience, the method of releasing smaller bundles of BOP work is the most prudent and effective means of reducing the risks inherent with BOP work, and in this case, because the ESMSA agreements are in place, would likely be the lowest cost option due to the schedule savings and risk avoidance the DR Project would yield.

BMcD/Modus has reviewed the status of the ongoing work at the DNGS station that is being performed as pre-requisite work for the DR Project. The Campus Plan work includes a wide variety of infrastructure projects OPG intends to aid in the refurbishment of DNGS or improve the reliability of the station from a life cycle management perspective. The most significant current Campus Plan work consists of the following new facilities that are being designed and built by the ESMSA contractors and managed by the Projects & Modifications group:

- D_2O Storage Facility
- Low Pressure Service Water Line Relocation
- Water and Sewer
- Maintenance Facility
- Boiler House
- Refurb Island Annex
- Retube Waste Processing Facility
- Power and Electrical.
- OSB Refurbishment
- SIO – Emergency Power Generator (EPG3)
- SIO – Powerhouse Steam Venting System
- SIO – Containment Filtered Venting System[70]

These various scopes of work vary from commercial buildings to more complex technical undertakings, and include work that OPG has performed before (Dry Storage) to entirely new evolutions. The one critical thing these projects have in common is they all must be completed prior to breaker open on Unit 2. Thus, these projects represent a significant risk to the overall DR Project, due in part to the number of projects, their relative complexity and the amount of work left to be done (from planning to execution).

BMcD/Modus sees the evolution of the Campus Plan (including Facilities & Infrastructure Projects) as highly significant for multiple reasons: (1) many of these projects are essential predecessors to the overall DR Project; (2) these projects provide an early test of the capabilities of and new processes employed by the DR Team; (3) these projects allow for an early assessment of the ESMSA contractors' effectiveness and readiness to perform on the broader DR Project; and (4) these projects will provide valuable OPEX for the future work as some of these Campus Plan projects (D2O Storage Facility in particular) have encountered significant challenges.

1. D20 Storage Facility

The following is a summary of the current status of the D20 Storage Facility, which is the most significant and mature of the Campus Plan projects. There are some of the significant events that have occurred to date and the lessons learned that have already been captured for the team's examination.

a. Background

The D2O Storage Facility will provide storage capacity for water removed from the units during refurbishment. The building consists of multiple tanks for Primary Heat Transport (PHT), Moderator and TRF Feed storage,

[70] Projects and Modifications Division Performance Report, June 2013

and has been sized to accommodate the volume of water from two of the Darlington units. This building has a complex design, is time sensitive, has a significant capital cost ($110 million budget) and employs one of the anticipated key contractors (Black & McDonald) such that its execution provides a good template for much of the work on the DR Project.

The current schedule identifies the following key milestones:

- Detailed Design Complete by Black & McDonald/RCMT by August 30, 2013. The DR Team currently reports that this date will not be met, and mitigation plans are in place to lessen this impact.
- Low Pressure Service Water Line Relocation, which is needed to clear the building's footprint, is planned to be performed during the D1341 Outage and complete by November 9, 2013
- Start of Tank installation – October 9, 2013
- Substantial Completion – February 15, 2015
- Available for Service – April 15, 2015

The DR Team believes that the baseline schedule had approximately 6 months of float, though some of the current design issues will reduce this float. Nonetheless, there are certain delays that have already been incurred that need to be mitigated to ensure the timely completion of the facility. Challenges to date in the planning and design phase have included:

- MDRs Lacked Scope Definition: The initial MDR for procurement of the EPC contract lacked specificity.[71] As a result, OPG's Engineering reworked the MDR with more specific requirements. This experience with MDR resulted in significant process and quality improvements to the MDR process for procurement of the remaining DR Project modification scope, and was a primary driver in Engineering's budget variance against the 2013 Business Plan.
- Project Schedule: The D20 Storage Facility's schedule included unrealistic durations for detailed design work, the root cause of which was the original bid package lacked meaningful information and definition.[72] As a result, Modification Planning, which was scheduled for a scant 2 months, actually required 6 months, and recovery schedules were also missed along the way.[73]
- Completion of Detailed Design: To overcome the earlier schedule issues, OPG's Engineering Team has dedicated five engineers to provide oversight of the drawing preparation. This bears monitoring, as OPG will not have the resources to provide this level of oversight to the EPC vendors for the other Project Bundles.
- Procurement: Black & McDonald's purchasing of long-lead Class 3 valves on-time is also at risk. This is systemic procurement problem, as these valves are in short supply industry-wide.

[71] *See* D20 Storage and Drum Handling Project: Modification Planning Lessons Learned Report, D-LLD-38000-1001 (March 4, 2013)
[72] *Id.*
[73] *Id.*

- Planning & Assessing: The delays to engineering and procurement are likely to ripple into the completion of detailed planning packages. BMcD/Modus will continue to monitor the package development.

- Construction: Ellis Don is the civil subcontractor and has been "daylighting" the excavation for some time in order to expose the buried services in this area of the site. Progress has been slower than planned due to the buried lines being found in different locations than shown on the as-built drawings, a configuration management issue dating back to the original construction of DNGS. Also, direct buried cable is being uncovered where cable trenches are shown on the drawings. These issues should be expected where excavations are undertaken in other areas of the site.

The DR Team appears to have responded to these challenges by increasing the active management of the contractor via daily meetings, additional schedule focus and more aggressive review of the engineering product. OPG has also assisted Black & McDonald in correcting some of its safety practices on site.

b. Key OPEX/Lessons Learned/Risks

The following are critical OPEX from the D20 Storage Facility that DR Team should take into account for the remaining Campus Plan work and the DR Project in full:

- **Corrective Actions to the MDR Process**: D20 Storage Facility was a leading indicator the DR Team used to revise the MDR development process, which is now significantly more robust as a result.

- **Planning Milestones:** A primary finding in the D20 Storage Lessons Learned report is the work for the project was under inordinate time pressure and the team lacked "managerial courage to recognize when [the] schedule is unrealistic for the required deliverable and to escalate."[74]

- **Management of Contractors**: The mitigation plans in place to recover the D20 Storage Facility have required significant management focus. While these mitigation plans have partially mitigated the impact to the schedule, BMcD/Modus sees a potential concern with the DR Team's bandwidth to deal with larger and more significant issues that are sure to arise on the DGNS Refurbishment Project. Moreover, the DR Team is evaluating the extent to which the vendor's performance is contributing to the issues with the D20 Storage Facility, as OPG intends to award a significant amount of work to Black & McDonald.

- **Impact of Design Delays**: As a result of the delays to detailed design, the D20 Storage Facility has lost float and the window for Planning & Assessing is shrinking. A key lesson learned from PARTS Unit 4 is that Planning & Assessing requires adequate time and focus or the field work will suffer.

- **Management of Engineering Deliverables**: The method being used to track engineering deliverables and the metrics used by Projects & Modifications and OPG Engineering should be examined for its effectiveness and possible export to the larger DGNS Refurbishment Project scopes of work. The OPG review cycles and the metrics capturing these cycles should be reviewed.

- **Configuration Management:** There have been buried services and underground conditions that were not accurately captured in the site plans. While it is virtually routine for site work to be adversely

[74] *Id.*, p. 10

impacted by unforeseen underground conditions on a decades-old utility site, the concern is that some of the configuration management issues materialize in other Campus Plan projects.

- **Procurement of Long Lead Valves**: Based on the D20 Storage Facility and the industry at large, the DR Team should examine how it is both determining and tracking long lead materials, whether or not these materials are being supplied by an EPC vendor. The DR Team needs to have proper tracking of such materials in order to establish reasonable schedule milestones and hold the vendors accountable for their performance.
- **ESMSA Performance**: As noted, the D20 Storage Facility as well as the other predecessor Campus Plan work provides an opportunity to fully examine the performance of the ESMSA vendors, and just as importantly, the management techniques that the DR Team is using. To date, the DR Team has added more staff, in particular engineering, and instituted additional accountability forums (more meetings, etc.) to manage this work. The DR Team is examining what has been effective and whether the assumptions in the current management plans for the broader DR Project need to be adjusted. Considering the additional resources and management focus that have been needed thus far on the D20 Storage Facility, BMcD/Modus would also recommend OPG focus on both the qualifications and right-sizing of the DR Team as part of such reviews.

The D20 Storage Facility is the most notable of the Campus Plan projects because of its size, complexity and history of problems to date. Each of the Campus Plan projects present risks, and mitigating those risks will require significant management focus.

2. Pre-Requisite Work

A leading indicator of site readiness for the refurbishment is the execution of pre-DR Project work orders during the IPG and planned outages approaching the first unit execution. While planned outage execution of pre-refurbishment work orders has been successful, performance of the normal "T-Week" activities are resource constrained by the station. Subsequently the pre-refurbishment work orders are not getting priority for execution by the station Maintenance organization and are requiring the use of no-station personnel for assessing and work order preparation. The addition of the refurbishment work is straining the organization and will require additional resources and continued focus by the station management for refurbishment work orders to get station priority.

This conclusion is supported by Audit OPGN NO-2013-002, Equipment Reliability determined that performance of the Managed System Controls for sustaining ER is not fully effective (Yellow). Finding 1.1 Deficiencies in Preventive Maintenance Implementation 2) Darlington, found that Preventive Maintenance (PM) was deferred for Fuel Handling (FH) equipment due to lack of parts resulting in equipment failures.[75]

These activities and other Campus Plan work will require additional focus.

D. Turbine Generator

1. Scope

The Turbine Generator Project consists of five scopes of work:

[75] Level 2, SCR D-2013-05089 was initiated to document this finding.

- **Steam Turbines and Turbine Auxiliaries**: inspections, repairs, and/or replacements of High Pressure ("HP") and Low Pressure ("LP") turbine components and a number of turbine auxiliaries;
- **Generator and Generator Auxiliaries**: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- **Moisture Separator Reheater ("MSR")**: inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- **Turbine Control Upgrade**: replacement of the obsolete analogue Steam Turbine Electronic Control ("STEC") System, includes entire Turbine Supervisory System with modern design (digital system); and
- **Generator Excitation Upgrade**: replacement of the obsolete Generator Excitation system controls with modern design (digital system) and a set of additional Generator Excitation and Protection equipment to resolve obsolescence.[76]

It is our understanding that the DR Team developed the Turbine Generator Project scope of supply based on a review of the station's operating history and OPG's OPEX with the equipment, and results from CCAs. The Project's Scope Review Board gave its approval for these scopes of work and the Turbine Generator Project Team achieved Project Gate 0 on March 5, 2011.

OPG's original cost estimates anticipated that the total estimated value for the Turbine Generator Project would be approximately $510M with a base cost of $365 M[77] and $150 M for contingency. The contingency amount included cost for scope that may ultimately be required depending on the outcome of certain planned inspections. OPG acknowledged that much of the Turbine Generator scope could be performed as a part of its regular inspection and maintenance program, but decided to add it to the DR Project at that time "for efficiency to minimize outage schedule.[78]

2. Contracting Strategy

The original contracting strategy contemplated bundling all of the scopes of work into a single EPC contract. The Original Equipment Manufacturer ("OEM") of the Darlington turbine generator sets, auxiliaries, and controls is Alstom Power ("Alstom").[79] This is highly specialized equipment designed which Alstom designed and supplied as an integrated system for the Darlington Station. Alstom was judged to have the optimal technical knowledge, expertise and full understanding of the complexity of the Turbine Generator Project scope of work. The DR Team identified the following major risks associated with not awarding single source contract to Alstom:

- **Execution Risks. Darlington Turbine Generators are specialized and unique in North America custom designed for Darlington**, and the OEM has provided parts, specialized services and engineering for the last 25 years. Hence, if a non-OEM that does not have knowledge or expertise respecting this highly specialized equipment provides the work in question, it will lead to significant execution risks.

[76] Contracting Strategy for Turbine Generators, N K38-REP-09701-10021 (August 31, 2012) at p. 6.
[77] This amount was revised to 346 M with the 2013 Business Plan estimate.
[78] N K38-REP-09701-10021 at p.8.
[79] The Darlington Turbine Generators were actually originally designed, manufactured and installed by Brown Boveri Canada Inc. ("BBC"). BBC was bought by Asea Brown Boveri ("ABB") and subsequently Alstom Power purchased ABB.

- **Integration Risks**. The interface of the Control systems and Generator Excitation with the Turbine Generator Hydraulics is paramount. Turbine and Excitation Controls replacement involves interface with a large number of field devices, components within the hydraulic system and excitation power system, and the respective auxiliaries. **The risks of the said pieces of equipment not integrating properly with each other are significant if a non-OEM provides the work in question.**

- **Compatibility Risks**. Due to excellent performance of the turbines, OPG is able to take advantage of a cost effective **piecemeal retrofit** rather than a complete steam path retrofit. Reverse engineered components may drive compatibility risks, further costs during commissioning, and lost revenue that could be significantly higher than reverse engineering costs.

- **Operational Risks**. If OPG retains a non-OEM to provide the work in question, the resultant mix of OEM and non-OEM components will lead to increased operational risks of the units post refurbishment. In the worst case, forced loss rate may be impacted.[80]

As a result, OPG intended to sole source the Turbine Generator EPC work to Alstom while in parallel, preparing an RFP package that would allow OPG to pursue a competitive bidding process as a backup option in the event that the negotiations with Alstom broke down or stalled.[81]

In fact, OPG was unable to negotiate a full EPC contract with Alstom. Alstom's proposed price for performing the installation work was significantly more than either OPG anticipated or that was reasonable based upon the known market. Alstom's price reflected its disinterest in performing this part of the work. As a result, the DR Team revised its strategy so that it sole sourced the engineering and equipment supply to Alstom, and will competitively bid and negotiate the construction portion of the work in the first quarter of 2014.

On March 27, 2013, OPG entered into an Engineering Services and Equipment Supply Agreement with Alstom Power and Transport Canada Inc. The estimated value of the Agreement is approximately $356 M. The DR Team determined that after adjusting for differences in scope assumptions between OPG's original estimate and the Alstom proposal, Alstom's pricing is generally aligned with the estimate. We have not performed our own analysis to verify this fact.

3. Summary of Observations/Risks

- The Turbine Generator Project includes scope that is commonly performed in the nuclear industry, and while there are always risks from discovery work and examining the condition of critical components, if the Project is properly scoped and procured, it shouldn't become headline news for the DR Project.
- The award to Alstom on the basis of its unique qualifications to refurbish the DNGS turbines was a sound decision and one that mirrors how other utilities make such decisions. The move to separate the construction from the engineering and procurement parts also appears to be sound, given the price OPG received.
- The DR Team is currently reviewing an option to move the performance of the Turbine Generator control work on Unit 2 to a later time. The key driver for this decision would be to simplify the work in

[80] Memorandum Re: Darlington Refurbishment Turbine Generator Project - Single Source Justification Approval Request by Todd Josifovski, Turbine Generator Project Director (March 18, 2013).
[81] N K38-REP-09701-10021 at p. 8.

Unit 2 and focus the team's attention on RFR execution. BMcD/Modus recognizes the logic behind this option and it should be strongly considered, and management needs to robustly document whatever decisions are made.

E. OPG Critical Path Activities

As noted, the DR Team estimates that OPG will control the critical path 25% of the time (243 of 968 total days) of the breaker-to-breaker unit duration[82]. Many of the work items in OPG's critical path scope have been performed before; however, some of the work, like defueling of the Darlington Units, has never been done by OPG, and here, it will have to be performed under enormous schedule pressure.. The DR Team is very aware of these risks and has made adjustments to the plan, most notably with refurbishment of the fueling machines prior to the opening of the Unit 2 breaker. The team is planning to continue to refine its schedule and sequence of events. The following is a summary of some of the DR Team's current efforts to organize and plan the critical path work.

1. Site Integration Planning

The DR Team's success in managing the critical path will depend on developing a cohesive and well-managed team that integrates the Project and Station personnel. BMcD/Modus monitored the integration plans and activities of the site integration team supporting these efforts.

Site Integration Plan meetings are focused at the management level which is appropriate given the time to the execution window. The initial integration plan was functionally based around the organization being reviewed for transition to refurbishment, Chemistry & Environmental, Safety, Design Engineering, Systems Engineering, EP, Licensing, etc. The initial presentations to the site are complete and while providing a broad based format for discussion of general personnel requirements and management structure, but contained few actionable items.

The Site Integration meeting agenda focuses on the near term actions required for the DR Project readiness with organizational transition plans discussed as a subtopic. The first integration topic covered is "Top Five Milestones." These Milestones were chosen by the leadership team and cover the near term actions, owners and due dates to support the milestone completion:

- Scope Frozen at Work Order level
- Improve Fuel Handling Reliability
- VBO Preparations
- Major Site Projects
- Development of Transition Plans

Once all actions are resolved for these priorities, the Site Integration Team will focus on additional strategic considerations and specific support for each of the DR Project Bundles.

2. Defuelling/Fuel Handling/PHTS Bulk Drain

OPG's portion of the Vault Preparation window is currently assessed at 88 days and consists of the following activities:

[82] DNGS RFR – Execution Phase Estimate Progression, June 21, 2013.

- Breaker Open – 1 Day
- Defuel – 62 Days
- Primary Heat Transport System Bulk Drain – 25 Days
- Airlock Open – 1 Day
- Vault Turn-over – 1 Day
- Moderator Bulk Drain – 25 Days

The DR Team is currently assessing each of these durations. The Fuel Handling systems present unique challenges due to the fact the fueling machines that are needed to support the DR Project are also needed to maintain operations of the operating units. In addition, there is a concern that the station and OPG lack specific operational experience with performing these evolutions under schedule pressure. The team has taken some significant steps since the outset of our engagement to address certain key risks:

- The DR Team's leadership and the CNO recognized the risk of fuel machine reliability and availability could not only impact the project but also the support of the operating units during the project. The FH Team was directed to move forward the work needed to refurbish the fueling machines before the Unit 2 outage.
- Much of the work originally planned for Project will be included in earlier outages or performed on-line.
- Primary responsibility for the defuelling was turned over the Station to manage. There are some risks that have been raised regarding resource availability and support.

B&McD/Modus sees OPG's decision to place the responsibility of the fuel handling system and equipment reliability and for the defuelling of the reactor on Operations as sound and likely to reduce project risk. For the revised plan to work, the Fuelling Machine Operators (FMO's) will need to familiarize themselves with the new Universal Carrier and the different tooling used for defuelling channels with different flow rates. This is a relatively minor addition to the current expertise of the FMO's. BMcD/Modus also sees the benefit of charging the Projects & Modifications and fuel handling maintenance groups with upgrading the fuel handling system and equipment, returning them to the required level of reliability (the as-designed system performance) and for placing the Service Area Rehearsal Facility (SARF) back into service. Consequently, Operations now has the responsibility to turn over a defuelled reactor to the Refurb team.

The planning and organizing of these reliability projects, on top of the routine operations staff work, will need to be addressed from a staffing and funding perspective. Our current observations indicate that the planning for Defuelling tool design is sound, with float included in the schedule for tool design modifications to be made should problems occur during the prototype testing.

Once the breaker is opened, defuelling the reactor core will be the critical path activity. In addition to fuel handling system and equipment reliability there are other key items that should be addressed in order to minimize the time taken to defuel the reactor. B&McD/Modus recommends that the following be considered:

- Staffing for continuous three trolley fuelling/defuelling capability (24 hours/day; 7days/week);
- Fuelling/defuelling across shift changes and breaks.

The remaining Vault Preparation work is being examined for opportunities to improve durations and sequencing.

VI. Summary of Recommendations

In the foregoing, BMcD/Modus has attempted to identify for the DR Team a number of recommendations based on our current assessment of the Project's risks. The most significant of these recommendations are summarized below:

Issue	Risk/Opportunity	Recommendation
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	• Continue the process of reducing and optimizing the Project's scope. • Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn. • Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	• Review strategic considerations for procurement of remaining scope. • Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews • Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	• As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration. • Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts. • Clarify reporting lines for matrixed Project Controls Personnel. • Actively seek to assemble the Execution Phase team as soon as possible.
Schedule Development	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	• Continue development of the C&C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase. • Redirect the Project Controls Team's efforts from the C&C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.

Issue	Risk/Opportunity	Recommendation
	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	• Clarify and include in commercial contracts OPG's requirements for schedule development by the contractors.
Risk Management	The current methods for scoring risks are inconsistent and the risk register includes "issues" or "concerns" that needlessly dilute management efforts.	• Provide consistent characterization and scoring of risks. • "Concerns" as currently defined should be eliminated from the Risk Management Program. • Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking. • Consider revising probability scoring to increase granularity and ranking of risks.
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	• Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function. • Review qualifications within the existing risk team. • Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team. • Provide training with a focus on the overall importance of the Risk Management Program
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	• IT needs to resolve the outstanding issues as quickly as possible. • Training should include instruction for populating databases. • The AIDA database should be examined and updated if it is to be useful for rate proceedings.
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	• Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.
	Revised planning assumptions for	• Document and characterize the

Issue	Risk/Opportunity	Recommendation
	The 2014 Business Plan revised assumptions that are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	information for the BOD and consider meaningful reporting metrics. • Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts than can be improved based on current OPEX. • Review capture and documentation of Unit 2 OPEX information so maximum benefit is derived from this revised plan.
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	• Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates a far as possible before the date of the RQE. • Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.
	Contingency calculations need closer alignment with the Risk Management Program.	• Actions summarized above • Create a clear and repeatable process for calculating contingency at all levels and for all program participants.
Management Processes	OPG's new processes and procedures are in some cases conflicting and repetitive.	• Look at reducing the number and optimizing the process map.
RFR	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	• Consider asking SNC/Aecon to monetize risks at a much earlier stage.
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.
	Project maturation specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	• The Class 3 Estimate preparation should be expedited if possible.

Issue	Risk/Opportunity	Recommendation
		• OPG should seek SNC/Aecon's monetizing of PMT costs.
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	• While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.
	There are technical improvements that should be reviewed based on OPEX.	• Study opportunities now that the effort is turning to Darlington.
BOP	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	• Accelerate engineering work as necessary / praticable with the OSS vendors. • Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort. • Change procurement method to a packaged approach (see below). • Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process. • Eliminate unnecessary duplication of effort between OSS vendors and EPC designers. • Review and eliminate OPG delays in approval of design work.
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this "competition" is essentially already known.	• Assign work to ESMSA vendors based on qualifications in smaller bundles. • Use the existing ESMSA agreements and eliminate bidding process.
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	• Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise. • Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently	• Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders. • Increase visibility of this potential risk.

Issue	Risk/Opportunity	Recommendation
	anticipated to the BOP work.	
Campus Plan	The D20 Storage Facility work has been delayed and the contractor's performance has been subpar	• Continue to devote adequate resources to recover the D20 Storage Facility's schedule. • OPEX from this project should be used to guide management of the future Execution Phase work.
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	• Additional management attention is needed to ensure planning and execution of the work
	The Campus Plan's scope is too large	• Continue to review the Campus Plan Scope and eliminate unnecessary projects.
OPG Critical Path	OPG-directed work is 25% of the Critical Path of the DR Project.	• Ensure that this work is given proper focus and resources.

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Darlington Refurbishment Final Report May 3	Internal Audit	5/12/2013
1 oversight summary	Refurbishment Oversight Report#1	2/22/2013
2 oversight summary	Refurbishment Oversight Report#2	4/2/2013
AssuranceMap_DRP_20130403A_ExecutiveSummary_GeneralApplicability	Part 1 of 2 - General Applicability/Mandate	3/7/2013
Presentation_20130325A_DrpAssuranceMap_Phase-1_Draft_lpapr3	DRP Risk Assurance Map – Phase-1	3/11/2013
Program Assurance Plan - PMP Sheet 11	Program Assurance Plan For Darlington Nuclear Refurbishment	3/1/2013
N-2013-00303 QA Gap analysis	GAP Assessment	2/11/2013
SCR N-2013-00303 from database	Station Condition Record	1/17/2013
SCR N-2013-00303	Common Cause Analysis	1/17/2013
NK38-CORR-09701-0401046 TG Project Contracting Strategy	Refurb Records; add'l correspondence dated 2/29/12 - Sweetnam & Reiner	3/28/2012
NK38-REP-09701-10020 Contracting Strategy - FH & Defueling	Contracting Strategy For Fuel Handling -Defueling	10/2/2012
NK38-REP-09701-10021 Contracting Strategy - TG	Contracting Strategy for TG; email attached	8/31/2012
NK38-REP-09701-10024 Contracting Strategy - Steam Generator	Contracting Strategy for Steam Generator	8/10/2011
NK38-REP-09701-10030 Contracting Strategy Summary - TG	for Turbine Generators; memo attached dated 3/28/12	8/24/2011
NK38-REP-09701-10034 Contracting Strategy - RFR	Contracting Strategy for Retube & Feeder Replacement	7/31/2011
NK38-REP-09701-10102 Contracting Strategy - BOP	Balance of Plant; email attached	3/19/2013
NK38-REP-09701-10130-R000 Contracting Strategy - FH Refurb	Fuel Handling - Refurbishment	11/16/2012
EDMS BRD Final R1	(BS&IT) Bus. Svcs. & Info. Tech. / (BRD) Bus. Rqmts. Doc. - Nuclear Projects EDMS - Define bus. & key syst. Requirements of target syst.	
Document Management Strategy Review Whitepaper	NK38-REP-08133-0460629-T20 WorleyParsons - Strategy Review Whitepaper	7/27/2012
WP EDM report	NR DOCUMENT MANAGEMENT / STRATEGY REVIEW WHITEPAPER - Worley Parsons	7/27/2012
Engineering Process Major Work Streams (Swim Lanes)	Project Unit 2 Major Work Streams - Org Chart	
EPC Vendor Interface Requirements Rev 2	13 page PowerPoint	
Gated Process Apr 8	Nuclear Projects Gated Process	4/8/2013
Scoping Overview	Organizational Chart	3/5/2013
1-EPC Vendor Engineering Interface Requirements - Intro	scanned PowerPoint	
2-Scope Strategy and Plan - 12-15-11	Refurbishment Scope Strategy & Plan	12/15/2011
3-Engineering Interface Requirements - 2-28-13	Engineering Interface Requirements	2/28/2013
5-Desktop Guide for the Preparation of a Needs Document - 2013	Desk Top Guide for the Prep. Of Needs Doc.	3/13/2013
6-Guide to the Development of a Conceptual Design Report - 12-18-12	Guide to the Development of a Conceptual Design Rpt.	12/18/2012
7-Preparation of Modification Design Requirements - 2013	Prep. Of Modification Design Requirements	
8-Modification Outline and Design Scoping Checklist	Modification Outline Report	
9-Design Completion Assurance - 10-15-12	Darlington Refurb.: Design Completion Assurance	10/15/2012
10-Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	10/15/2012
11-Construction Completion Declaration Process - 12-31-12	Nuclear Refurb. Constr. Compl. Declaration Process	
12-Appendix C - Good Practices for Achieving High Product Quality	Good Practices	
13-Nuclear Projects Gated Process	Org chart	
14-Unit 2 Major Work Streams - pg1	Org chart	
15-Unit 2 Major Work Streams - pg2	schedule	
DR Scope Strategy and Plan NK38-INS-09701-10001	Refurb Program-Scope Control	12/12/2012
N-FORM-10958 Modification Outline Form	Modification Outline form	
N-GUID-00700-10002 Preparation of Needs Document	Desk top guide for the Prep of a needs doc (email attached)	
N-GUID-01920-10000 Engineering Oversight	Guideline For Engineering Oversight	
N-INS-00700-10007 Preparation of MDR	PREPARATION OF MODIFICATION DESIGN REQUIREMENTS	
NK38-GUID-01900-10001 Design Completion Assurance	Design Completion Assurance	
NK38-GUID-01900-10002 Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	
NK38-GUID-01900-10003 Engineering Interface Requirements	Engineering Interface Requirements	2/28/2013
NK38-GUID-01900-10004 Development of Conceptual Design	Guide to the Development of a Conceptual Design Report	12/18/2012
N-PROC-MP-0090 Modification Process	MODIFICATION PROCESS	
N-STD-MP-0009 Engineering Interface & Oversight	CONTRACTOR/OWNER ENGINEERING INTERFACE AND OVERSIGHT	
Audit Report NO-2013-005 DRAFT_TW (2)	Modification Design Requirements and Design Quality Oversight	
CCA 21 June	Common Cause Analysis associated with Ref. SCR# N-2013-02294	Jun-13
N-NR SCRs from 2012 March 1st to 203 May 31	System Lay-Up Technical Requirements Documentation Compliance	
SCRs from July 1-2012 to 30- April 2013 keyword Contractor Interface	database; tabs - Key Word Contractor & Contractor Interface	5/28/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
1 - Agenda - Eng. Schedule Review - 24 May 2013	Engineering Schedule and Metrics Review Meeting	5/24/2013
2 - Minutes - Eng. Schedule Review - 17 May 2013	Engineering Schedule and Metrics Review Meeting	5/17/2013
6 - Other engineering 24 May2013	VBO Outage Status, MDR Work Streams, Eng. Studies	5/24/2013
2013 06 20 Weekly Meeting Presentation	Meeting Minutes	6/21/2013
20130522_WP_Quad_Chart	MDR Pre-Requisites and Completion Status Report chart	5/22/2013
20130523_AMEC NSS_Quad_Chart	MDR Pre-Requisites and Completion Status Report chart	5/21/2013
April 5 2013 Engineering Schedule and Metrics Review Meeting	Meeting Minutes	
April 12 2013 Engineering Schedule and Metrics Review Meeting	Meeting Minutes	
Copy of B-O Chart and MR Tracking_Eng Leads-PM Updates as of 50113	MR Tracking & P6 Blackout	
Engineering MDR and Studies Summary slides June 14	VBO Outage Status, MDR Work Curves, Eng. Studies (Hos), etc.	
Outstanding Actions MDR Issues-Actions	9 Outstanding actions	5/24/2013
Outstanding Actions MR Holds	Outstanding Actions	5/24/2013
Outstanding Actions Weekly Meeting	Engineering Schedule and Metrics Review Meeting - 5 outstanding actions	5/24/2013
1-NR Engineering Communication Book - cover	Project Values - 1 page	
2-AIP Scorecard and Focus Areas - 2013	Scanned doc - database	
3-Program Status Report - 12-31-12	Meeting Minutes	1/23/2012
4-Nuclear Safety, Engineering Services, Project Engineering - 2-27-13	Scanned doc - nuclear safety	
5-Weekly Tactical Update - 3-15-13	Engineering Key Milestones	
6-Design Engineering Weekly Report - 3-5-13	Weekly Report	
7-Engineering Organizational Chart - 1-14-13	Org chart - photos included	
8-Nuclear Safety Division Organizational Chart - 1-14-13	Org chart - photos included	
9-Engineering WBS - 2-1-13	Org chart	
10-Engineering Cost Breakdown Structure - 2-1-13	Org chart	
12-DSRs for Engineering Studies Work Down Curve - 3-11-13	Chart	
13-Engineering Hours Budget - 2-21-13	scanned doc - database	
14-Darlington Integrated Master Schedule March 18 2013	schedule	2/6/2012
15-Engineering Schedule and Metrics Review Meeting - 3-8-13	Meeting Minutes	3/8/2013
16-MDR Prerequisite Blackout Chart - 3-11-13	database	
17-MDR Workdown Curve, MDR Starts, Acceptance Process - 3-11-13	chart	3/11/2013
18-DSRs for Modifications Blackout Chart - 2-21-13	database/chart	2/21/2013
19-MDR Process - 2-28-13	org chart	2/28/2013
21-EV Engineering Breakdown for MODs	org chart	
22-Earned Value Process for MDRs - Example - 3-1-13	org chart	
23-Project Planning, Engineering Staffing - 1-1-13	database	Jan-13
24-Project Numbers - 7-27-12	org chart	7/27/2012
25-Funding Analysis - 3-7-13	scanned doc - database	3/7/2013
26-EC Modification Tracking Report - 3-19-13	EC Black out chart	3/19/2013
27-Management Plan - 1-30-13	DNGS Refurbishment Mgmt. Plan - Refurb. Eng.	1/30/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L1	MDRs Integrated Schedule - Level 1	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L2	MDRs Integrated Schedule - Level 2	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L3_OPG_O	MDRs Integrated Schedule - Level 2 - OPG Activities ONLY	4/25/2013
AMEC 2013-04-26-MDR Program- Level 1	AMEC NSS MDR Program Integrated Schedule	
AMEC 2013-04-26-MDR Program- Level 2	AMEC NSS MDR Program Integrated Schedule - Level 2	
AMEC 2013-04-26-MDR Program- Level 3-OPG activities	AMEC NSS MDR Program Integrated Schedule - Level 3	
AMEC202013-05-27-Level2	MDR Program Integrated Sched. - Level 2	
B-O Chart and MR Tracking_Eng Leads-PM Updates	MR Tracking & P6 Blackout	
D1321 scope for refurb	DSR tracking	
DSR Database	DSR database	
DVBO scope for refurb	DSR for vacuum bldg.	
P6 Blackout Chart	charts included; add'l tabs	
WC Scope Review 13-05-02	DSR Based Estimate - Based on Estimate Details as of August 30, 2012	8/30/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Scope Review Process	NK38-REF-09701-10004-R000 [TBC] Independent Scope Review	5/23/2013
Master_Outage Prep Meeting_Jul_11	Action Log; DSR HOS, etc.	
Memo 20130618160713465 Planning Assumptions	memo; changes in refurb planning assumptions	6/6/2013
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-Core Scope Valve Cost Benefit Analysis memo	5/28/2013
Scope Presentation	Darlington Refurbishment Scope	2/1/2013
Scope Review as of 062013	Scope type data (CS02, CS03, etc.)	6/20/2013
Scope_Status_Meeting_June6_2013	Review readiness for refurbish preparation work	6/6/2013
ScopeStatusPackageMay9_2013	Outage Preparation Review Meeting	5/9/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-core Scope Valve cost benefit analysis	5/28/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
DR_Engineering WeeklyTactical_Update003 April 19, 2013	Weekly Report	4/19/2013
DR_Engineering WeeklyTactical_Update003	Weekly Report	4/19/2013
Engineering Weekly Tactical Update March 15, 2013	Weekly Report	3/15/2013
D1231 Outage Report	D1231 Planned Outage	5/18/2012
NK38-PLAN-31160-10003_R000(22Jan2013) Detailed Design & Qualification for RFR	Scope of Work - Fuel Channel Zr-Nb-Cu Annulus Spacer - Detailed Design & Qual. For Darlington Retube & Feeder Replmt.	1/22/2013
Bulk MDR Contracting Strategy	Engineering Projects Department to execute Bulk MDR as follows in document	6/27/2013
Contracting Strategy D20 Storage	Memo; Proj. 16-31555 D_2O Storage Facility Contracting Strategy; Contracts Rev. Table	3/18/2011
DNGD D20 Storage- Gate 3 Project Execution Plan Form	Heavy Water Storage & Drum Handling Facility; NK38-PEP-38000-0434605	7/10/2012
G1 - 13 - TS Preliminary Contracting Strategy (3) NCD Comments -scf edit oct	CONTRACTING STRATEGY FOR BALANCE OF PLANT – CONVENTIONAL SYSTEMS; **no NK38 #, no date**	
G1 Preliminary Contracting Strategy	COMMERCIAL STRATEGY; **no NK38#**	3/15/2011
G1-14 - PR Contracting Strategy	CONTRACTING STRATEGY FOR BALANCE OF PLANT – Pre-Refurbishment Sub-Bundle	1/30/2013
NK38-CORR-09701-0401046 Contracting Strategy Summary TG	Refurb Records; add'l correspondence dated 2/29/12 - Sweetnam & Reiner	3/28/2012
NK38-CORR-38000-0374630 Contracting Strategy D20 Storage	Project D_2O Storage Facility; contracts review table attached	3/18/2011
NK38-REF-00150-0379237 2009 Presentation Program Contracting Strategy	Email - fr/ Laura Oakes to Refurb Doc Mgmt.; ppt attached - 'Prelim Procurement & Contracting Strategy'	3/16/2011
NK38-REP-00150-10001 Rev001 Program Commercial Strategy	Commercial Strategy report	10/1/2012
NK38-REP-09701-10020 Contracting Strategy FH Defueling	Contracting Strategy For Fuel Handling -Defueling	10/2/2012
NK38-REP-09701-10021 Contracting Strategy TG	Contracting Strategy for TG; email attached	8/31/2012
NK38-REP-09701-10024 Contracting Strategy SG	Contracting Strategy for Steam Generator	8/10/2011
NK38-REP-09701-10030 Contracting Strategy Summary TG	for Turbine Generators; memo attached dated 3/28/12	8/24/2011
NK38-REP-09701-10034 RFR Contracting Strategy-signed R000	Contracting Strategy for Retube & Feeder Replacement	7/31/2011
NK38-REP-09701-10102 Contracting Strategy BOP	Balance of Plant; email attached	3/19/2013
NK38-REP-09701-10130-R000 Contracting Strategy for FH Refurb	Fuel Handling - Refurbishment	11/16/2012
NK38-REP-09701-0442800 BOP Pre Refurb Contracting Strategy	Pre-Refurbishment Sub-Bundle	1/30/2013
N-MAN-00120-10001-RDM R000 Nuclear Projects Records and Document Management	Nuclear Projects Records And Document Management	3/14/2013
N-MAN-00120-10001-RDM Project Records & Doc Mgmt.	Records And Document Management	3/14/2013
N-MAN-00120-10001-RDM-01-R001 Sharepoint 2007	Nuclear Projects Sharepoint 2007	2/19/2013
N-MAN-00120-10001-RDM-02-R001 Supplier Document Hub	Supplier Document Hub	4/17/2013
N-MAN-00120-10001-RDM-09 Release of OPG Docs to Ext Oversight	Release Of OPG Documents To External Oversight Organizations	4/17/2013
Nuclear Projects Records and Document Management	Nuclear Projects Records And Document Management	3/14/2013
DR Scope Strategy and Plan NK38-INS-09701-10001	Program-Scope Control	12/12/2012
NK38-GUID-01900-10001-R001 Design Completion Assurance	Design Completion Assurance	10/15/2012
NK38-GUID-01900-10002-R001 Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	10/15/2012
NK38-GUID-01900-10003-R001 Engineering Interface Requirements	Engineering Interface Requirements	2/28/2013
NK38-GUID-01900-10004 Development of Conceptual Design	Guide to the Development of a Conceptual Design Report	12/18/2012
NK38-GUID-09701-10020 Gen Process for Conceptual Studies	Generic Process for Execution of Darlington Refurbishment Services Conceptual Studies	2/15/2013
NK38-INS-01900-10001-R001 Preparing & Issuing Eng. Directives	Management Expectations On Preparing And Issuing Engineering Directives	8/24/2012
Nk38-INS-01920-10002 Quality Engineering Plan	Quality Engineering Plan	10/18/2012
NK38-INS-09701-10001-R004 Program Scope Control	Program-Scope Control	12/12/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-INS-09701-10008 Tracking Compliance with Environmental Commitments	Tracking Compliance With Environmental Commitments	11/1/2012
NK38-PLAN-1060-10003 Reference Plan Scope Definition	REFERENCE PLAN - SCOPE DEFINITION	6/25/2008
NK-38-PLAN-09701-10003 Terms of Reference	Scope Review Board – Terms of Reference	2/1/2011
NK38-PLAN-09701-10067 Scope Mgmt. Plan	Program Scope Management Plan	1/31/2013
N-MAN-00120-10001-Scope	Nuclear Projects Scoping Process	12/11/2012
N-MAN-00120-10001-Scope-06 Transfer of Work Process	Transfer Of Work Process	7/26/2012
N-MAN-00120-10001-Scoping Process	Nuclear Projects Scoping Process	12/11/2012
Project Planning, Engineering Staffing - 1-1-13	Release 4: Project 73019, 73020, 73094, 73021 & 73022 Detailed Planning	2/1/2013
GOVERNANCE FRAMEWORK	Index	
Governance Chart	Chart	
N-CHAR-AS-0002 Nuclear Management Systems	NUCLEAR MANAGEMENT SYSTEM	
N-PROG-AS-0001 Managed Systems	MANAGED SYSTEMS	
N-PROC-MP-0090 Mod Process	MODIFICATION PROCESS	
N-PROC-AS-0001 Mgmt. of Administrative Governance	PROGRAM MANAGEMENT OF ADMINISTRATIVE GOVERNANCE	
N-STD-AS-0001 Requirements for Admin Governance Docs	REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS	
E-Manual Template	N-STD-AS-0028 – Project Management Standard	7/17/2013
N-PROG-AS-0007 Project Management	PROJECT MANAGEMENT	
NK38-PLAN-09701-10067-0017-R000 Contract Mgmt. Plan	identifies how the major contracts will be defined, managed and controlled throughout program	1/31/2013
N-PROC-AS-0081 Technical Contractor Management Process	TECHNICAL CONTRACTOR MANAGEMENT PROCESS	
N-STD-AS-0028 Project Management Standard	PROJECT MANAGEMENT STANDARD	
N-STD-AS-0029 Contract Management Standard	CONTRACT MANAGEMENT STANDARD	
N-STD-AS-0030 Project Oversight Standard	PROJECT OVERSIGHT STANDARD	
N-STD-AS-0031 Field Engineering Standard	FIELD ENGINEERING STANDARD	
1 Refurbishment Program Structure And Summary Management Plan	Refurbishment Program Structure And Summary Management Plan	1/31/2013
2 Refurbishment Program Scope Management Plan	Refurbishment Program Scope Management Plan	1/31/2013
3 Program Cost Management Plan	Program Cost Management Plan	1/31/2013
4 Program Schedule Management Plan	Program Schedule Management Plan	1/31/2013
5 Refurbishment Program Reporting Management Plan	Refurbishment Program Reporting Management Plan	1/31/2013
6 Darlington Refurbishment Risk Management Plan	Darlington Refurbishment Risk Management Plan	1/31/2013
8 Refurbishment Program Staffing Management Plan	Refurbishment Program Staffing Management Plan	1/31/2013
9 Program Documentation Management Plan	Program Documentation & Project Closure Management Plan	1/31/2013
12 Program Environmental Management Plan	Program Environmental Management Plan	1/31/2013
13 Program Management System Oversight Management Plan	Program Management System Oversight Management Plan	1/31/2013
16 Nuclear Refurbishment Program Health and Safety Management Plan	Nuclear Refurbishment Program Health & Safety Management Plan	1/31/2013
17 Program Contract Management Plan	Program Contract Management Plan	1/31/2013
18 Program Return to Service Management Plan	Program Return to Services Management Plan	1/31/2013
Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
0 Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
2 Refurbishment Program Scope Management Plan	Refurbishment Program Scope Management Plan	1/31/2013
3 Program Cost Management Plan	Program Cost Management Plan	1/31/2013
4 Program Schedule Management Plan	Program Schedule Management Plan	1/31/2013
5 Refurbishment Program Reporting Management Plan	Refurbishment Program Reporting Management Plan	1/31/2013
6 Darlington Refurbishment Risk Management Plan	Darlington Refurbishment Risk Management Plan	1/31/2013
8 Refurbishment Program Staffing Management Plan	Refurbishment Program Staffing Management Plan	1/31/2013
9 Program Documentation Management Plan	Program Documentation & Project Closure Management Plan	1/31/2013
12 Program Environmental Management Plan	Program Environmental Management Plan	1/31/2013
13 Program Management System Oversight Management Plan	Program Management System Oversight Management Plan	1/31/2013
16 Nuclear Refurbishment Program Health and Safety Management Plan	Nuclear Refurbishment Program Health & Safety Management Plan	1/31/2013
17 Program Contract Management Plan	Program Contract Management Plan	1/31/2013
18 Program Return to Service Management Plan	Program Return to Services Management Plan	1/31/2013
NK38-PLAN-09701-10067-0001-R002 Refurbishment Program Structure And Summary Management Plan	Prog. Structure & Mgmt. Plan	1/31/2013
Earned Value Guide	N-MAN-00120-10001-SCH-07-R000 - EV Mgmt.	3/15/2013
NK38-PLAN-09701-10067-0004 Sh 0004	Program Schedule Management Plan	3/27/2013
NK38-PLAN-09701-10072 Critical path	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
N-MAN-00120-10001-COM	Project Communications	1/1/2013
N-MAN-00120-10001-CST	Cost Management And Project Reporting	7/19/2012
N-MAN-00120-10001-Est-01	NUCLEAR REFURBISHMENT COST ESTIMATE	7/25/2012
N-MAN-00120-10001-Est-R001	Nuclear Projects Cost Estimating	11/30/2012
N-MAN-00120-10001-GRB	Nuclear Projects Gated Process	11/28/2012
N-MAN-00120-10001-PC	Project Controls	1/1/2013
N-MAN-00120-10001-PC-02-R001	Cost And Schedule Change Control Instruction	4/25/2013
N-MAN-00120-10001-Sch	Schedule Management	7/19/2012
N-MAN-00120-10001-Sch-01	Work Breakdown Structure Direction	
N-MAN-00120-10001-Sch-02-R001	Program/Project WBS Manual	4/5/2013
N-MAN-00120-10001-Sch-02-R003	DNG Refurb -Standard Projects Milestone List	
N-MAN-00120-10001-Sch-03-R001	Program & Project missed milestones recovery process	
N-MAN-00120-10001-Sch-05-R001	Program/Project WBS Manual	4/5/2013
N-MAN-00120-10001-Sch-06	Milestone Definition Framework	8/2/2012
N-MAN-00120-10001-Sch-07	Earned Value Management	3/15/2013
Nuclear Contract Management Manual	guidance for the implementation of the five stages in the contracting process	11/28/2012
Program Schedule Mgmt. Plan Rev 1	Program Schedule Management Plan	3/27/2013
Contingency Instructions	bullet points	
Contingency Presentation for RPET (Jan-30-2013)	proposed strategic direction of contingency development and management	1/30/2013
Contingency Worksheets	database template	
N-MAN-00120-10001 Risk	Task Instruction – Closing Risks	
N-MAN-00120-10001 Risk-R001	Nuclear Projects Risk Management Process	11/22/2012
N-MAN-00120-10001-Risk-03	Nuclear Projects Risk Management Process	11/22/2012
N-MAN-00120-10001-Risk-04	Nuclear Refurbishment Risk Management	7/25/2012
N-MAN-00120-10001-RISK-05-R001 Contingency (1)	Contingency Development And Management Guide	6/26/2013
Do not use--Use R001N-MAN-00120-10001-Risk-05 Contingency Development & Mgmt.	Contingency Development And Management	7/19/2012
N-MAN-00120-10001-Risk-06	Darlington Refurbishment Lessons Learned And OPEX Management	7/19/2012
N-MAN-00120-10001-Risk-07	Nuclear Refurbishment Earned Value Management	3/15/2013
Nuclear Projects Risk Management Manual (1)	Risk Management	7/25/2012
Nuclear Projects Risk Management Process	Risk Management Process	11/22/2012
Nuclear Projects Planning & Control Earned Value Management April 2013	Planning & Controls	Apr-13
R3 May 1 Oversight Workshop	for Senior Management	
GRB Schedule 2013	Nuclear Refurbishment Gate Review Board, 2013 Schedule	3/18/2013
Nuclear Projects Gated Process	Nuclear Projects Gated Process	11/28/2012
OPG Proposal Org and Labor Resource revA	Organization & Labour Resource Strategy	5/11/2010
R3 May 1 Workshop on Oversight	Oversight workshop for senior mgmt.	May-13
PR_G1_Presentation	Gate 1 Pre-Refurbishment Sub-Bundle	4/15/2013
Dispositioning Comments scf	Tabs: Comments, Contingency Table	
G1-0 Gate Progression Form	1.0 GATE SUMMARY, 2.0 GATE PROGRESSION STRATEGY, etc.	4/15/2014
G1-0 Gate Progression Form (pdf)	Balance of Plant: Pre-Refurbishment	4/15/2014
G1R BoP S and C GPF	Balance of Plant Safety and Controls	
G1-2 Cost Estimate	DSR Line Estimate _ Scope List - as of Mar 8, 2013 (In $K)	
G1-3 PR Funding Request Form	Funding Request Form	4/15/2013
BoP_PR_DRAS_Combined	DRAS - Decision Record & Analysis Sum. Form	
G1-4 - PR Decision Records and Analysis Summary	Balance of Plant Pre-Refurbishment Sub-Bundle	4/15/2013
BoP_PR_L1_G1_Waterfall_20130328	Initial Gate Submission - BoP View	2/28/2013
BoP_PR_L1_G1_WBS_20130328	Gate Review Level 1	2/28/2013
BoP_PR_Milestones_20130328	All Pre-Refurbishment Key Milestones	2/28/2013
BoP_PR_WBS_20130328	Primavera org chart	3/28/2013
BoP_PR_L3_G1_Waterfall_20130328	Initial Gate Submission - BoP View	2/28/2013
BoP_PR_L3_G1_WBS_20130328	Gate Review Level 3	2/28/2013
G1-7 - PR Pre-Req. Inspections	Gate 1 Submission Document	4/15/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
G1-9_RiskAssessment	Project Risk Assessment	4/15/2013
G1-10 - PR Alternative Option Decision Making Strategy	Alternative Option Decision Making Strategy	4/15/2013
G1-11 2013-2025 Cash Flows	Sheet 2 -Nuclear Refurbishment Program Staffing ($) and Contract Cost	
G1-11 2013-2025 Resource Plan	Sheet 1 -Nuclear Refurbishment Program Staffing (FTE) and Contract Cost	
G1-11 Annual Cash Flows	2013 to 20XX CASH FLOWS	
G1-12 Key Assumptions	Key Assumptions & Constraints; Balance of Plant, Pre-Refurbishment	4/15/2013
G1-13 - PR Gate Progression Strategy	Gate Progression Strategy Plan	4/15/2013
G1-14 - PR Contracting Strategy	CONTRACTING STRATEGY FOR BALANCE OF PLANT – Pre-Refurbishment Sub-Bundle	1/30/2013
ESMSA Overview	Extended Svcs. & Master Svc Agreement	2/23/2012
Extended Services MSA - Main	MASTER SERVICES AGREEMENT; redacted version	2/15/2012
Extended Services MSA Appendix 1 - EPC (Owner, Constructor)	Terms & Conditions for Eng., Procurement & Constr.	2/15/2012
Extended Services MSA Appendix 2 - EPC (Owner Only)	Terms & Conditions for Eng., Procurement & Constr.	2/15/2012
Extended Services MSA Appendix 3 - Engineering	Terms & Conditions for Engineering	2/15/2012
Extended Services MSA Appendix 4 - Procurement	Terms & Conditions for Procurement	2/15/2012
Extended Services MSA Appendix 5 - Construction	Terms & Conditions for Construction	2/15/2012
Extended Services MSA Appendix 6 - Engineering and Procurement	Terms & Conditions for Engineering & Procurement	2/15/2012
Extended Services MSA Appendix 8 - Procurement and Construction	Terms & Conditions for Procurement & Construction	2/15/2012
Extended Services MSA Appendix 9 - Augmented Staff	Terms & Conditions for Augmented Staff	2/15/2012
Labour Requirements Acknowledgement	executing acknowledgement of labour requirements	12/6/2010
Labour Requirements Clause - Form 1	Form 1	11/28/2011
Schedule 5 - Cost Allocation Table	table	
Schedule 6 - COIR	Contractor/Owner Eng. Interface Requirements for Nuclear	6/29/2011
Schedule 8 - Business Expense Schedule	STANDARD FORM	7/27/2010
Schedule 10 to Extended Services MSA	table	
Schedule 11 - Definition of First Aid	informative document	
Schedule 11 - List of Items for Human Performance PI	table	
Schedule 11- Annual Performance Indicators and Scoring	table	
Schedule 13 - Free Issue Materials	informative document	
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
NK38-CORR-09701-046500	Non-core Scope Valve cost benefit analysis	5/28/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
Gate 3 Presentation 73821	Gate 3 GRB Meeting	6/11/2013
Campus Plan	arial view of campus	
13MAY2013 - DNGS WHITEBOARD	CAMPUS PLAN WHITEBOARD	5/13/2013
16-31555 Full Execution Release April 19 GRB Distribution	Type 3 Business Case Summary	
Business Case - DN Refurb - 2011	N-REP-00120.3-10000-R001, Economic Feasibility Assessment	11/15/2011
CSIS (05-Mar-2013)	Campus Plan Integration Plan - Master Plan - Layout B	3/5/2013
Extended Services MSA - Main	MASTER SERVICES AGREEMENT	2/15/2012
NK38-REF-09701-0439454 T10 Integrated Work Flow Analysis	Personnel Flow; R&FR Workers, BoP Workers, etc.	Jun-12
Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
Projects and Modifications information	Email - fr/ Dragan Popovic to E. Gould	5/13/2013
Remaining Work Status 19Apr2013.pdf	DNGS-Heavy Water Management Building West Annex	4/19/2013
Risk Register Template C - Gate 3b R1	Instructions & Notes for Risk Register (RR) Template C; add'l tabs	
Site Layout Yearly Option-Model May 7 2013.pdf	Campus Plan Proposed Refurb Gen Arrangement	
Visio-27FEB2013 DNGS OUTAGE CAMPUS PLAN - Lookahead 2013 Level 1.pdf	2013 LEVEL 1 PROJECT REVIEW	2/27/2013
Visio-Copy (1) of 08APRIL2013 - DNGS - 20 Week Project Look Ahead (3).pdf	20 WEEK PROJECT LOOK AHEAD	4/8/2013
Components requiring Unit overlap Memo	Memo to summarize review performed FH refurb	6/17/2013
Darlington Defueling Study	Darlington NGS Defueling Study	4/1/2011
Email response from FH Proj. Mgr. re documents	Email - Doc for External Oversight Team	4/29/2013
FH and Refurbishment Integration Readiness May 8 2013	chart	5/8/2013
NK38-PLAN-35000-10005- Basis of Flow Defueling Critical Path Evaluation Feb 21 2013	Refurbishment Defueling Basis For Critical Path Estimation	2/21/2013
REVISED Terms of Reference	FH Equipment Reliability and Refurbishment Integration Steering Committee	
2013_Defuel Presentation-Gate 2-June 14-final	Project Status	6/14/2013
Defueling Project Management Plan Rev 0	Defueling Project Management Plan	6/5/2013
Gate Progression Form-Gate 2-final	Fuel Handling Defueling	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-REP-09701-10005 R001 White Paper Islanding Strategy	White Paper - Refurbishment Island Strategy	4/20/2012
BH Gate 2 Scope Summary Statement	Islanding Bulkhead and Containment Isolation Sub bundle	
Dispositioning Comments scf	templates/tables - blank	
Islanding BH G2 GPF	Islanding - Bulkhead	
NK38-PLAN-09701-10159	Islanding Project Management Plan	4/16/2013
Risk Management Plan R00 Signed	NR Islanding Project - Risk Mgmt. Plan	2/19/2013
Gate 2 DRAS Cover Sheet	Islanding – Bulkhead and Containment Isolation	4/30/2013
BH Milestones Gate 2	Bulkhead Milestones	4/4/2013
BHLevel 1 Gate 2	Bulkhead Level 1	4/4/2013
BH G2-7 Analysis of alternative options	Evaluation of preferred alternative; Islanding – Bulkhead and Containment Isolation	4/30/2013
BH G2-8 Review of Engineering Analysis	Review of scope and engineering analysis to determine/anticipate scope additions; Islanding – Bulkhead and Containment Isolation	4/30/2013
AIDA_Islanding	Current Islanding Assumptions; add'l tabs	
Bulkhead Assumptions	Darlington Refurbishment - Planning & Cntls. (3 pgs. of 150)	4/17/2013
Gate 2 Assumptions Cover Sheet	G2-9 Key Project Assumptions & Constraints	4/30/2013
BH G2-10 2 Percent Design Complete	G2-10 ~2% Design Complete	4/30/2013
PDRI-2 Nuclear bulkhead Letter	Nuclear Bulkhead Containment Project, PDRI-2 Results	4/18/2013
PDRI-Nuclear Bulkhead	Nuclear Islanding (Bulkhead & Containment); instructions & database	
BH G2-12 Identification of major long lead items	G2-12 Identification of major long lead items	4/30/2013
Gate 2 Risks Cover Sheet	G2-13 Project Risk Assessment Subject Project Bundle: Islanding	4/30/2013
Gate 2A Risk Contingency	Islanding Bulkhead & Containment Isolations and Project Management Gate 2A Risk Contingency	
Islanding BH and PM Risks	Residual Risk Description	
BH G2-14 PIR Criteria	G2-14 PIR Criteria	4/30/2013
DRAFT Islanding Oversight Plan Rev 00 (2) 8April2013	Island Project Oversight Plan	4/23/2013
BH G2-16 Review of G0 Scope	G2-16 Review of G0 Scope	4/30/2013
BH G2-17 Level 2 and 3 Schedule	G2-17 Level 2 and Level 3 Schedule	4/30/2013
BH OPG Level 2 3 Gate 2	Bulkhead OPG Level 2/3	4/4/2013
BH Vendor Gate 2	RFR Team; DRAFT Containment Isolations Remaining Work Status: 23Apr2013	4/24/2013
BHLevel 2 Gate 2	Bulkhead Level 2	4/4/2013
Volume Reduction Strategy CP0420-1 Combined	scanned doc - RFR Volume Reduction Location	
QA_RFR_Contract_Confidential	Questions & Answers	4/9/2013
RFR Contract Summary of Key Terms	Eng., Procurement, & Constr. Agreement for Refurb Retube & Feeder Replmt. Proj.	3/12/2012
Contract Strategy for RFR NK38-REP-09701-10034	Retube & Feeder Replacement	7/31/2011
NK38-DAI-0901-10008 RFR Contractor Interface Requirements	RFR Contractor/Owner Interface Requirements	8/15/2012
RFR Eval Summary NK38-REP-09701-10084	R&FR RFP Evaluation & Negotiation Process Sum.	6/25/2012
Dispositioning Comments scf RFR -Gate 2 A	P&C Cost Review; add'l tabs included	
Gate 2 A Summary	Mar 2013 - May 2014	
NK38-REP-09701-10034 RFR Contracting Strategy-signed R000	Retube & Feeder Replacement	7/31/2011
Projects - Retube and Feeder Replacement	Current Gate 2A; Fiscal Mo End 03-July-2013	7/3/2013
RFR G2A GPF	Retube and Feeder Replacement Project	
RFR Gate 2A Level I Schedule 28Feb13	Review Level 1	2/28/2013
RFR Gate 2A Progression Signed off	Retube & Feeder Replacement Proj.	
RFR Risks - by RBS - Feb 21 2013	Risks Level 1 and Level 2; RFR - Retube & Feeder Replacement	2/21/2013
Dec 2012 Estimate Report	ESTIMATE, LEVEL 2 SCHEDULE & RISK REPORT	12/21/2012
RFR Resource Plan - Revised March 6 -Gate 2A	March, 6	
RFR Resource Plan 15 Feb 2013-Gate 2A	Feb 15 2013	
RFR Resource Plan 20 Feb 2013-Execution	Feb 20 2013	
34-120019 Annulus spacer Qual-9jan2013	Annulus Spacer Qualification Test for Darlington Retube	
34-120019 Inconel 9jan2013	Inconel Spacer Qualification Test for Darlington Retube	
2013-02-08- R0031- Basic	R0031 : Retube and Feeder Replacement Resources	
2013-02-08- R0031- Cash flows- Basic with actuals-Oct12-May14.pdf	CT-01 Monthly Project Cash Flow -with actuals	2/8/2013
2013-02-08- R0031- Cash flows- detailed by WBS with actuals.pdf	CT-02 Monthly Project Cash Flow by WBS	2/8/2013
2013-02-08- R0031- detailed	R0031 : Retube and Feeder Replacement Resources	2/2/2013
AECL Op 3 Pricing Submission Form Annulus Spacer	Option 3: Combined Inconel X-750 & Zr-Nb-Cu Tight Fitting Spacers	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
AECL Zr - R1	Zr-Nb-Cu Irradiation Program High Level Schedule and Budgetary Estimate	
AMEC NSS OSS Services- Gate 1 and 2A Deliverable List (verified - Updated)	Appendix B: Deliverable Budgetary Cost and Schedule; add'l tabs	
Appendix 01 - 509407-0000-00000-33RA-0035 OSM (Rev PB)	MATERIAL ALLOWANCE CALCULATIONS - BASED ON A SINGLE UNIT ONLY (2013)	4/12/2013
Assistance for RFR - Hours Estimate	Document list, engineering reviewers, hrs, etc	
Contractor Owner Interface Requirements RFR	NK38-PLAN-28200-10006-R000 Engineering Quality Oversight Plan for RFR Islanding Svc Annex	3/15/2013
NK38-PLAN-31160-10002_R000(22Jan2013)	Scope of Work Fuel Channel Modified Inconel X-750 Annulus Spacer	1/22/2013
NK38-PLAN-31160-10003_R000(22Jan2013)	Scope of Work Fuel Channel Zr-Nb-Cu Annulus Spacer	1/22/2013
RFR Cash Flow 2013 -R2 Current	Progress Curves - Calculations	
RPET Presentation Gate 2A Meeting 1	Execution Phase Estimate	1/23/2013
RPET Presentation Gate 2A Meeting 2	Gate 2a Project Plans	2/6/2013
RPET Presentation Gate 2A Meeting 3	Gate 2a Look Ahead	2/13/2013
Contractor Owner Interface Requirements RFR	NK38-PLAN-28200-10006-R000 Engineering Quality Oversight Plan for RFR Islanding Svc Annex	3/15/2013
NK38-DP-09701-10001 RFR Design Plan Rev. 000	Retube & Feeder Replacement Design Plan	
NK38-DP-09701-10001 RFR Design Plan	RFR Design Plan (Proj. #73100)	3/11/2013
NK38-PLAN-0970-10126 Retube and Feeder Replacement Oversight Plan Rev 01 (3)	Retube And Feeder Replacement (RFR) Project Oversight Plan	2/1/2013
NK38-PLAN-09701-10074 R002 RFR Project Mgmt. Plan	RFR Project Mgmt. Plan	2/4/2013
NK38-PLAN-09701-10126 Oversight Plan Rev 000	RFR Project Oversight Plan	2/27/2013
NK38-PLAN-09701-10148-RFR Project Controls Plan	RFR Project Controls Plan	3/1/2018
NK38-PLAN-09701-10148-RFR Project Controls Plan-3	RETUBE & FEEDER REPLACEMENT (RFR) Project Controls Plan	1/18/2013
NK38-PLAN-09701-10150-RFR Contract Management Plan	(RFR) Contract Management Plan	2/28/2013
NK38-PLAN-09701-10152 RFR Engineering Plan Rev. 000	RFR Engineering Plan	2/4/2013
NK38-PLAN-09701-10152 RFR Engineering Plan	RFR Engineering Plan	2/4/2013
PMP Rev 2	(RFR) Project Management Plan	2/4/2013
509407-0000-00000-30RM-0006 R00 Monthly Progress Report September 2012	Retube & Feeder Replmt. Proj.	Sep-12
509407-0000-00000-30RM-0008_R00 Monthly Progress Report October 2012	Retube & Feeder Replmt. Proj.	Oct-12
509407-0000-00000-30RM-0011_R01 Monthly Report January 2013 Complete	Retube & Feeder Replmt. Proj.	Jan-13
509407-0000-00000-30RM-0012_R00 Monthly Report February 2013 Complete	Retube & Feeder Replmt. Proj.	Feb-13
509407-0000-00000-30RM-0013_R00 Monthly Report March 2013	Retube & Feeder Replmt. Proj.	Mar-13
509407-0000-00000-30RM-0014_R00_Monthly Report April 2013	Retube & Feeder Replmt. Proj.	Apr-13
509407-0000-00000-30IM-0001_RPB_Project_Controls_Plan	identifies the required Project Controls systems, processes and procedures	6/15/2012
509407-0000-00000-30IM-0002 RPA - Resources Management Plan 20120515	identifies the required resource management processes utilized for the purposes of this DNGS RFR Project	5/10/2012
509407-0000-00000-30IM-0003 RPA - Scope Management 20120515	includes a change control process so it has been abbreviated as SCP – a short form for Scope and Change control Plan	5/15/2012
509407-0000-00000-30IM-0003_R02 Scope and Change Management Plan	to ensure there is a controlled work process that will document, track and manage all project changes	5/6/2013
509407-0000-00000-30IM-0005 - R00 JV Risk Management Plan	to describe risk management processes that will be implemented; shall describe the application of SLN-Aecon's corporate risk management program	8/28/2012
509407-0000-00000-30IM-0005_RPB_Risk_Management_Plan	shall describe the application of SLN-Aecon's corporate risk mgmt. program as well as OPG's risk management program(s).	6/13/2012
509407-0000-00000-30IM-0008 Proj Admin Plan RPB - 20120601	to describe SLN-Aecon's project admin practices and policies to provide systematic and practical approach for the project admin function	6/4/2012
509407-0000-00000-30IM-0012_R00 Interface Coordination Plan	will focus solely on the technical interfaces of the Project where differing scopes interface with each other during the Definition Phase	4/10/2013
509407-0000-00000-30IM-0013_R00 JV Human Performance Program	shall aim to recognize and address error-likely situations and potential challenges in task performance by establishing, promoting and reinforcing positive behaviours throughout project	3/1/2013
509407-0000-00000-32IM-0001 Schedule Management Plan -	identifies the required management systems, processes and procedures to be utilized by	4/13/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Apr 13 2012	the DNGS RFR Team	
509407-0000-00000-32IM-0001_R02 Schedule Management Plan	describes the requirements and work processes to be used as they relate to the various schedules	5/6/2013
509407-0000-00000-33IM-0001 RFR - Estimate Plan - Apr 13 2012	to prescribe the processes and the basis of Estimate and requirements for production of the Execution Phase Estimate	4/13/2012
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB JV RFR CL 4 Cost Estimate OSM	TMOD material, supports, hardware, feeder vision system, and miscellaneous items.	5/15/2013
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB	CL-4 Cost Estimate - Owner Specified Materials (OSM)	5/15/2013
509407-0000-00000-34IM-0001_R00_JV Cst_Mgmt_Pln	This Cost Management Plan (CMP) is a component of the Project Controls Plan (PCP). It identifies the required management systems, processes and procedures to be utilized	6/12/2012
509407-0000-00000-40EP-0001 R00 - Engineering Plan	Provide a description of eng. work; how work will be organized; applicable procedures & processes to be used	8/23/2012
509407-0004-00000-60IM-0001_R00 - D1341 Walkdown Plan - 08FEB13 – MASTER	RFR team will perform a series of walkdowns to perform inspections, take measurements and photos to support plant modifications engineering and tooling design	2/7/2013
509407-30CC-I-0224-Letter-Submission of Schedule Management Plan R02	correspondence referring to SMP, Retube & Feeder Replacement	5/27/2013
Appendix 02 - 509407-30CC-I-0109-Intermediate Level Waste Assessment	revised estimate: intermediate level waste components and key assumptions	10/12/2012
JV Project Controls Plan	509407-0000-00000-30IM-0001; Rev 01	5/6/2013
JV Project Management Plan	509407-0000-00000-30IM-0006; Rev 01	8/10/2012
OPG Org Strategy Study Plan _Rev 2a	Faithful & Gould report	Sep-10
Transmittal Milestone and Submittal Schedule 10Agu2012	Milestone schedules/database attached	8/10/2012
OverallRemainingWork2013-05-30 Part1	RFR Team - Retube & Feeder Replacement	5/30/2013
OverallRemainingWork2013-05-30Part2	RFR Team - Retube & Feeder Replacement	5/30/2013
OverallRemainingWork2013-05-30Part3	RFR Team - Retube & Feeder Replacement	5/30/2013
ALSTOM AGREEMENT	ENGINEERING SERVICES AND EQUIPMENT SUPPLY AGREEMENT	3/27/2013
RFR Agreement		3/2012
TG Project - Integration Update - July 4, 2013 v1	TG Project Update (pdf of ppt)	7/4/2013
Turbine Risk Register	Scanned doc - Nuclear Refurb - Turbine Generator	4/3/2013
1 -Table of Contents		3/19/2013
2-Title Page		3/19/2013
3 -Memo - Darlington Refurbishment Turbine Generator Project - Single Source Justification Approval Request	Memo	3/19/2013
4 -Darlington Generator Equipment Single Source Justification	Report, March 18, 2013	3/19/2013
Exhibit 1	Description of Item and/or Service: Darlington Refurbishment Turbine Generator Project Engineering Services and Equipment Supply	3/19/2013
Exhibit 2	Major Contract Memorandum	3/19/2013
Exhibit 3	Contracting Strategy Summary For Turbine Generators (8/24/11)	3/19/2013
Exhibit 4	Turbine Generator Refurbishment Project Alternate Contracting Plan (11/9/12)	3/19/2013
Exhibit 5 - Worley Parsons Burns and Rowe Technical Evaluation Report	Turbine Generator ("TG") Project Independent 3rd Party Technical Scope Evaluation and Validation	3/19/2013
Exhibit 6 - Design Basis Documentation Gap Analysis	Design Basis Documentation Gap Analysis	3/19/2013
Exhibit 7 - Design Basis Documentation Estimate	Design Basis Documentation Estimate	3/19/2013
Exhibit 8 - D.C. Cook OPEX	D.C. Cook OPEX	3/19/2013
Exhibit 9 - Faithful and Gould Class 5 Estimate	Independent Estimate for Fixed Priced Contract	3/19/2013
Exhibit 10 - Pricing Team Evaluation	Pricing Team Evaluation	3/19/2013
Exhibit 11 - Alstom Benchmarking Presentation		3/19/2013
Exhibit 12 - OPG Benchmarking		3/19/2013
Exhibit 13 - Technical Team Evaluation		3/19/2013
Faithful and Gould Proponent Information Form revB	PROPONENT INFORMATION FORM REQUEST FOR PROPOSALS	7/21/2010
Faithful and Gould Risk Program Gap Analysis	Risk Mgmt. Best Practice	Jul-11
Memo to CPO March 2013 rev 3	Single Source Justification approval request (3/10/13)	3/19/2013
NGD Refurbishment Contracting Report_Final	Plant Life Extension Project (PLEP) - Phase II & III Contracting Strategy Analysis	10/6/2006
Summary Memo rev 2	Single Source Justification Summary (3/10/13)	3/19/2013
Gate 2a Presentation to GRB April 2013 [19-Apr-13 revision]	Presenter: Todd Josifovski	Apr-13
TG G2 GPF 19-Apr-13	Turbine Generators	
Gate 2a Presentation to GRB April 2013	Presenter: Todd Josifovski	Apr-13

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
TG G2 GPF	Turbine Generators	
TG Project Staffing Plan Rev 6	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 6b	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 2	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 3 (with Gate Plan and Interest)	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 4	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
TG Project Staffing Plan Rev 5 Elisabeth's Version r	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
TG Project Staffing Plan Rev 5	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
NK38-PLAN-41000-10001-R000	Turbine Generator (T-G) Project Management Plan	3/12/2013
Attachment to TG11	Technical Evaluation Report	9/21/2012
Condenser Reconfiguration AIDA109 or TG07	Decision Record & Analysis Sum. Form; Condenser Tube Reconfiguration for MW Output Increase	
DRAS TG09 TS0760-43 Remove from scope	Turbine Generator Project - Steam Turbines and Turbine Auxiliaries: Gas Cooling DSR to be removed from scope	
DRAS TG10 SI0300-16 19 remove from scope	Turbine Generator Project Strategic Outage Improvements DSRs to be removed from scope	
DRAS TG11 Final	Turbine Generator Sustaining DSRs	
Generator Aux Improvement AIDA216 or TG04	Turbine Gen. Proj. #73255	
Generator Core Replacement and Rewind AIDA218 or TG06	Gen. Core Replacement & Rewind	
Moisture Separator Reheater Improvement AIDA214 or TG02	DSR TS0680-13; Moisture Separator Rehealer Improvement Initiative	
Stator Cooling Water Skid Replacement AIDA217 or TG05	Stator Cooling Water skid Replacement DSR #TS0760-25	
Stop Valve Seating AIDA213	Stop Valve Revised Seating Angle	
TCV, PRV FRF DRAS AIDA215 TG03	DSR Ts0750-28, SI10270-1, TS0750-34; elimination of the lube Oil TCV, etc	
TG List of DRASs		
2012 01 04 TG Estimate (1.01) 300113	Turbine Generator Independent Estimate	1/30/2013
BOEfxed	TG Independent Estimate for Fixed Cost Contract	1/30/2013
Estimate for Fxed	Confirmation of Faithful-Gould completed estimate	1/30/2013
NOC Data 8th Draft	DSR Database; includes Alstom data	
NOC Data TJ IW March 6th 2013	TG Scope elements	
20130402_TG_Level0 and Level1	Refurbishment Program Coordination & Control Schedule Gate Review Level 1	2/28/2013
Contractors proposed schedule	Classic schedule layout	1/29/2013
P6 milestones	Turbine Generator Gate 2A milestones	2/28/2013
TGContractScheduleandDefinitions_Feb 20 2013	TG Equipment Supplier Vendor (ESV) Contract Milestones & Definitions	
Level 3 april22013	Gate Review Level 3	2/28/2013
TG_Level 1_OPG	Gate Review Level 1	2/28/2013
TG_Level 3_OPG	Gate Review Level 3	2/28/2013
G2-1 Gate 2A Option Decision Making Strategy	Alternative Option Decision Making Strategy DNGS Turbine Generator Refurbishment	3/10/2013
Assumption gaps	Turbine Generator #73255 Key Assumptions Identification Form	2/27/2013
Assumption layup	Turbine Generator #73255 Key Assumptions Identification Form	
Assumption prereqs	Turbine Generator #73255 Key Assumptions Identification Form	
Assumption RFP	Turbine Generator #73255 Key Assumptions Identification Form	
Key Assumption 229	Turbine Generator #73255 Key Assumptions Identification Form	2/27/2013
Output 5 - 2 percent design completion	Initiation Phase Output #5: ~2% of Design Complete	
PDRI-2 TG Letter	Turbine-Generator Project, PDRI-2 Results	3/19/2013
PDRI-2 TG Mar-14-2013 R1	Turbine Generator Project	3/14/2013
Long lead items	Turbine Generator Gate 2A (one page)	
73802 Water and Sewer FULL BCS 3Apr2013	Executive Summary & Recommendations Darlington Water & Sewer Project	
Execution Full Release GRB Presentation 73802 Water and Sewer[1]	Gate 3 Presentation	4/8/2013
W and S G3 GPF[1]	Darlington Water and Sewer	
Processes and Procedures re Cost and Schedule	Project Controls	5/9/2013
RFR Project Controls Requirements	Exhibit 2.9(j) - Project Controls	
AACE Rec Prac 37R-06 Schedule Levels of Detail	applied to eng., procurement & constr.	3/20/2010

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
AACE Rec Prac 38R-06 Documenting the Schedule Basis	7.2 Sched Planning & Development	6/18/2009
AACE Rec Prac 40R-08 Contingency Estimating -- General Principles	7.6 Risk Mgmt.	6/25/2008
AACE Rec Prac 41R-08 Risk Analysis and Contingency Determination	7.6 Risk Mgmt.	10/27/2008
5 DN Refurb_Release 4b Cost Summary	Program & Annual Cash Flow Sum. > Proj. Bundles/Work Pkgs.	
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
Determining P50 Contingency for a Target Price Contract	a proposal of the methodology to determine a 50% confidence level contingency for a Target Price Contract	11/30/2012
Engineering Cost Breakdown Structure - 2-1-13	Scanned Organizational chart	
Engineering WBS - 2-1-13	Scanned Organizational chart > Nuclear Refurb. Eng. WBS	
Funding Analysis - 3-7-13	Eng. Proj. Director - RC 1066, 2077, 2073	3/7/2013
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-core Scope Valve cost benefit analysis	3/28/2013
N-MAN-00120-10001 Cost and Schedule Change Control Instruction		7/31/2012
N-MAN-00120-10001 Nuclear Projects Cost Estimating		11/30/2012
N-MAN-00120-10001 Nuclear Refurbishment Cost Estimate		7/25/2012
N-MAN-00120-10001 Risk-05 Contingency Development and Management Guide	hand written notes on doc	6/30/2013
NR Program Cost and Cashflow 2011 E2 R13 (GHR) Sep 28 2011	R&FR Data Summary	9/28/2011
NR Program Cost and Cashflow Estimate File for 4b	2013-2015 Business Plan Listing - Project Life Cycle Costs (K$)	9/14/2012
Proposal for Determining P50 Contingency for Target Cost Contract	proposal of the methodology to determine a 50% confidence level contingency for a Target Price Contract at Nuclear Refurbishment	11/30/2012
RFR Roadmap	Cost Variance Roadmap; RFR used as an example	6/27/2013
Strategic Direction for Nuclear Refurbishment Contingency Development and Management	Basis of Strategy, Classification, Accountability, Development & Monitoring	12/5/2012
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R03	Initiatives, Cost Estimate and Cash Flow	
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R04	DN Refurbishement Feasibility Cost Assessment	Nov-09
Target Cost Contracts Presentation 31 Mar 11	PDF ppt - Target Cost Contracts presentation	3/31/2011
4b Estimate p2	Tabs = Rev. Status, ISR Analysis, Syst. Layup, EPW & Passport Issues	7/22/2013
4b Estimate P3	**NOTE:** Password Protected; Tabs = ISR, 4b, Campus Plan, ISR Mods, ISR Programmatic & ISR TRF	7/22/2013
Estimate Analysis 4b vs. 3 April 2013	DNGS Refurbishment Estimate Analysis	4/25/2013
NR Program Cost and Cashflow 2011 E2 R13 (GHR) Sep 28 2011	R&FR Data Summary	9/28/2011
NR Program Cost and Cashflow Estimate File for 4b	Program and Annual Cash Flow Summary - Release 4b	10/9/2012
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R03	Cost Estimate High Level Summary, Rev 1.1.03 Cost Estimate High Level Summary, Rev 10 (Including Contingency)	
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R04	DN Refurbishement Feasibility Cost Assessment - Board - November 2009 (Rev 1.1.04)	11/1/2009
4b Dataset	Revised DSR Based Estimate > multiple entries for DSR TS0010-4	
DSR Estimates by BoE	Tabs: Passport Issues, Summary, RFR G1, FHG1, ETC. (Jacob Mills)	3/26/2013
Estimating Baseline Schedule 2013		Jan-13
Status Report	Tabs: Status, DSR Database 03282013, Passport Issues, BoE DSRs, ETC. (Jacob Mills)	3/28/2013
Example BoE	example only	
Example Estimate	example only	
Example Factored Rate + Indirect Costs	example only	
Campus Plan Status Report	Tabs: Status, DSR Summary, 4b Data, ETC.	4/2/2013
Campus Plan Estimate validation Report (1)	Parking Constr. Estimate Validation	3/1/2011
Campus Plan Estimate	Tabs: DSR Summary, 4b Data, 2013BP Life Cycle Costs, DSR Database	
N-REP-00120-0373568	Memo fr/ Gary Rose (Campus Plan Est. Validation Rpt. attached)	3/3/2011
RFR BoE	Execution Conceptual Independent Class 5 Summary Basis of Estimate	1/27/2012
RFR DSR Cost Estimate	R&FR Bundle	
4B Data Summary	Tabs: Summary, 4b Data Summary, ETC.	3/7/2013
LISS Nozzle replacement assessment R-01	Retube & Feeder Replacement Study	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
RE DEC CCO Matrix Listing costing and overview drawing		
NK38 SOW 31100 10016 RFR SOW	Retube & Feeder Replacement Scope of Work	1/4/2012
TS0010-3	Est. Sum: LISS Nozzle Replacement Unit 1, 2, 3 & 4	7/8/2011
TS0010-5	Est. Sum: Contingency: Headers Replacement for Unit 1, 2, 3 & 4	7/7/2011
TS0100-6	Est. Sum: Extend Inspection of Pressurizers	8/21/2011
TS0100-7	Est. Sum: Clean Sludge Deposits from Pressurizer	8/21/2011
TS0100-8	Est. Sum: Repair/replace bleed cooler	8/21/2011
TS0100-9	Est. Sum: Replacement of Pipe Sections for 33310-L62, L37 and 33320	8/21/2011
TS0220-4	Est. Sum: Review the Phase 1 Outputs of COG Project on Calandria Vessels	8/5/2011
TS0240-1	Est. Sum: Replace all sections of the high instruments lines	8/8/2011
TS0260-2	Est. Sum: Replace SDS2 Orifice Flow Element	8/9/2011
TS0260-5	Est. Sum: Recommended Actions of SDS2 Instrument tubing	8/10/2011
TS0770-1	Est. Sum: ECI Pressure Breakdown Flow Elements	8/12/2011
TS1310-1	Est. Sum: Investigate the Benefit and Risks of Chromium Plating	8/21/2011
TS1310-2	Est. Sum: Modification of Plate end fittings	8/21/2011
TS1310-5	Est. Sum: Modification of Garter Springs	8/21/2011
RFR Tooling BOE FPage	Tooling Project Chosen Lead Proponent Tooling Fixed Price Cost	1/19/2012
RFR Mock-up BOE FPage	Darlington Energy Complex Chosen Lead Proponent Mock-up Fixed Price Cost	1/24/2012
RFR OSM BOE Fpage	OSM Conceptual Cost Summary	1/24/2012
RFR Independent Class 5 Estimate BOE Fpage	Execution Conceptual Independent Class 5 Estimate w/ Lead Proponent Fee	1/25/2012
RFR Class 5 Summary BOE Fpage	Execution Conceptual Independent Class 5 Summary Basis of Estimate	1/27/2012
Visio-RFR_March20 WBS	WBS Rev 0 - Organizational Chart	3/21/2013
RFR Class4 Estimating Kick-off	Email - From: James Laudanski; material for Kick-off mtg.	1/22/2013
OPG RFR 7March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #2	3/19/2013
OPG RFR 14March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #3	3/14/2013
OPG RFR 28March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #4	3/28/2013
Send RFR DSR with comments Dec. 19, 2011 cost Rev. 1		12/19/2011
UI Prereq Mods BOE Review	Email w/ NR Islanding Project Basis of Est. Prerequisite Modifications doc. attached	2/14/2012
Plot Plan Unit 2 Elev. 100	Dwg: RB, RAB, Turbine AB Turbine Hall	
NK38-SOW-09701-10005 R000 FINAL	Outage Unit Containment Isolations	10/18/2011
Seal Plate	Reactor Bldg. Structure; Calandria Seal; Installation Details; Misc. Steel	
TS0810 1 Install remove Shielding for the Bulkhead	Est. Sum: Install & Remove Shielding for the Bulkhead	2/6/2012
TS0810 1 Install Remove Temp Hor. Bulkheads	Est. Sum: Install & Remove Horizontal bulkheads	2/3/2012
TS0810 1 Install Remove Temp Supports for Hor. Bulkheads	Est. Sum: Install & Remove temporary Supports for hor. Bulkheads	2/2/2012
TS0810 1 Install Seal Plate	Est. Sum: Install Seal Plates	2/3/2012
TS0810 1 Remove install Catenary Deflector	Est. Sum: Remove & install Catenary Deflector	2/2/2012
TS0810 1 Remove Reinstall Plugs for the Bulkhead drain holes	Est. Sum: Install & Remove Plugs for the Bulkhead drain holes	2/6/2012
TS0810 1 Repair Vertical Bulkheads	Est. Sum: Repair Vertical Bulkheads	2/2/2012
TS0810 1 Turnover Closeout	Est. Sum: Turnover/Closeout	2/15/2012
Lessons Learned from D2O Storage 2-13	MODIFICATION PLANNING LESSONS LEARNED REPORT	2/27/2013
NK38-REF-03810-0405549 Need Stmt.-Heavy Water Mgmt.	Need Stmt.: Heavy Water Mgmt.	10/3/2011
NK38-REF-34200-0405550 Need Stmt-Neg Pressure Containmt	Need Stmt.: Neg. Pressure Containment	10/3/2011
NPC Cost Estimating Approximations_R01.docx	Email - NPC Cost Estimating Approximations -attachment	2/13/2012
UI D2O NPC cost estimating approximations	Email - 2 attachments: D_2O Cost Estimating Approximations; NPC Cost Estimating Approx.	1/30/2012
Air Lock Seal Drawings	Drawings	
Airlock Seals CATID Price	Screen prints of Master Materials Catalog	
NK38-REF-34200-0405550 Need Stmt-Neg Pressure Containmt	Need Stmt.: Neg. Pressure Containment	10/3/2011
Signed BOE for Barriers FPage	NR Islanding Proj - Basis of Est. Barriers	2/29/2012
Pre-req. DSR Estimates	Est. Sum: U2-Containment Safety Monitoring - Common Containment Pressure	1/27/2012
Signed BOE for Bulkheads FPage	NR Islanding Proj - Basis of Est. Containment Bulkhead	3/8/2012
Signed UI BOE - Summary Front Page	NR Islanding Proj - Gate 1 Summary Basis of Est	4/3/2012
SHD 4b Comparison	Tabs: DSR Database, 4b Data Sum, Shutdown Est, ETC.	3/7/2013
Moderator-PHT BOE	NR RFR – Moderator Auxiliary, PHT & Auxiliary Layup Project - Gate 2 Basis of Estimate	3/1/2013
Moderator-PHT Estimate	Tabs: Ts0890-2; Ts0890-1; Summary	
RE Planning Basis	Email - Fr: Audrey Razo; To: Nicole Zhang	2/22/2013
Re Request for Your Feedback - Roles and Responsibilities	Email - Fr: Lonnie Schofield; To: Ron Chatterton	3/21/2013
PM Signed SG Estimate Summary	SG Bundle - DSR Line Estimate_Scope List as of 8/31/11	9/1/2011
SG BOE-signed with type of doc. changed	Steam Generator Basis of Estimate	11/11/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Signed SG BOE	Steam Generator Basis of Estimate	11/11/2011
FH-Defueling BOE	Darlington – Fuel Handling Refurbishment – Defueling Basis Of Estimate	1/17/2013
FH-Defueling Estimate	FH-DEFUELING DSR COST	
Final Draft Defueling SOW Oct232012	Scope Of Work: Reactor Defueling	10/23/2012
Signed BOE for FH - Defueling FPage	Darlington-Fuel Handling-Refurb-Defueling Basis of Estimate	1/17/2013
FH Refurbishment BOE	Fuel Handling (FH) Basis Of Estimate	12/28/2012
FH Refurbishment Estimate	FH-REFURBISHMENT BUNDLE	
FH Refurbishment Factors Rates and Costs	Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (Appendix B, 7 day Coverage); add'l tabs	
Updated DSR fr Sunil May 24, 2012	TSO Approved Scope	
Cable Estimates	Email - attachment, Trolley Cable estimate Rev 00; Fr: Raihan Khondker/ To: Juan Natividad	6/28/2012
Fuel Handling Mtce Jan 292007	Chart	1/29/2007
List of all cables in the trolley	Email - attachments, List of all Trolley Cables & Trolley Cable estimate Rev 00; Fr: R.Khondker/ To: J.Natividad	6/26/2012
Trolley Cable Estimate	Email - attachments, Trolley Cable Qty estimate & Trolley Cable Manhours Est; Fr: R.Khondker/ To: J.Natividad	6/27/2012
DRAS Comparison	Fuel Handling; add'l tabs	
Work Breakdown Structure	breakdown	
Signed BOE FH-Refurbishment FPage	Basis of Estimate	12/28/2012
FH Defueling Work Packages WBS Layout		
FH - Defueling WBS and Work Package Details	Email - attachment, FH Defueling Work Packages; Fr: Sunil Ingle/ To: J.Natividad	4/3/2013
BoE BOP Common	"Common " Sub Project Basis Of Estimate	11/28/2012
BOP Common Estimate	Tabs: DSR Sum., Overall Sum., ETC.	
01-NK38-FEX-20100-2501-01	Reactor Bldg.	
02-NK38-FEX-20100-2502-04	T.H.R.A.B. & Turbine	
03-NK38-FEX-20100-2502-04	T.H.R.A.B. & Turbine	
04-NK38-FEX-20100-2503-06	R.B., R.A.B., Turbine	
05-NK38-FEX-20100-2503-06	R.B., R.A.B., Turbine	
06-NK38-FEX-20100-2504-01	Reactor Bldg	
07-NK38-FEX-20100-2505-02	R.B., R.A.B., Turbine	
08-NK38-FEX-20100-2505-02	R.B., R.A.B., Turbine	
09-NK38-FEX-20100-2506-02	Reactor Bldg & R.A.B.	
10-NK38-FEX-20100-2507-04	R.B., R.A.B., Turbine	
11-NK38-FEX-20100-2507-04	R.B., R.A.B., Turbine	
12-NK38-FEX-20100-2508-00	R.B., R.A.B., Turbine Aux. Bay	
13-NK38-FEX-20100-2509-00	R.B., R.A.B., Turbine Aux. Bay	
14-NK38-FEX-20100-2510-02	Reactor Bldg & R.A.B.	
16-NK38-FEX-20102-0503-00	Equipment Layout	
18-NK38-FEX-20102-0505-00	Equipment Layout	
19-NK38-FEX-20102-0506-00	Equipment Layout	
20-NK38-FEX-20102-0507-00	Equipment Layout	
22-NK38-FEX-20102-0509-00	Equipment Layout	
23-NK38-FEX-20102-0510-00	Equipment Layout	
24-NK38-FEX-20102-0501-02	Site Building Layout	
25-NK38-FEX-20102-0501-02	Site Building Layout	
27-NK38-FEX-20102-2507-01	Equipment Layout	
28-NK38-FEX-20102-2513-00	Equipment Layout Unit Pumphouse	
29-NK38-FEX-20102-0512-00	Equipment Layout Standby Generator	
30-NK38-FEX-20102-0513-00	Equipment Layout Standby Generator	
CBA_ASW Pressure Regulating Valve	DSR Number SI0270-3, ASW Pressure Regulating Valve	9/13/2012
DSR_SI0270-3	Gate Review Form	5/5/2011
Email Recom_11.01.2012	Email - OPG Acceptance of Balance of Plant Scope Feasibility Studies Report; Fr: G.Mills/ To: L.Crisologo	11/1/2012
NK38-F0H-72500-0002_FLOWD_DWG	Ctrl. Svc. Area Aux. Svc. Water Syst. Flow Diagram	
Pipe Price_passport	Screen prints of Master Materials Catalog	
DSR_TS0150-2	Inspect civil structure of Emergency Coolant Injection Storage Tank	1/26/2011
DSR_TS0150-8	CCA 001441 Contingency - ECI Water Storage Tank	1/26/2011
IWST Construction 1	photograph	
IWST Construction 2	photograph	
IWST Construction 3	photograph	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
IWST Construction 4	photograph	
TS0150-2	ECI Water Storage Tank	
CCA001600	Aging Management Program Component Condition Assessment (CCA) Equipment Room Sump(SUO-RlS)	
NK38-REP-0368-10078	Ageing And Actual Condition Of Systems, Structures And Components Safety Factor Report	10/14/2011
CCA000366	Aging Management Program Component Condition Assessment (CCA) MVC Recirculation pump	
DSR_TS0210-15	Negative Pressure Containment: Rebuild or Replace All 3 Pumps (Contingency)	3/2/2011
NK38-D2H-34222-9026_Vacuum Pumps GA Drwg	vacuum pumps	
NK38-DM-34220	Service Manual - Main Vacuum Pumps	
NK38-DM-34220_Vac System Manual	Vacuum Syst. Manual	
NK38-RH-34222_Main Vac Pumps Manual	Vacuum Syst. Manual	
34220 - P 1-3 vacuum pmp	photograph	
DSR_TS0210-17	Negative Pressure Containment: Replace NPC Vacuum System TK 1-4 (Contingency)	3/2/2011
NK38-D2H-34222-9024_TK4 Drwg	Vertical Tank	
NK38-D2H-34222-9025_TK1-3 Drwg	Horizontal Separator Tanks	
NK38-D2H-34222-9026_Vacuum Pumps GA Drwg		
NK38-F5H-34220-0001_Vacuum Flow Diag		
NK38-FXX-34220-0501_NPC Vacuum Sys		
NK38-WAH-34222-9041_NPC Drwg		
CCA000076	Aging Management Program Component Condition Assessment (CCA) Reactor Building Structure	
NK38-PIP-21100-10001	Reactor Building Non-Containment Components Periodic Inspection Program	4/16/2012
NK38-SR-03500-10001	Darlington Safety Report, Part 1 & 2	12/19/2010
CCA000077	Reactor Building Internal Structure	
NK38-PIP-21200-10001	Reactor Building Internal Structure Periodic Inspection Program	3/29/2012
CCA000083	Central Service Area - Nuclear	
NK38-PIP-22600-10001	Central Control Area Periodic Inspection Program	4/29/2012
NK38-PIP-24100-10001	Turbine Support Structure Periodic Inspection Program	6/8/2012
NK38-FEX-27103-1501-00	C.W. & S.W. Pumphouse 1	
NK38-PIP-27110-10001	Circulating Water Pump House Periodic Inspection Program	5/7/2012
Book3	2009 conversion USD - CAD; Equip. - Carried to Summary	
2004 Underwater Inspection Report	Final Report - Underwater Inspection of Circulating Water Intake Tunnel, Intake Structure & Intake shaft	
DSR_TS0510-7_CCA000092	Component Condition Assessment - Pipes, Ducts & Encasements	
DSR_TS0510-17	DNGS Structures: Perform Inspections on Pipes, Ducts Encasements Structures	4/13/2011
NK38-FEX-20102-0516-00	Equipment Layout - EPS Electr. Bldg.	
NK38-FEX-20102-0517-00	Equipment Layout - EPS Electr. Bldg.	
NK38-FEX-20102-0518-00	ESW Pumphouse	
NK38-FEX-20102-0519-01	ESW Pumphouse	
NK38-FEX-78400-0502-03	EPS Fuel Mgmt. Bldg.	
NK38-PIP-28300-10001	Emergency Power Supply And Emergency Service Water Complex Periodic Inspection Program	
NK38-PIP-22200-10001	Turbine Hall and Turbine Auxiliary Bay Periodic Inspection Program	3/29/2012
CCA000085	Component Condition Assessment (CCA) Central Service Area - Conventional Part	
NK38-PIP-22400-10001	Central Service Area –Conventional Periodic Inspection Program	4/17/2012
CCA000085	Aging Management Program Component Condition Assessment (CCA) Central Service Area - Conventional Part	
NK38-PIP-22400-10001	Central Service Area –Conventional Periodic Inspection Program	4/17/2012
CCA000078	Component Condition Assessment (CCA) Reactor Auxiliary Bay including structural and architectural elements	
NK38-PIP-21300-10001	Reactor Auxiliary Bay Periodic Inspection Program	3/20/2012
CCA000079	Component Condition Assessment (CCA) FFAA - West & East	
NK38-FEX-21400-0501-02	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0502-01	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0503-02	Fueling Facilities Aux. Area West	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-FEX-21400-0504-05	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0505-02	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0506-01	Fueling Facilities Aux. Area	
NK38-FEX-21400-0507-01	Fueling Facilities Aux. Area West	
NK38-PIP-21400-10001	Fuelling Facilities Auxiliary Area Periodic Inspection Program	
NK38-PIP-21500-10001	Irradiated Fuel Area (West and East) Periodic Inspection Program	
CCA000081	Component Condition Assessment (CCA) Fuel Handling & Service Area	
NK38-PIP-21600-10001	Fuel Handling and Service Area (West and East)Reception Bay Periodic Inspection Program	
CCA000077	Component Condition Assessment (CCA) Reactor Building Internal Structure	
CCA000083	Component Condition Assessment (CCA) Central Service Area - Nuclear	
NK38-PIP-24100-10001	Turbine Support Structure Periodic Inspection Program	
CCA000090	Component Condition Assessment (CCA) Pumphouse	
DSR_TS0510-23	DNGS Structures: Repair/Replacement of Pipes, Ducts, and Encasements (Contingency)	4/13/2011
nk38_bom_27117	Removal of Submerged Injection Piping in Ul Pumphouse	
nk38_d5h_27121_1001_intake tunnel	CW Syst. Structures Intake Tunnel	
nk38_d5h_27141_2003_intake pipe	Pumphouse to Powerhouse Intake Pipes	
nk38_d5h_27141_5001-u2_intake pipe misc	Pumphouse to Powerhouse Intake Pipes & Manifold	
nk38_d5h_27141_pipe earth excav	Pumphouse to Powerhouse Concrete Press Pipe	
nk38_draw_27113_pipe sleeve	CW Pumphouse No. 2 Pipe Sleeve	
nk38_draw_27117_10001_injection piping	CW Syst. Structures, CW Pumphouse, Chlorine Injection Piping Support	
nk38_draw_27117_injection piping	CW Syst. Structures, CW Pumphouse, Chlorine Injection Piping Support	
nk38-rep-27124-10001_Underwater_inspection	Final Report - Underwater Inspection of Circulating Water Intake Tunnel, Intake Structure & Intake shaft	
CCA000084	Component Condition Assessment (CCA) Turbine Hall & Turbine Auxiliary Bay civil/ structural elements	
CCA000469	Component Condition Assessment (CCA) Fire Protection Panel (Conventional)	
CP—35	Siemens CP-35 System 3™ Control Panel	
NK38-FEX-67861-0501-04	Inactive Chem. Waste Transfer Facility Fire Panel	
NK38-FEX-67870-0501-11	Fire & Smoke Detection Syst. Panels	
NK38-FEX-67870-0505-05	Domestic Waste Water Pumphouse	
NK38-FEX-67870-0507-02	Fire & Smoke Detection Syst. Panels	
NK38-FEX-78400-0501-01	CO2 Fire Protection	
NK38-FEX--78400-0502-03	CO2 Fire Protection	
NK38-FEX-78400-0503-02	CO2 Fire Protection	
NK38-FEX-78400-0504-02	CO2 Fire Protection	
NK38-FEX-78610-0501-02	Inactive Chem. Waste Transfer Facility Fixed	
Ansul_Bladder Tank Sight Gauge	Bladder Tank Sight Gauge; Hydraulic Concentrate Control Valve	
Ansul_Bladder_Specs	Vertical & Horizontal Bladder Tanks	
Ansul_Drawings_Specs	Typical Bladder Tank Syst. Piping Requirements	
ANSUL_Email_Prices	Email - OPG CID 187668; Fr: Robert Whiting/ To: Liza Crisologo	11/19/2012
Bladder tank drawing	Drawing	
CCA 000707	Component Condition Assessment (CCA) Foam Concentrate Tank	
DSR_TS0660-2	Fire Protection System: Replace Diaphragm of the Foam Concentrate Tanks	4/13/2011
Email_Ansul Quote	Email - OPG CID 187668; Fr: Yatin Nayak/ To: G. Mills	10/3/2012
Existing Diaphragm drawing	drawing	
Flow Diagram	Standby Generators, Oil Tanks Foam Fire Protection System	
Flowsheet	Air Form Fire Protection	
Foam Fire Protection Piping	Standby Generator Fuel Mgmt. Bldgs. #1 & #2	
FW bladder tanks	Email - attachments, Vertical Bladder Tank, Bladder Replacement vertical, picture	
FW OPG CID 187668	Email - attachments, Vertical & Horizontal Bladder Tanks svc. Manual/specs & drawing	
RE BOP-CS DSR TS0660-2 - Replace Diaphragm of the Foam Concentrate Tanks	Email - attachment, CHUBB Fire Security Installation, Operation & Maint. Manual	
NK38-D1H-24900-9021	Ground Floor Plans	
Appendix C_Productivity Factors (1)	Tabs: Rubber Day/Night 10, Zone 1/2	
Appendix D_Height factor	Appendix D: Height Factors	
Appendix E_Crew Rates_Factors	Tabs: shifts for Pipefitters, Boilers, and Electr.	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Appendix F_Indirect cost	Tabs: Auditing, Site ofc., Summary, BOE	
Appendix A_CS Summary	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In $K) / Provided from database; several tabs included	
Appendix A_Estimate Summary_11 28 2012	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In $K) / Provided from database	
Appendix A_System_Summary	Tabs: FIRE PROTECTION-SUMMARY, NPC REPAIRS-SUMMARY, MCR HVAC UPGRADES - SUMMARY, STRUCTURES -SUMMARY	
Appendix B_Project Breakdown of DSR	The 38 Darlington Scope Review (DSRs) items approved by the SRB (and pending approval as noted) for the CS Systems Sub-Bundle	
Appendix C_Productivity Factors	Appendix- C: Productivity Factors	
Appendix D_Height factor	Appendix D: Height Factors	
Appendix E_Crew Rates_Factors	Appendix-E: Crew Rates	
Appendix F_Eng Assessment and Mods	APPENDIX F- Assessment Engineering and Modification Works; add'l tabs	
Appendix F_Indirect cost	Appendix -F: Indirect Cost; add'l tabs	
Appendix G_RFI -List-Common Systems.docx	Appendix G: RFIs, Emails & references; emails, status reports, etc. included in file	
Appendix H_Detailed Estimates	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In $K) / Provided from database; add'l tabs	
BOP CS BOE R000_11 28 2012	Darlington Refurbishment Balance of Plant (BOP) “Common ” Sub Project Basis Of Estimate	
BOP_CS_Index	BOP Common Systems Sub-bundle	
BOP Conventional BoE	Darlington Refurbishment Balance of Plant (BOP) “Conventional ” Sub Project Basis Of Estimate	
BOP Conventional Estimate	Tabs: DSRs List, BOP_TS (Summary), individual DSR tabs	
Answer for RFI 019	Request for Info: BOP - Conventional Sub-Bundle	9/11/2012
Conventional system_RFI 009_08 29 2012	Clarify the cost arrangement	8/29/2012
Conventional system_RFI 010_08 29 2012_	Clarify the scope, DSR - TS 0530 -1, DSR - TS 0530-3 (CCA-000144 related to the DSR)	8/29/2012
Conventional system_RFI 011_08 30 2012	Clarify the scope, DSR - TS 0840 -3 (CCA- related to the DSR ; Not applicable).	8/30/2012
Conventional system_RFI 013_09 04 2012	Clarify the scope, TS-0560-9, related with CCA 001732	9/4/2012
Conventional system_RFI 014_09 04 2012	Clarify the scope, TS-0170-1, related with CCA 000337	9/4/2012
Conventional system_RFI 016_09 06 2012	TS-0570-21, related with CCA 001296	9/6/2012
Conventional system_RFI 018_09 010 2012	TS-0570-25, related with CCA 001313	9/10/2012
Conventional_RFI012_30.08.2012	TS0630-7/TS0630-11	8/30/2012
Conventional_RFI015_05.09.2012	SI0280-2, SI0280-3, SI0390-1, TS0590-22	9/5/2012
Conventional_RFI017_07.09.2012	TS0590-22, TS0590-18, TS0610-17	9/7/2012
Conventional_RFI019_11.09.2012	TS0610-17, TS0610-3, TS0610-18, TS0610-22, TS0610-3/18/22	9/11/2012
F+G RFIs_client answer	RFI Master List; add'l tabs per RFI included	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
Design Basis	documents sourced from OPG systems in support of information provided from the DSR database	
CCA 000337	Component Condition Assessment (CCA) MCCs, contactor, motor starter	
NK38-F3S-53397-0018	600V Distr., EPS Reactor Aux Bay, EPS MCC 821	
NK38-FXX-53390-1501-04	Unit, 600V EPS Distr. Syst.	
NK38-F0S-55490-0002	129V CC Distr. Syst.	
NK38-F0S-55590-0002	4 BV DC Distr. Syst.	
NK38-F0S-55590-0003	4 BV DC Distr. Syst.	
NK38-FEX-55410-0501	Common 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55410-1501	Unit 1 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-0502	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1502	Common 48V Class 1 Pwr. Supplies	
NK38-F0S-55490-0002	128V DC Distr. Syst.	
NK38-F0S-55590-0002	48V DC Distr. Syst.; EPS Powerhouse	
NK38-F0S-55590-0003	48V DC Distr. Syst.; EPS Powerhouse	
NK38-FEX-55410-0501	Common 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55410-1501	Unit 1 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0501	Common 48V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0502	Common 48V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-1501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1502	Common 48V DC Class 1 Pwr. Supplies	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
CCA 000049	Component Condition Assessment (CCA) Distribution Bus	
NK38-CMP-53307-03-R012	KLOCKNER MOELLER SERIES 200 MOTOR CONTROL CENTRE INSPECTION AND MAINTENANCE	
NK38-D1S-53320-9012	Automatic Transfer Switch	
NK38-D1S-53320-9014	Ctrl. Panel Parallel Syst.	
NK38-D1S-53320-9016	Channels A&B 347/600V Class II	
NK38-E3S-53320-9018-SHT0004	D2O/TRF Bldg.	
WMS-Equipments list	List	8/31/2012
ABB product list	list	
CCA 000048	Component Condition Assessment (CCA) Transformers	
NK38-D1S-53320-9016	Channels A&B 347/600V Class II	
NK38-D1S-53320-9017	Channels A&B 347/600V Class II	
NK38-F0S-53520-0001-U2	120V/208V AC Class II Distr. Syst.	
NK38-F0S-53520-0002-R011	120V/208V AC Class II Distr. Syst.	
NK38-F1S-53520-0005-R007	Unit 1 Ctrl. Computer	
ABB-TX price list	Transformers	
CCA 000048	Component Condition Assessment (CCA) Transformers	
NK38-F1S-53520-0005-U2-R007	Unit 1 Ctrl. Computer	
CCA 001732	Component Condition Assessment (CCA) Transformers, 4 kV (10MVA) (oil)	
NK38-D1S-53202-9001	drawing	
NK38-D2S-53202-9005-U2	wiring diagram distr. Syst. Transformer	
NK38-FEX-53240-1501-01	Electr. Pwr. Distr. Unit 4	
CCA 001292 (1)	Component Condition Assessment (CCA) Isolated Phase Bus	
NK38-D0S-51100-0001-U2	Generator Voltage Output Syst.	
NK38-D3S-51100-0002-U2	Generator Voltage Output Syst. Isolated Phase Bus Electr. Arrng. - Isometric	
NK38-D4S-51100-9031-U2	Deionizing Grid Syst.	
NK38-F1S-51100-9012-REV 007	Isolated Phase Bus Cooling Syst. Flow Diagram	
NK38-M4S-51100-9017-SHT002	Isolated Phase Bus	5/26/1986
CCA 001301	Component Condition Assessment (CCA) Main Switch	
NK38-D1S-52120-9008-REV9	Unit Service Transformer	
NK38-D1S-52520-9014-REV13	Syst. Svc. Transformer	
NK38-D3S-51521-9006-U2	Main Output Transformer	
NK38-D3S-51521-9007-REV005	Main Output Transformer	
NK38-D5S-51521-9008-B	Main Output Transformer	
NK38-D5S-51521-9009-A	Main Output Transformer	
Passport finding- equipment location	Screen Prints of TIMD030-Equipment/Component Header	
CCA 001323	Component Condition Assessment (CCA) Switchyard Voltage Transformer	
NK38-DM-51500-R001	500 KV OUTPUT SYSTEM Design Manual	
NK38-DXS-15400-0031-R1	Proposal, Land Use & Planting Programme	
NK38-OM-51000-R055	MAIN POWER OUTPUT	11/14/2011
CCA 001292	Component Condition Assessment (CCA) Isolated Phase Bus	
NK38-CMP-51150-01-REV011	Ctrl. Maint. Procedure, Isolated Phase Bus Link Removal, Install. & Meggering, IPB Inspection & Cubicle Checks	
CCA 001296	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Ctrl. Maint. Procedure, MAIN OUTPUT TRANSFORMER ROUTINE MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer, One Phase	
CCA 001296 (1)	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Control Maintenance Procedure MAIN OUTPUT TRANSFORMER ROUTINE MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer, One Phase	
CCA 001305	Component Condition Assessment (CCA) Unit Service Transformer	
NK38-D0S-52120-0002-U2	Gen. Voltage Sta. Serv. Sup. Sys. Unit Serv. Transformer T2	
NK38-D1S-52120-9003-U2	Unit Service Transformer	
NK38-WAS-52120-9021-REV05	Westinghouse Instruction Book No. CT-289, Four 80 MVA Type OFAF Three-Phase	
CCA 001296	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Control Maintenance Procedure MAIN OUTPUT TRANSFORMER ROUTINE	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
	MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer One Phase	
CCA 001305	Component Condition Assessment (CCA) Unit Service Transformer	
NK38-D0S-52120-0002-U2	Gen. Voltage Sta. Serv. Sup. Sys. Unit Serv. Transformer T2	
NK38-D1S-52120-9003-U2	Unit Service Transformer	
NK38-WAS-52120-9021-REV05	Westinghouse Instruction Book No. CT-289, Four 80 MVA Type OFAF Three-Phase	
NK38-D0S-52520-0002-U2	500KV Station Serv. Supply Sys. Transformer T3	
NK38-D0S-52520-0002-U2	500KV Station Serv. Supply Sys. Transformer T3	
NK38-CMP-53130-01	Control Maintenance Procedure STANDBY GENERATOR BUS MAINTENANCE	
NK38-CMP-65300-28	Control Maintenance Procedure CALIBRATION GUIDE FOR PROTECTIVE RELAYING ASSOCIATED WITH 13.8 KV SWITCHGEAR ASSEMBLIES	
NK38-D1S-53103-9020	13.8 KV Distribution System	
NK38-F0S-53130-0001	13.8 KV Distribution System	
NK38-FXX-53130-0501	Electr. Pwr. Distr. 13.8 KV Class III/IV	
Conventional system_RFI 009_08 29 2012	BoP -Conventional Sys Sub-Bundle	
Conventional system_RFI 010_08 29 2012_	DSR - TS 0530 -1, DSR - TS 0530-3 (CCA-000144 related to the DSR);	
Conventional system_RFI 011_08 30 2012	DSR - TS 0840 -3 (CCA- related to the DSR ; Not applicable)	
Conventional system_RFI 013_09 04 2012	TS-0560-9, related with CCA 001732	
Conventional system_RFI 016_09 06 2012	TS-0570-21, related with CCA 001296	
Conventional system_RFI 018_09 010 2012	TS-0570-25, related with CCA 001313	
Conventional_RFI012_30.08.2012	TS0630-7/TS0630-11	
Conventional_RFI015_05.09.2012	SI0280-2, SI0280-3, SI0390-1, TS0590-22	
Conventional_RFI017_07.09.2012	TS0590-22, TS0590-18, TS0610-17	
Conventional_RFI019_11.09.2012	TS0610-17, TS0610-3, TS0610-18, TS0610-22, TS0610-3/18/22	
F+G RFIs_client answer	RFI Master List; add'l tabs per RFI included	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
NK38-CMP-53140-01-REV007	Control Maintenance Procedure 13.8KV BUS INSPECTION AND MAINTENANCE	
NK38-CMP-53200-01-REV003	Control Maintenance Procedure 4.16 KV BUS INSPECTION AND MAINTENANCE	
NK38-F0S-53230-0001-U2	4.16KV Distr. Syst. Class III (Unit)	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
BOP Pre-Refurb Estimate	PRE-REFURBISHMENT- DSR Line Estimate _ Scope List - as of Mar 8, 2013 (In $K) / Provided BY PM; add'l tabs included	
BOE BOP Pre-Refurb	Darlington Refurbishment Balance of Plant (BOP) "Pre-Refurbishment " Sub Project Basis Of Estimate	
Appendix A_ PR System_Summary	Tabs: ESW, ALW, VALVES, CONTROLLERS	
Appendix B_Project Breakdown of DSR	The 8 Darlington Scope Review (DSRs) items included in the BOP Pre-refurbishment Sub-Bundle.	
Appendix C_Productivity Factors	Appendix- C: Productivity Factors	
Appendix D_Height factor	Appendix D: Height Factors	
Appendix E_Crew Rates_Factors	ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage); Add'l Tabs included	
Appendix F_Mods 021513	OPG- MODIFICATION PROCESS - COST ESTIMATING	
Appendix G_Correspondence	RFIs, Emails & references	
BOP Reactor Estimate	BOP Reactor Systems - Overall Estimate Summary	
BOP Reactor Factors Rates+Costs	Appendix- C: Productivity Factors; add'l tabs	
BOP Reactor BoE	Darlington Refurbishment Balance of Plant (BOP) "Reactor Systems" Sub Project Basis Of Estimate	8/28/2012
BOP_RS_Appendix G_Emails	Emails	
BOP_RS_Appendix G_RFI List	RFI List	
BOP_RS_Appendix G_RFI006_RFI007	Emails	
1_Supporting Docs_Design Basis	List of reference docs	
SI0300-30	Strategic Outage Improvements: Dedicated Vault Vapour Relocated Flowpaths for Ice Plus	5/5/2011
SI0300-31	Strategic Outage Improvements: Dual Pwr. Supple for Vault Vapour Recovery Purge Dryer	5/5/2011
SI0300-36	Strategic Outage Improvements: Provide On-Line De-Tritiation Capability for Heat Transport	5/5/2011
TS0070-1	Inspect End Shield Cooling Expansion Tanks	1/26/2011
TS0070-2	Inspect Piping of End Shield Cooling System	1/26/2011
TS0070-3	Contingency - End Shield Cooling Expansion Tanks	1/26/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
TS0070-4	Contingency - Piping Associated with End Shield Cooling	1/26/2011
TS0080-10	Contingency - Moderator Pumps	1/26/2011
TS0090-1	Overhaul & Inspect the Two Main HT Pumps w/ Cover Gasket Leaks	1/26/2011
TS0090-3	Inspect One Representative PHT Purification Strainer	1/26/2011
TS0090-4	Inspect Collection Tank, Vent Condenser Tank, & Collection Tank Coolers on U2	1/26/2011
TS0090-7	Replace the Switch Modules & Connecting Cable Associated w/ PHT Trip Press. Switches	1/26/2011
TS0090-12	Contingency - Refurbish All PHT pumps	1/26/2011
TS0090-14	Contingency - Extend Collection Tank Inspection to the Rest of the Units	1/26/2011
TS0100-3	DNGS Primary Heat Transport Pressure & Inventory Ctrl: One-Time Inspection of Piping	3/11/2011
TS0110-1	Video Inspection of Shell Side	1/26/2011
TS0110-4	Inspect Flow Orifices (x28)	1/26/2011
TS0120-2	Darlington Arilocks & Transfer Chambers: Replacement of non EQ Pressure Switches	4/13/2011
TS0200-3	Liquid Zone Ctrl. Syst.: Replace the Recombination Units	3/2/2011
TS0200-5	Liquid Zone Ctrl. Syst.: Replace the Recombination Units (Contingency)	3/2/2011
TS0210-12	Neg. Pressure Containment: Replacement of all Reactivity Mechanism (RMD) Seals	3/2/2011
TS0320-1	Refurbish all PHT Pump Motors	12/6/2010
TS1370-1	Vapour Recovery - Part 3: Replace all the Dryers	5/5/2011
TS1370-2	Vapour Recovery - Part 3: Replace all the Dryers (Contingency)	5/5/2011
TSO110-16	Contingency for HX	1/26/2011
0_BOE Signed	Darlington Refurbishment BOP 'Reactor Systems' Sub Project Basis of Estimate	8/28/2012
1_BOP RS BOE R000_08.28.2012	Darlington Refurbishment Balance of Plant (BOP) “Reactor Systems” Sub Project Basis Of Estimate	8/28/2012
2_Overall Summary signed	Scanned, BOP Reactor Systems - Overall Estimate Summary	
3_Funding Stream Signed	Scanned documents	
5_Appendix A_Overall and Per System Summaries	Scanned docs, BOP Reactor Systems Overall Estimate Summary	
6_Appendix B_WBS from PM	Scanned doc, Applicable DSR	
7_Appendix C_Productivity Factors	Scanned docs	
8_Appendix D_Height Factor	Scanned docs, Appendix D: Height Factors	
9_Appendix E_Crew Rates	Scanned docs, ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage)	
Appendix G	Scanned doc, RFI List	
Appendix G_Emails	Emails	
Appendix G_RFI006_RFI007	Emails	
0_BOE Signed	Darlington Refurbishment BOP 'Reactor Systems' Sub Project Basis of Estimate	8/28/2012
1_BOP RS BOE R000_08.28.2012	Darlington Refurbishment Balance of Plant (BOP) “Reactor Systems” Sub Project Basis Of Estimate	8/28/2012
2_Overall Summary signed	Scanned, BOP Reactor Systems - Overall Estimate Summary	
3_Funding Stream Signed	Scanned documents	
5_Appendix A_Overall and Per System Summaries	Scanned docs, BOP Reactor Systems Overall Estimate Summary	
6_Appendix B_WBS from PM	Scanned doc, Applicable DSR	
7_Appendix C_Productivity Factors	Scanned docs	
8_Appendix D_Height Factor	Scanned docs, Appendix D: Height Factors	
9_Appendix E_Crew Rates	Scanned docs, ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage)	
Appendix G	Scanned doc, RFI List	
Appendix G_Emails	Emails	
Appendix G_RFI006_RFI007	Emails	
BOP DSR	DSR List	
BOP_Gate1_WP1	DSR List	
Accepted BOP Estimating	Outlook Mtg. Response	2/3/2012
Accepted BOP Summary BOE	Outlook Mtg. Response	3/21/2012
Below is the UPDATED DRAFT Timeline based on Garry Rutledge input	BOP SAFETY AND CONTROLS SYSTEM GATE 1 (based on Gary Rutledge input)	
BOE Comments	Email - attachments, BOE_Sbagshaw Comments_2012-03-03 / BOE_Summary_SBagshawComments_2012-03-03	3/3/2012
BOE	Email - Fr: Jennifer Nodwell / To: Ian Wright; request for BOE, Summary Table & Estimate Sheets on gate submission	3/13/2012
BoEs	Email - Fr: Ian Wright / To: Jennifer Nodwell; Ian hasn't recvd. Updated BoEs	3/5/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
BOP - Safety and Control Sub-Bundle	Includes links to Sharepoint	1/10/2012
BOP - SCS Estimates	Email - Fr: Sean Bagshaw / To: Ian Wright	2/10/2012
BOP Fee	Total hrs & rates	
BOP Overview Package	Email - Outlook mtg. request	4/2/2012
BOP Summary Report	Email - Fr: Gary Rutledge / To: Lonnie Schofield; request for Summary Rpt. updated	5/8/2012
BOP_WP1.4_ Prereq Mods BOE R0_ Feb 27	NR Islanding Project – Basis of Estimate – Pre-requisite Modifications	
CANDU Reactivity Devices		1/1/2008
DSR_IP0510-7	ISR Acceptable Deviations - Contingency: Shut Down Systems	4/27/2011
DSR_SI0270-2	SPV - Potential Redesign for Refurbishment: Logic and Control Modules	5/5/2011
DSR_TS0220-1	Darlington Reactor Regulating: Inspection of the Spiroid Gear Set	3/2/2011
DSR_TS0220-2	Darlington Reactor Regulating: Replace Gear Boxes Based on Results of D1111 (Contingency)	3/2/2011
DSR_TS0220-3	Darlington Reactor Regulating: Replace Control Absorber Rods and Adjusters (Contingency)	3/2/2011
DSR_TS0220-5	Darlington Reactor Regulating: Replace All RRS Flux Detectors	3/2/2011
DSR_TS0220-13	Darlington Reactor Regulating: Replace Spiroid Gear Set (Contingency)	3/2/2011
DSR_TS0220-14	Darlington Reactor Regulating: Review the Phase I Outputs of COG Project	3/2/2011
DSR_TS0220-15	Darlington Reactor Regulating: Reactivity Worth Check	3/2/2011
DSR_TS0220-16	Darlington Reactor Regulating: Inspection of Worm Gear Boxes	3/2/2011
DSR_TS0240-10	Shutdown System 1 Process: Replace All 228 Vertical Flux Detectors	3/2/2011
DSR_TS0260-1	Shutdown System 2 Process: Perform Video/Visual Inspection on 1-34710-TK4	3/2/2011
DSR_TS0260-8	Shutdown System 2 Process: Replace all SDS2 In-Core Flux Detectors	3/2/2011
DSR_TS0260-9	Shutdown System 2 Process: Replace 34710-TK4 (Contingency)	3/2/2011
DSR_TS0350-1	Replacement of the SDS1 Trip Computers	12/22/2010
DSR_TS0350-2	Replacement of the SDS1 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-3	Replacement of the SDS1 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-4	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-5	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-10	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-11	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-12	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-13	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-14	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-15	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-16	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-17	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-18	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
Darlington SDS Refurb	Darlington SDS Computers Refurbishment Level 1 Logic/Schedule	
BOP Safety and Controls BOER000	Balance of Plant “Safety and Control Systems” Sub Projects (BOP) Basis Of Estimate	1/3/2012
Signed Copy	Darlington Refurbishment BOP "Safety & Control Systems" Sub Project Basis of Estimate	1/3/2012
BOP Safety and Controls Summary BOER000 030412 _2__05 25 2012 _3_	Darlington Refurbishment Balance of Plant (BOP) “Safety and Control Systems” Sub Project For BOP & SIO Summary Basis Of Estimate	5/25/2012
BOP Safety and Controls BOER000	Balance of Plant “Safety and Control Systems” Sub Projects (BOP) Basis Of Estimate	1/3/2012
BOP Safety and Controls Summary BOER000 030412 (2)	Darlington Refurbishment Balance of Plant (BOP) “Safety and Control Systems” Sub Project For BOP & SIO Summary Basis Of Estimate	4/12/2012
BOP Safety and Controls Summary BOER000 030412 (2)_rev105.25.2012	Darlington Refurbishment Balance of Plant (BOP) “Safety and Control Systems” Sub Project For BOP & SIO Summary Basis Of Estimate	4/13/2012
BOP Safety and Controls Summary BOER000 030412 (3)	Darlington Refurbishment Balance of Plant (BOP) “Safety and Control Systems” Sub Project For BOP & SIO Summary Basis Of Estimate	4/18/2012
BOP Safety and Controls Summary BOER000 030412	Balance of Plant “Safety and Control Systems” Sub Projects (BOP) Summary Basis Of Estimate	2/3/2012
BOP Summary Errata	DARLINGTON REFURBISHMENT BALANCE OF PLANT (BOP) “SAFETY AND CONTROL SYSTEMS” SUB PROJECTS SUMMARY BASIS OF ESTIMATE	4/18/2012
BOP S+C BoE	Darlington Refurbishment Balance of Plant (BOP) “Safety and Control Systems” Sub Project For BOP & SIO Summary Basis Of Estimate	5/25/2012
bop summary R001 (2) (Final032712)	Scope List - as of March 09, 2012	3/9/2012
bop summary R001	Scope List - as of Feb. 28, 2012	2/28/2012
BOP	Tabs: DCMS, DSR Calc	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
bopDSR List (4)	dbo_MASTER_SYS_LINEITEM	
Copy of BOP_GRB_04 03 2012 (8)	DSRs; add'l tabs	
Copy of BOP_GRB_04 03 2012 (8)_REV1_05.23.2012	DSRs; add'l tabs	
Copy of BOP_GRB_04 03 2012 (9)	DSRs; add'l tabs	
BOP S+C Estimate	BOP Summary DSR, PROJECT - SUMMARY ESTIMATE +/- 00%; add'l tabs	2/27/2011
BOP007_TS03500-1-18_Estimate	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	
Estimate SDS Computer Replacement	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	8/23/2011
Estimate SDS Computer Replacement_rev1	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	8/23/2011
BOP S+C 1A BOE	Balance of Plant "Safety and Control Systems" Sub Projects (BOP) Basis Of Estimate	3/13/2013
BOP S+C 1A Estimate	Appendix A_DSR Summary by DSR; add'l tabs	4/29/2012
Preparatory Work	Tabs: Excitation, Turbine Ctls, Pwr. Cables, etc.	
TG BOEN	Turbine Generator (TG) Basis Of Estimate	9/13/2011
TG Signed BOE Sheet	Turbine Generator (TG) Basis Of Estimate	9/13/2011
Approved Scope by Project-2.xlsb	Scope List - as of August 18, 2011 (In $K)	8/18/2011
Approved TG DSR List Page 1	PAGE 1, Scanned Doc: …System DSR Line Estimate_Scope List	8/18/2011
Approved TG DSR List Page 2	PAGE 2, Scanned Doc: …System DSR Line Estimate_Scope List	8/18/2011
Approved TG DSR List Page 3	PAGE 3, Scanned Doc: …System DSR Line Estimate_Scope List	8/18/2011
Scope Summary August 31 2011 (Revised 030911 IMW)	Scope List - as of August 18, 2011 (In $K)	8/18/2011
Canceled Turbine Generator - F G Class 5 Estimate Update and Review	Email: Mtg. Cancellation	8/2/2011
Dale	Digital Plant Control Systems and Plant Simulators	
Bearings 1 (thrust 2)	Organizational Chart	4/1/2010
Bearings 3+4	Organizational Chart	
Bearings 5,6+7	Organizational Chart	
HI POT Testing	D1021 HI POT Testing Org Chart	
HP Turbine Overhaul	D1021 HP Turbine Overhaul, Org Chart	
LP 2 Overhaul	D1021 LP 2 Overhaul (with BCH in Place), Org Chart	
LP1 Overhaul	D1021 LP1 Overhaul Org Chart	
LP2 Cleaning Logic	D1041 LP2 Cleaning Logic Org Chart	
MSR Inspection	D1021 MSR Inspection Org chart	
NR TURBINE GENERATOR WORK ORDER MATRIX	NR TURBINE GENERATOR WORK ORDER MATRIX	
Slip Ring Grind	1021 Slip Ring Grind WO #1762744	
Stage 5 Liner Repair	LP1, LP2 & LP3 Stage 5 Liner Repair	
Standardization of network technologies	Alstom	
Steam turbines	Article	8/1/2007
STOP GOV Valves MV1 MV2 MV3 MV$	D1021 - STOP/GOV Valves MV1, MV2, MV3 & MV4	
The Alstom control system ALSPA Controplant is designed for energy applications	Alstom Control System ALSPA Controplant	
Unit 2 HP Large Scale	Turbine Overhaul	
Unit 2 HP Spindle Removal	Spindle Removal	
Apendiix F PWU 10HR Burdened Pipefitters	Shifts	
Appendix B TG Work Breakdown Structure	WBS Code & Name	
Appendix D Productivity Factors 10 Hr Shift Z2	Basic Shift	
Appendix E Height Factors	Height	
Appendix F -1 Crew Rate 10Hr	2011 Overnight Burdened Rate	
Appendix F CSU+PWU 10Hr Burdened Electrician	10 hr day shift	
Appendix F PWU 10Hr Burdened Boilermakers	10 hr day shift	
Appendix F PWU 10Hr Burdened Machinist	10 hr day shift	
Appendix F PWU 10Hr Burdened Millwright	10 hr day shift	
Appendix F PWU 10Hr Burdened MTE	10 hr day shift	
Appendix G Estimators Assumptions and Instructions	Release 4 AACE 5 Estimating Assumptions/Instructions	
Appendix H Control Systems Draft_ Estimate_TGSI_25.08.11	TG summary DSR Line No. SI0010-1	
Appendix H Excitor Draft_ Estimate_TGSI_25.08.11	TG summary DSR Line No.	
Appendix I Revised Estimate Range 03 September 2011	TG System DSR Line Estimate Scope List	
SI0010-1	TG ELECTRONIC CONTROL SYSTEM	8/29/2011
SI0020-1	OBSOLETE GENERATOR EXITATION SYSTEM	7/21/2011
SI0020-2	INSPECT, TORQUE CHECK AND CLEAN 830 VOLT AC	8/2/2011
SI0020-3	REPAIR 830 VOLT AC BUS SECTIONS	8/2/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
SI0270-1	INSTALLATION OF NEW SPV FOR INCREASED REDUNDANCY	8/2/2011
SI0280-1	FIELD WORK RECONFIGURE CONDENSOR TUBE $	8/2/2011
SI0300-16	INSTALL 15 TONNE CAPACITY CRANE	8/2/2011
SI0300-18	LP CASING DOWELS	8/2/2011
SI0300-19	COMPONENT SWAPPING AND OFFLINE OVERHAUL CREW	8/2/2011
TS0680-1 (1 OF 6)	UNIT 1- 1st Stage GV 1 to 4-41870-MV1, MV-2	7/28/2011
TS0680-1 (2 OF 6)	UNIT 1- 2nd Stage GV 1 to 4-41880-MV1, MV-2 $	8/2/2011
TS0680-1 (3 OF 6)	UNIT 1- Separator GV 1 to 4-48100-MV16, MV17, MV18 & MV19	8/2/2011
TS0680-1 (4 OF 6)	UNIT 1- HP Drain GV 1 to 4-48500-MV30 &MV192	8/2/2011
TS0680-1 (5 OF 6)	UNIT 1 -HP Turbine Extraction GV 1 to 4-48100-MV22 & MV23	8/2/2011
TS0680-1 (6 OF 6)	UNIT 1- HP DRAIN GV 1 to 4-48500- MV36, MV48, MV115, MV121, MV145, MV151, MV1	8/5/2011
TS0680-4 (1 OF 3)	X-48100-NV1/2/3 LP TURBINE 1,2 & 3	8/2/2011
TS0680-4 (2 OF 3)	X-48100-NV10/11/12/13 HEADER 4	8/2/2011
TS0680-4 (3 OF 3)	X-48100-NV14 DEAERATOR	8/2/2011
TS0680-6 (3 OF 6)	UNIT 1 Separator GV 1 to 4-48100-MV16, MV-17, MV18 & MV19	8/4/2011
TS0680-6 (4 OF 6)	UNIT 1 HP Drain GV 1 to 4-48500-MV30 & MV192	8/4/2011
TS0680-10 (1 OF 2)	INCREMENTAL WORK TO MOISTURE PRE-SEPARATOR (MOPS)	8/2/2011
TS0680-11	MSR MOP REPAIR	8/2/2011
TS0680-13 (2 OF 2)	REPLACE HEATING SYSTEM IN THE PIPES TO THE FIRST STAGE BUNDLE	8/2/2011
TS0680-15	RE-TUBE MSR	8/2/2011
TS0680-17	REPLACE CROSSOVER LINES	8/2/2011
TS0680-19	REPLACE MSR INLET LINE	8/3/2011
Crew Rate 10Hr	10 hr day shift	
DR Estimating Assumptions and Instructions		
EPSCA_Elec 2011-2012	Burdened Labour Rate Calculation - Plain Time - Electrical Worker	1/20/2012
Height	OPG Height Factors	
Overhead	Definition Phase - RFR & Assumed TG Estimate	
TGP BoE	Turbine Generator (TG) Independent Estimate Basis Of Estimate For Fixed Cost Contract	
TGP FC Estimate		
Estimate	Tabs: DSR Summary, 4b Data, DSR Database, etc	
FC Signed Estimate	Turbine Generator (TG) Independent Estimate Basis Of Estimate For Fixed Cost Contract	
Independence Confirmation Signed	Turbine Generation	
SGP 4b Comparison	Steam Generator Status 8th March 2013	
SGP 1 Estimate	Current DSR Estimates as of March. of 2013; Tabs - SG, Summary (Rel4), Rel4B (DSR estimate)	
SGP BOE	Steam Generator (SG) Basis Of Estimate	2/3/2011
SGP Factors Rates Costs	Steam Generator Project Crew 12 Hrs Shift Hourly Rate Calculation	
SG DSR list as August, 2011	Screen Print, TS0050-1, etc., approved/not approved	
SG Validate Info	Project: Steam Generator	
PM Signed SG Estimate Summary	Scanned Doc - SG Bundle - DSR Line Estimate_Scope List as of 8/31/11	9/1/2011
SG BOE-signed with type of doc. Changed	Steam Generator (SG) Basis of Estimate	11/11/2011
Signed SG BOE	Steam Generator (SG) Basis of Estimate	11/11/2011
2013-2015%20CEO%20CFO%20BP%20Presentation_Sept%2013%20r1	2013-2015 Bus Plan	9/18/2012
DN 2012-2014 BP Presentation Sept 8 Final	2012-2014 Bus Plan	9/12/2011
2013-2015 CEO CFO BP Presentation_Sept 13 r1	2013-2015 Business Plan	9/18/2012
N-GUID-00400-10000 Nuclear Refurbishment Cost Estimate Review Guide	Nuclear Refurbishment Cost Estimate Review	5/6/2011
ON Outlook Highlights - Draft for Committee Review	Construction Looking Forward - Draft	2/1/2012
Ontario LMI -- Preliminary Trade Rankings (Dec 2011)	GTA: December 2011 Forecast	12/1/2011
Productivity Factors 10 Hr Shift Z2	Rubber Day & Night 10 Zone 2	
Productivity Factors 10 Hr Shift Z3	Rubber Day & Night 10 Zone 3	
Productivity Factors 12 Hr Shift Z2	Rubber Day & Night	
Productivity Factors 12 Hr Shift Z3	Rubber Day & Night	
Productivity Factors	hourly rate	
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB	TMOD material, supports, hardware, feeder vision system, and miscellaneous items.	5/15/2013
Appendix 01 - 509407-0000-00000-33RA-0035 OSM (Rev PB)	Material Allowance Calcs based on Single Unit	4/12/2013
Appendix 02 - 509407-30CC-I-0109-Intermediate Level Waste	revised estimate: intermediate level waste components and key assumptions	10/12/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Assessment		
Dec 2012 Estimate Report	Docs & Correspondence from Aecon Joint Venture - ESTIMATE, LEVEL 2 SCHEDULE & RISK REPORT (373 pgs)	12/21/2012
RFR May_Data	Planned, Actual, Forecasted & Earned budget breakdowns by period. WP breakdown.	11/6/2012
RFR Resource Plan - Revised March 6 -Gate 2A	Retube & Feeder Replacement Project- Cash Flows by Year- Gate 2A (March 2013- May 2014); add'l tabs	
RFR Resource Plan 15 Feb 2013-Gate 2A	Retube & Feeder Replacement Project- Cash Flows by Year- Gate 2A (March 2013- May 2014); add'l tabs	
RFR Resource Plan 20 Feb 2013-Execution	Retube & Feeder Replacement Project - Resource and Contract Cost Estimate Sheet- Gate 2A to Project Completion (2014-2025)	
34-120019 Annulus spacer Qual-9jan2013	Annulus Spacer Qualification Test for Darlington Retube; schedule portion	
34-120019 Inconel 9jan2013	Inconel Spacer Qualification Test for Darlington Retube; schedule portion	
2013-02-08- R0031- Basic	All Active Project - Master Schedule (10 pgs)	
2013-02-08- R0031- Cash flows- Basic with actuals-Oct12-May14.pdf	CT-01 Monthly Project Cash Flow -with actuals	2/8/2013
2013-02-08- R0031- Cash flows- detailed by WBS with actuals.pdf	CT-02 Monthly Project Cash Flow by WBS	2/8/2013
2013-02-08- R0031- detailed	All Active Project - Master Project Schedule; NSS-OPG-001-Ganttchart-with SPI-Final	2/8/2013
AECL Op 3 Pricing Submission Form Annulus Spacer	Pricing Submission Form - Fuel Channel Annulus Spacer Design Concept for Darlington NGS Refurb. Program	
AECL Zr - R1	AECL Zr-Nb-Cu Irradiation Program High Level Schedule and Budgetary Estimate	
AMEC NSS OSS Services- Gate 1 and 2A Deliverable List (verified - Updated)	Appendix B: Deliverable Budgetary Cost and Schedule; add'l tabs - Deliverable List, Summary by Area, PO Named Individuals	
Assistance for RFR - Hours Estimate		
NK38-PLAN-31160-10002_R000(22Jan2013)_RFR-Fuel Channel Modified Inconel X-750	Scope of Work - Fuel Channel Modified Inconel X-750 Annulus Spacer	
NK38-PLAN-31160-10003_R000(22Jan2013)_RFR - Fuel Channel Zr-Nb-Cu Annulus Spacer	Scope of Work - Fuel Channel Zr-Nb-Cu Annulus Spacer	
RFR Cash Flow 2013 -R2 Current	Tabs: Curve Data, Summary 2013-2014, Issued Curves, CPI-SPI Ctgcy Curves, Mock Up Milestones, etc.	
RFR Cashflow 20121116	Mark RL-03 Cost Loading RFR by Groups (Late Dates)	11/16/2012
summary of cost estimate - feasibility asmt - board nov 2009_r04	Darlington Site Master Plan; Cost Estimate and Cash Flow	
DVBO scope for refurb	DSR tracking	
information for Jim... with MDRs	database	
D1321 Level 1 REV H - May 7th draft	D1321 Unit 2 Outage Logic Level 1October	5/8/2013
D1501Level 1 - Rev A April 19, 2013	Vacuum Building Outage ** Rev A ** Level 1 Overview	4/19/2013
Darlington Critical Path Schedule January 31 2013	Critical Paths before Oct 15 2016	1/31/2013
Darlington Integrated Master Schedule March 18 2013	Integrated Master Sched	2/6/2012
Darlington Integrated Master Schedule	Critical Paths before Oct 15 2016	1/31/2013
Darlington Unit 2 Conceptual Level 1	schedule	7/20/2012
Engineering Major Work Streams	schedule (draft)	2/14/2013
June 17 Latest Eng Schedule_ALL	Integrated Master Sched	5/30/2013
Key Milestone Report and Contract Status Nov 2012	Key Milestone & Contractor Status	11/15/2012
Nuclear Projects Planning & Control Earned Value Management April 2013	EV Mgmt.	Apr-13
Program Integration Summary Master Schedule Revision 1 Visio Overview	Org Chart - Revision 1 (Visio Overview)	
Program Master Schedule Dec 19 2012	Critical Paths before Oct 15 2016	12/19/2012
Revised Project Controls Chart 1	Org Chart	5/17/2013
Program Schedule Mgt Plan Rev 1	Program Schedule Management Plan	3/27/2013
RFR Contract Schedule	Exhibit 3.1(c)(A) Definition Phase Target Schedule (scanned doc)	
Appendix A - Health of CandC Score_Card	Health of the C&C Schedule as of April 04 ,2013	4/4/2013
Appendix_07_Fuel Handling Defueling	Program C&C Schedule	4/4/2013
Appendix_08_Turbine Generator Bundle	Turbine Generator Project Bundle	4/4/2013
Appendix_09_Campus Plan Bundle	Campus Plan Project Bundle	4/4/2013
Appendix_C_PMSS_Completed	Program Milestones & Key Dates -- Achieved	4/4/2013
Appendix_D_PMSS_3M_Lookahead	Program Milestones and Key Dates -- 3 Months Look Ahead	4/4/2013
Appendix_E_PMSS_All_Remaining	Program Milestones & Key Dates -- All Remaining	4/4/2013
Appendix_F_PMSS_All_in_2013	Program Milestones and Key Dates -- 2013 Milestones	4/4/2013
Appendix_G_Outage_Prep_Milestones	Program Milestones and Key Dates -- Refurb Outage Prep Milestones	4/4/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
APPENDIX_H_Update-Critical_Path-2013-04-04	RFR Bundle Schedules - Critical Activities	4/4/2013
AppendixBCandC-Schedule-Development Plan	C&C Schedule Development Plan	4/7/2013
Copy of Appendix A - Health of CC Score_Card	May 2013 Status	May-13
Planned Outages Inspections - BOP	Major Works for All Planned Outages Prior U2 Breaker Open	Apr-13
Planned Outages Inspections - FH	Fuel Handling and Defueling Bundle - Major Works for All Planned Outages Prior U2	4/4/2013
Planned Outages Inspections - Islanding	Major Works for All Planned Outages Prior U2 Breaker Open	4/4/2013
Planned Outages Inspections - RFR	Major Work for All Planned Outages Prior U2 Breaker Open	4/4/2013
Planned Outages Inspections - SG	Steam Generator Bundle - Major Works for All Planned Outages Prior U2 Breaker Open	4/4/2013
Preamble 032013	Preamble – March 2013 Status Submission – Unit 2	4/7/2013
Scope Development - BOP	Scope Development Schedule	4/4/2013
Scope Development - ISL	ISL Bundle - Scope Development Schedule	4/4/2013
Scope Development - Shutdown and Layup Serv	Shutdown and Layup Services - Scope Development Schedule	4/4/2013
Update-MU-3M-2013-04-04-APPENDIX Q	RFR Bundle - Mock Up Schedule - 3 Months Lookahead	4/4/2013
Update-MU-CM-2013-04-04-APPENDIX O	RFR Bundle - Mock Up Schedule - Completed Activities	4/4/2013
Update-MU-RM-2013-04-04-APPENDIX P	RFR Bundle - Mock Up Schedule - Remaining Activities	4/4/2013
Update-PM-3M-2013-04-04-APPENDIX T	RFR Bundle - PMOD's Schedule - 3 Months Lookahead	4/4/2013
Update-PM-CM-2013-04-04-APPENDIX R	RFR Bundle - PMOD's Schedule - Completed Activities	4/4/2013
Update-PM-RM-2013-04-04-APPENDIX S	RFR Bundle - PMOD's Schedule - Remaining Activities	4/4/2013
Update-TL-3M-2013-04-04-APPENDIX N	RFR Bundle - Tooling Schedule - 3 Months Lookahead	4/4/2013
Update-TL-CM-2013-04-04-APPENDIX L	RFR Bundle - Tooling Schedule - Completed Activities	4/4/2013
Update-TL-RM-2013-04-04-APPENDIX M	RFR Bundle - Tooling Schedule - Remaining Activities	4/4/2013
Update-TM-3M-2013-04-04-APPENDIX W	RFR Bundle - TMOD's Schedule - 3 Months Lookahead	4/4/2013
Update-TM-CM-2013-04-04-APPENDIX U	RFR Bundle - TMOD's Schedule - Completed Activities	4/4/2013
Update-TM-RM-2013-04-04-APPENDIX V	RFR Bundle - TMOD's Schedule - Remaining Activities	4/4/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L1	MDRs Integrated Schedule - Level 1	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L2	MDRs Integrated Schedule - Level 2	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L3_OPG_O	MDRs Integrated Schedule - Level 2 - OPG Activities ONLY	4/25/2013
AMEC 2013-04-26-MDR Program- Level 1	AMEC NSS MDR Program Integrated Schedule	
AMEC 2013-04-26-MDR Program- Level 2	AMEC NSS MDR Program Integrated Schedule - Level 2	
AMEC 2013-04-26-MDR Program- Level 3-OPG activities	AMEC NSS MDR Program Integrated Schedule - Level 3	
AMEC202013-05-27-Level2	MDR Program - Integrated Schedule Level 2	
OverallRemainingWork2013-05-30 Part1	RFR TEAM - Part 1	5/30/2013
OverallRemainingWork2013-05-30Part2	RFR TEAM - Part 2	5/30/2013
OverallRemainingWork2013-05-30Part3	RFR TEAM - Part 3	5/30/2013
WorleyParsons_2013-05-27_MDR_Integrated_Schedule_L2	Level II Schedule	5/9/2012
OPG Darlington Schedule Quality	ribbon & phase analysis; details 2007-2025	5/9/2013
NK38-PLAN-09701-10067-0004 Sh 0004	Program Schedule Management Plan	3/27/2013
NK38-PLAN-09701-10072 Critical path (1)	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012
NK38-PLAN-09701-10072 Critical path	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012
CC_Apr_ME	schedule	
5_BOP_L2	schedule	
5_FUNCTIONAL_L3 1b	schedule	
5_FUNCTIONAL_L3 b	schedule	
5_FUNCTIONAL_L3	schedule	
6_BOP_L2	schedule	
9_FUNCTIONAL_L3 1b	schedule	
9_FUNCTIONAL_L3 b	schedule	
9_FUNCTIONAL_L3	schedule	
CC_Apr_ME	schedule	
CMP_L2 b	schedule	
CMP_L2	schedule	
D1321 Level 1 REV H - May 7th draft	D1321 Unit 2 Outage Logic Level 1October	5/8/2013
D1501Level 1 - Rev A April 19, 2013	Vacuum Building Outage ** Rev A ** Level 1 Overview	4/19/2013
FH_DF_OPG_Uc_L2	schedule	
FH_DF_OPG_Uc_L3	schedule	
IS_OPG_Uc_L3	schedule	
Program Master Schedule Dec 19 2012	Critical Paths before Oct 15 2016	12/19/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Revised Project Controls Chart 1	Org Chart	5/17/2013
RFR_L2 b	schedule	
RFR_L2	schedule	
SD_OPG_Uc_L3	schedule	
TG_SG_OPG_Uc_L3	schedule	
2010 a year in review_final (3)	PowerPoint - Dietmar Reiner	Jan-11
Program Update - External Advisors - Feb 27 2013	Program Update ppt (145 pgs)	2/27/2013
SC_NCD_Prj_Execution_Workshop _FINAL _March_18_2013	PDF ppt - Excellence in Executing Accountabilities & Interacting in a Mega-Proj. Environment	3/18/2013
NP Information Management SC Mtg.		
Refurb SC 26 April 13	Adobe PowerPoint - Refurb Program Contract Steering Committee	4/26/2013
EAC April 29 013	Adobe PowerPoint - Refurb Executive Advisory Comm.	4/29/2013
May 22 2013 NPMSRB Decisions docx	File: N-REF-09701-0465832	5/22/2013
N-PLAN-09701-10002-DN Refurb Executive Advisory Committee DRAFT	Darlington Refurbishment Executive Advisory Committee Terms Of Reference	2/15/2012
Oversight and Control - EAC	Adobe PowerPoint - Oversight & Ctrl. Function of Major Projects	4/29/2013
May 22 2013 NPMSRB Decisions docx	Decisions and Records of Key Points	5/22/2013
Outstanding Actions for NPMSRB Latest	Outstanding Actions	11/22/2012
April Program Status Report	DN Refurb Program Status Report Meeting	5/22/2013
Darlington Refurbishment Program Update Outline Feb 2013	Program Update outline	2/1/2013
June Program Status Report	Agenda, Mtg. Minutes, Outstanding Actions	7/24/2013
March Program Status Report REV02	Meeting Minutes: Outstanding Actions & Status Rpt.	3/1/2013
May Program Status Report	agenda, Mtg. Minutes, Outstanding Actions (5)	6/19/2013
Program Status Meeting June 12(2)	Agenda; Attached docs: Listing of Outstanding Actions, Program Status May ppt, Functional Update	6/12/2013
Program Status Report Mtg for Period Ending December 2012	Outstanding Actions & Sect. 5.0, B - Project Quad Charts included	1/23/2012
Program Status Report Mtg for Period Ending February 2013	Outstanding Actions & Darlington Refurb Overview	3/20/2013
Darlington Refurbishment D2O Board Memo - May 2013	Heavy Water Storage and Drum Handling Facility - submitted to BOD	5/16/2013
Darlington Refurbishment Economic Update - NOC May 2013	Darlington Refurbishment Program Economic Update - submitted to NOC	5/14/2013
Darlington Refurbishment Refurb Project Office Memo - May 2013	Refurbishment Project Office - submitted to BOD	5/16/2013
Darlington Refurbishment Water and Sewer May 2013 (2)	Darlington Water and Sewer Project - submitted to BOD	5/16/2013
NOC Q1 2013	Darlington Refurbishment Program Status Report - submitted to NOC	May-13
Outstanding Actions for NPMSRB Latest	NPMSRB - Outstanding actions, total of 2	11/22/2012
13-04-17 20U2 20Readiness	Scope Status Meeting (revised format – 3/fiscal month)	
April 17-13 Integrated Proj. Functional Coordination Mtg	INTEGRATED PROJECT/FUNCTIONAL COMMUNICATION MEETING; attachments included	4/17/2013
Functional Update March	Update	Mar-13
Functions - Quad Charts March 2013	Management System Oversight	4/3/2013
Projects - Quad Charts March 2013	Fuel Handling Refurbishment	3-Apr
Outstanding Actions	scanned doc - NR Execution RPET/Proj. Mgr.	4/16/2013
Program Status March	PowerPoint	Mar-13
Action Items 051513 Project Meeting	NR Execution RPET/Project Mgr. - Outstanding Actions	5/14/2013
Functional Update April 2013	April 2013 Month End	Apr-13
Functions - April 2013	Management System Oversight	5/1/2013
Pre reqs	Unit Ready for Refurb	
Program Status April 2013	April 2013 Month End	Apr-13
Projects - April 2013	Fuel Handling Refurbishment	5/1/2013
Functional Update May 2013	Update (ppt)	May-13
Functions - 05 13	Management System Oversight	5/29/2013
Program Status May 2013	Report card, cost perf., program milestones	May-13
Projects - 05 13	Fuel Handling Refurbishment	5/29/2013
Projects - Retube and Feeder Replacement	Current Gate 2A; Fiscal Mo End 03-July-2013	7/3/2013
Arnone Email unlapping of units 070713	Email, Attachments: Impact of Changing Units, Considerations, copy of Outage Duration Impact & Components documents	7/4/2013
Components requiring Unit overlap Memo	Attachment to Arnone Email; review conducted on the FH refurbishment and defueling approved scope	6/17/2013
Considerations for Refurbishment Outage Logistics Ver2_U2Finish_toStartU1	Attachment to Arnone Email; U2 Finish to Start U1	6/26/2013
Copy of Outage Duration Impact	Impact of Planned Darlington Refurbishment Unit Outage Overlap Dates	6/28/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Impact of Changing Units 2 and 1 from Parallel to Series	Re: Contracts, 4C, Staffing, Procurement, Changed/New Risks, Help Required, & Actions	7/4/2013
Monthly Integrated Projects and Funtional Comm Meeting (July 17)	Agenda, Action Items, Qtly rpt. info, Program Status	7/17/2013
TG Turbine and Excitation Controls removal from Unit 2 Refurb scope - draft June 28, 2013	TG Turbine and Excitation Controls removal from Unit 2 Refurbishment scope with installation during 1st planned outage after Unit 2 Refurbishment	6/27/2013
Refurb Work Program ActionDecision Log	Action, Decision, Completed Actions	7/22/2013
Refurb Work Program Integration Meeting COMBINED Agenda - June 3 2013	Meeting Agenda	6/3/2013
Project Quality Assurance Plan (CD-0022) 509407-0000-00000-38QP-0001 R0 1	Assurance report	5/31/2012
12-H13.1-Written submission from OPG on EA for Darlington Nuclear Generating Station	Proposed Environmental Assessment Screening Report	9/13/2012
12-H13.80A-Presentation from CNWC	Environmental Assessment of OPG's proposed Refurbishment and Continued Operation of the DNGS	11/26/2012
12-H13.80-CNWC and DDLC	Environmental Assessment; renew Waste Mgmt. Facility license; renew Nuclear Pwr. Reactor Operating license	10/15/2012
12-H13.A Supplementary Submission from CNSC Staff on the Proposed EA Screening for DNGS	Proposed Environmental Assessment Screening Report	11/15/2012
12-H15.1-Written submission from OPG on Licence Renewal for Darlington Nuclear Generating Station	Renewal of the licence for the Darlington Nuclear Generating Station	9/14/2012
12-H13.1A-Presentation from OPG	Environmental Assessment; renew Waste Mgmt. Facility license; renew Nuclear Pwr. Reactor Operating license	11/23/2012
12-H13.1-Written submission from OPG on EA for Darlington Nuclear Generating Station	Proposed Environmental Assessment Screening Report	Nov-12
12-H13.2-Sierra Club Canada	HOW NOT TO EXTEND THE LIFE OF AGING REACTORS IN ONTARIO	7/18/2012
12-H13.59-Bruce Power	Bruce Pwr. - in support of license renewal for Darlington Waste Mgmt. Facility	10/15/2012
12-H13.79A-Presentation from Power Workers Union	presentation	11/26/2012
12-H13.79-Power Workers Union	REQUEST TO INTERVENE and WRITTEN SUBMISSIONS	10/15/2012
12-H13.83A- Presentation from the Organization of CANDU Industries	supplementary info & presentation	11/26/2012
12-H13.83-Organization of CANDU Industries	Request to Intervene at CNSC Public Hearing on November 13 and 14, 2012	10/15/2012
12-H13.86-Candu Energy Inc	Environmental Assessment of OPG's proposed Refurbishment	10/15/2012
12-H13.A Supplementary Submission from CNSC Staff on the Proposed EA Screening for DNGS	Proposed Environmental Assessment Screening Report	11/15/2012
12-H13-Written submission from CNSC Staff on EA Screening-DarlingtonNGS	Proposed Environmental Assessment Screening Report	9/12/2012
12-H15.1-Written submission from OPG on Licence Renewal for Darlington Nuclear Generating Station	Licence Renewal for Darlington Nuclear Generation Station	9/14/2012
12-H15-Written submission from CNSC Staff on Darlington Nuclear Generating Station Licence	Request for License Renewal	9/14/2012
April Meeting Schedule	Agenda	Apr-13
OPG_IRM_Report_of_the_Board_20130328	Incentive Rate-making for Ontario Power Generation's Prescribed Generation Assets	3/28/2013
Power_Advisory Presentation OEB 82812 Incentive Regulation Options	Incentive Regulation Options for Ontario Power Generation's Prescribed Generation Assets	8/28/2012
Power_advisory_report_OPG_20120511	Incentive Regulation Options for Ontario Power Generation's Prescribed Generation Assets	4/20/2012
5142_First_Amendment_BPRIA_20070829	First Amending Agreement to the Bruce Pwr. Refurb. Implementation Agreement	8/28/2007
Assumptions - Detailed Report	Planning and Controls - Key Assumptions	5/9/2013
Assumptions - Summary Report	Planning & Ctrls - Assumptions Summary	5/9/2013
Decisions - Detailed Report	Planning & Ctrls - Decisions Identification	5/9/2013
Decisions - Summary Report	Planning & Ctrls - Decisions Summary	5/9/2013
AECON Lessons Learned	Nuclear Restart Early Lessons Learned	7/27/2007
Bruce Lessons Learned	Self-Assessment D11-000190	6/2/2011
Lesson Learned Bruce Self Assessment	Nuclear Refurb Islanding	5/18/2011
Lessons-Learned_Wolsong	List; Fuel Channel Installation NIR	
NK38-REP-09701-10164R00 Lessons Learned Report	Quarterly Lessons Learned Rpt. - Q3 2012	4/29/2013
OPEX Process Chart	org chart	
Report from OPEX	Lessons Learned database	
Tooling OPEX Database 03 18 2013	database - Type, Evidencing, etc.	5/2/2013
Wolsong OPEX list	OPEX-1 thru OPEX-VI	
Concerns	RFR Construction Management	12/20/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
PLN OPEX - Constable	database	12/20/2012
Copy of Outage Duration Impact	Impact of Planned Darlington Refurbishment Unit Outage Overlap Dates	6/28/2013
Contingency Presentation for RPET (Jan-30-2013)	proposed strategic direction of contingency development and management	1/30/2013
ROC-June 2013	Risk Oversight Committee	6/5/2013
Components requiring Unit overlap Memo	Attachment to Arnone Email; review conducted on the FH refurbishment and defueling approved scope	6/17/2013
Considerations for Refurbishment Outage Logistics Ver2_U2Finish_toStartU1	Attachment to Arnone Email; U2 Finish to Start U1	6/26/2013
F&G RISK MANAGEMENT REVIEW	Faithful+Gould Assessment	3/4/2012
Impact of Changing Units 2 and 1 from Parallel to Series	Re: Contracts, 4C, Staffing, Procurement, Changed/New Risks, Help Required, & Actions	7/4/2013
N-FORM-11306	Program Risk Identification Form	
N-FORM-11390	Decision Record & analysis Sum.	
N-FORM-11394	Key Assumption Identification Form	
OPG Risk Management Review - rev 1	Assessment of Program & Project Risk Management	3/4/2012
RISK MANAGEMENT SUMMARY TABLE	Risk Self-Assessment Summary Table	
ROC June Meeting Agenda	Agenda	6/5/2013
TG Turbine and Excitation Controls removal from Unit 2 Refurb scope - draft June 28, 2013	TG Turbine and Excitation Controls removal from Unit 2 Refurbishment scope with installation during 1st planned outage after Unit 2 Refurbishment	6/27/2013
1 oversight summary	Oversight Report#1	2/22/2013
2 oversight summary	Oversight Report#2	4/2/2013
3 oversight summary	Oversight Report#3	5/7/2013
Darlington Refurbishment Risk Management Plan	Risk Mgmt.	1/31/2013
DARLINGTON REFURBISHMENT RISK REPORT	Risk Reporting for the Darlington Refurb Progress	4/5/2013
ENTERPRISE RISK MANAGEMENT PROCESS AUDIT	Internal Audit report	Feb-13
Enterprise Risk Org Chart	Org chart	
Meeting Minutes March 2013 Risk Oversight Committee	Meeting minutes	3/12/2013
N-MAN-00120-10001 Sh RISK-03	Task Instruction – Closing Risks	
N-MAN-00120-10001 Sh RISK-05	Contingency Development And Management	7/19/2012
N-MAN-00120-10001 Sh RISK-06	Lessons Learned And OPEX Management	7/19/2012
N-MAN-00120-10001 Sh RISK-07	Assumptions And Decisions Management	7/19/2012
Nuclear Projects Risk Management Manual	Nuclear Refurbishment Risk Management	7/25/2012
Nuclear Projects Risk Management Process (1)	Nuclear Projects Risk Management Process	11/22/2012
OPG-MAN-08708-0001 Guide to Proj Risk Mgmt	Guide To The Project Risk Management Standard	12/23/2011
OPG-STD-0062 Proj Risk Mgmt Standard	PROJECT RISK MANAGEMENT STANDARD; correspondence attached to file	2/27/2012
Program Risk Register RADAR	Risks Mitigation - Summary (114 pgs)	4/4/2013
Program-RiskList	Risks Mitigation - Summary (118 pgs)	3/11/2013
RFR Overall risk list	Risk Mitigation summary by Category	4/4/2013
RFR-Level 1 and Level 2 Risks	Risks Level 1 and Level 2	4/4/2013
Risk Management Self Assessment	Self-Assessment rpt. details	4/14/2013
Risk Work Flow Diagrams	org chart/diagram	
ROC June 2013 Minutes	Meeting minutes	6/5/2013
ROC-June 2013	PPT presentation	6/5/2013
SNC Lavalin 2225_Corporate_Project_Risk_Mgt_Procedure	Risk Mgmt Procedure 2225	Sep-10
Visio-Sharepoint DB Relationship Map	Organizational Chart	3/11/2013
Wolsong OPEX re Estimating RFR	Feeder program breakdown	
Campus Plan Risks	Campus Plan Program	6/18/2013
Contract Management Risks May	Refurbishment Contract Management	6/18/2013
EA Risks May	Licensing & Environment	6/18/2013
ENG NS Risks May	Refurbishment Nuclear Safety	6/18/2013
ENG Proj Risks May	Refurbishment Engineering Projects	6/18/2013
ENG Risks May	Refurbishment Engineering	6/18/2013
Ops_Mtc Risks May	Operations and Maintenance	6/18/2013
Oversight Risks May	Management System Oversight	6/18/2013
PA Risks May	Public Affairs	6/18/2013
P-C Risks May	Planning and Controls	6/18/2013
Program Risk Register - Review of Risk Descriptions	Review of the Darlington Refurbishment Program Risk Register	Apr-13
RFR Contract Language - Target Cost and Risk	Definitions	7/3/2013
RFR Exhibit 3.5 Target Cost and Schedule	Exhibit 3.5- Development of the Execution Phase Target Schedule, Execution Phase Target Cost and Execution Phase Fixed Fee	
Risk List Program	Risks Mitigation - Summary	7/2/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Risk List Projects run July 3	Risk Mitigation summary by Category	7/3/2013
Sample Program Risk Register Format	Risks Mitigation - Summary	4/4/2013
Section 3.5 RFR Contract-Risk Register	Section 3.5 for Definition Phase Work	
Supply Chain Risks	Supply Chain	6/18/2013
2011-CNSC-NPP-Safety-Report-INFO-0823_e	CNSC Staff Integrated Safety Assessment	Sep-12
03-21-13 -Chem and Environ	Transfer Ownership Plan – NR, Chemistry and Environment	3/21/2013
03-21-13 -ERT and SATM	Transfer Ownership Plan - Fire and Emergency Response	2/22/2013
04-11-13 Conv Safety	Department Transfer Ownership Plan – Conventional Safety	4/11/2013
02-04-13- Design Eng	Design Engineering	4/4/2013
02-04-13-WMa Transition plan	Transfer Plans Update	2/4/2013
02-22-13 Systems Transition Plan	Perf/Syst. Engineering	2/22/2013
02-25-13 Presentation Frank	Site Transition Oversight Committee	2/22/2013
03-07-13 - EP Presentation	Transfer Ownership Plan: NK38-PLAN-09701-10113 EP-01 R000	3/7/2013
03-07-13 -Licensing Presentation	Department Ownership Transfer Plan – LICENSING	3/7/2013
03-07-13 Operations	Transfer Ownership Plan: NK38-PLAN-09701-10113 OPS-01 R000	3/7/2013
03-21-13 Radiation Protection	Department Transfer Ownership Plan – Radiation Protection	3/21/2013
04-11-2013 CAP STOC pres	Corrective Action Control Group/MSO	4/11/2013
2013-04-25 - Nuclear Safety	Department Transfer Ownership Plan – Nuclear Safety Analysis	4/25/2013
FH Dept Transfer Plan	Department Integration/Transition Ownership Plan – Fuel Handling	
Training Transition STOC Apr 11_13	PROJECT TRAINING WORK PLAN	4/11/2013
Chemistry and Environment - Ownership Transfer Plan D2	Chemistry & Environment - Ownership Transfer Plan	11/26/2012
EP Ownership Transition Plan	Refurbishment Emergency Preparedness Ownership Transfer Plan	2/28/2013
FH Tansition Plan_LN (3)	FUEL HANDLING - INTEGRATION / TRANSITION PLAN	4/19/2013
Fire Protection - Ownership Transfer Plan	Fire Protection - Ownership Transfer Plan	11/15/2012
Licensing Ownership Transfer Plan	Licensing - Ownership Transfer Plan	11/23/2012
Maintenance Ownership Transfer Plan	Maintenance Ownership Transfer Plan	10/15/2012
MSO Department Ownership Transfer Plan	Corrective Action Control Group/Oversight - Ownership Transfer Plan	11/21/2012
Nuclear Safety Analysis Ownership Transfer Plan	Nuclear Safety Analysis - Ownership Transfer Plan	4/23/2013
OPS - Ownership TP	Operations - Ownership Transfer Plan	2/27/2013
Radiation Protection - Ownership Transfer Plan	Radiation Protection - Ownership Transfer Plan	11/1/2012
Work Managment Ownership Transfer Plan	Work Management Ownership Transfer Plan	11/23/2012
02-22-13- Mtce Presentation	Maintenance	2/22/2013
2012- Prj Execution Update_ Oct 19 2012 Final	TG, SG, RFR Constr. Update information	10/19/2012
COMBINED Agenda - July 19 2013	Refurbishment Work Program Integration Meeting	7/19/2013
COMBINED Agenda - June 13 2013	Refurb Work Prog. Integration Mtg agenda; top 5 milestones	6/13/2013
Conventional Safety - Ownership Transfer Plan	Conventional Safety - Ownership Transfer Plan	10/22/2012
Design Engineering - Ownership Transfer Plan	REFURB DESIGN ENGINEERING OWNERSHIP TRANSFER PLAN	8/19/2011
Licensing Ownership Transfer Plan (pdf)	Licensing - Ownership Transfer Plan	11/23/2012
Project Training Work Plan	scanned doc - Training Work Plan	6/10/2011
Refurb Work Program Integration Meeting COMBINED Agenda - June 3 2013	Refurb Work Prog. Integration Mtg agenda; top 5 milestones (docs attached to agenda)	6/3/2013
Systems-Components Eng. Ownership Transfer Plan	SYSTEMS/COMPONENTS ENGINEERING OWNERSHIP TRANSFER PLAN	11/15/2011

Report to Nuclear Oversight Committee

4th Quarter 2013

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

November 12, 2013

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 31, 2013. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015.

The following is a brief summary of the Project's most significant developments over the last quarter:

- **Retube & Feeder Replacement Project Risk**: The RFR project remains the DR Project's most notable risk, and the schedule for SNC/Aecon's Tooling and Definition work of the Mock-up has degraded significantly over the last quarter. From July 1 to September 30, 2013, SNC planned to earn $61.0M. However, during this period, SNC/Aecon earned only $43.2M (70% of plan). Additionally, SNC/Aecon first claimed that it was entitled to meet its late-finish payment milestones in its contract, a sure way to eat up schedule float and significantly increase the risk that it will not meet its dates to support the planned start of execution in 2016. OPG's RFR Management has rejected that approach and has required SNC/Aecon to develop a recovery plan to restore progress to the plan by May 2014 based on its target schedule. In addition, SNC/Aecon's Class 3 Estimate, which is also due in May 2014, is off to a slow start. The DR Team is committed to holding SNC/Aecon accountable for both a timely and a robust Class 3 Estimate. SNC/Aecon's progress will require close monitoring.

- **4c Cost Estimate Release**: The DR Team completed the Project's request for release of funding as part of the 2014 Business Plan ("4c Cost Estimate"). The DR Team used the 4c Cost Estimate to evaluate the status of the Project and all of its component parts, and address potential risks to the Project's success. In this Report, we provide our comments regarding the 4c Cost Estimate effort and recommendations for the development of the 4d Cost Estimate and related contingency model, which will be an important predecessor to the Release Quality Estimate ("RQE") in 2015.

- **DR Project Scope and Schedule Review**: Project scope and schedule assumptions were vetted and management issued its recommendations for reducing the DR Project's scope and "unlapping" the performance of Unit 2. The 4c Cost Estimate reflects these changes. BMcD/Modus found the process the DR Team used for revising its plan to be robust and in keeping with the Project's core mission and processes. The results achieved – reducing the Project's scope and focusing on a single unit refurbishment – are reasonably calculated to mitigate the Project's overall performance risks.

- **Balance of Plant ("BOP") Contracting Model Change**: BOP planning and related Engineering product are advancing well. Management has moved forward with suggested modifications to the BOP contracting model that should streamline the work and reduce performance risks, as well as advance the work to the detailed engineering phase that underpins a robust and reliable RQE. Engineering has geared up to support the BOP work and has met interim milestones. In addition, the scope reduction should positively impact both BOP and Engineering.

- **Campus Plan Project Risk**: The Campus Plan also remains a significant risk. The work on the D20 Storage Facility excavation has been impacted by unforeseen conditions and ongoing engineering challenges and is projecting to complete four weeks late. Management is taking appropriate action to bring needed focus to this work and the remainder of the Campus Plan scope.

Overall, the DR Team's senior leadership has positively responded to the recommendations in our Initial Project Assessment that we presented to the NOC last quarter as well as ongoing challenges. Attachment A to this Report summarizes the Project's current risks and generally tracks the Team's progress in implementing improvements to the Project's plan.

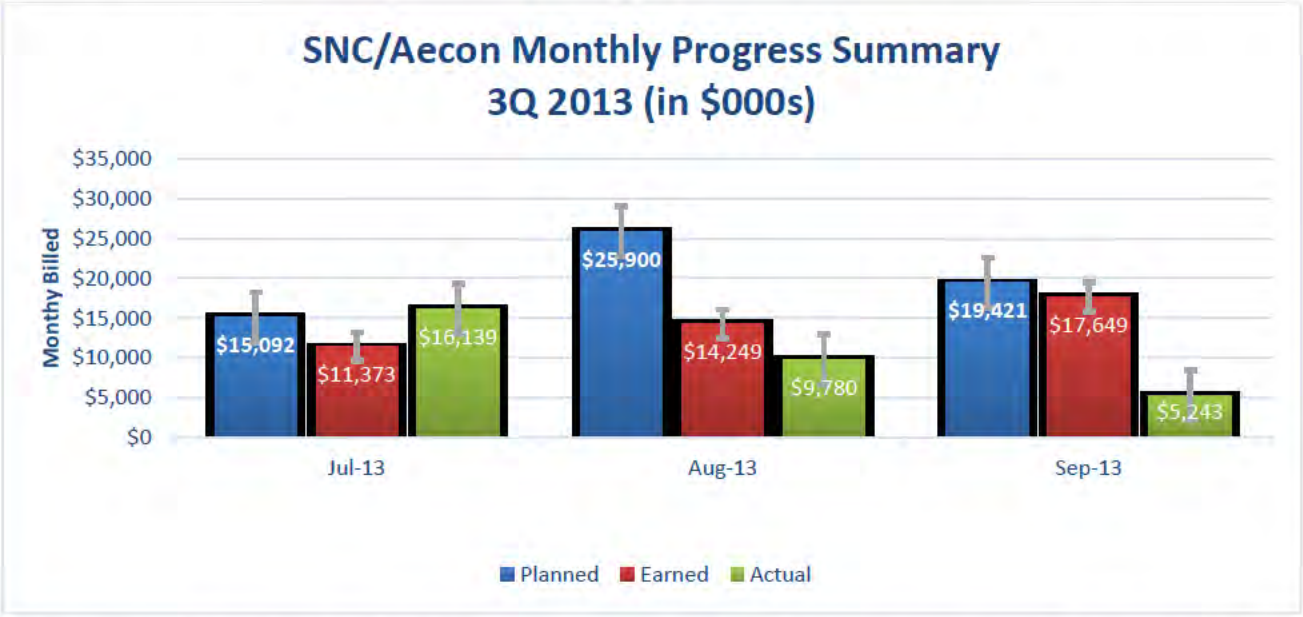
BMcD/Modus has worked with Internal Audit to identify areas within the Project's Assurance Plan that BMcD/Modus is covering in our Independent Oversight role. It is important to note that BMcD/Modus is not performing audits and that this assurance coverage will be performed under our existing reporting and lines of authority. As such, it should provide the DR Team some relief from "audit fatigue." We will continue to work at the NOC's direction in support of OPG's Assurance Plan.

II. Major Projects – Summary of Key Risks

A. Retube & Feeder Replacement

1. Work Status – Tooling, Definition and Mock-up

SNC/Aecon is behind schedule in the Definition, Tooling and Mock-Up phases of its work and is continuing to trend downward for these scopes of work. When the DR Team baselined the C&C Schedule in June 2013, SNC/Aecon was essentially on or slightly ahead of plan. OPG's monthly report for July 2013 reflected that SNC/Aecon had planned to earn a total of $168.6M, earned $169.4M and expended $165.7M, yielding a cumulative CPI of 1.02 and an SPI of 1.0. However, in the three months since the baseline, SNC/Aecon's progress has taken a significant turn for the worse. From July 1 to September 30, 2013, SNC planned to earn $61.0M. During this period, however, SNC/Aecon earned only $43.2M (70% of plan); notably, they only expended $31.1M, or 51% of plan, which indicates they are not spending enough to keep pace. The chart below depicts SNC/Aecon's monthly earned and actual billings in comparison to its plan for each month of the 3rd Quarter 2013:



Overall, these figures when translated to schedule progress show SNC/Aecon was approximately 30% behind its planned schedule for 3Q 2013. SNC/Aecon's most significant delays appear to be:

- **RT Platform**: Originally planned to complete June 13, 2013; now that the schedule performance is visible, it is now apparent that this work is one year late and slipping; this is the critical path for the mock-up;
- **Procurements of Feeder Tube and Retube Waste Containers**: Originally planned for 2Q 2013, these procurements have slipped to 4Q 2013, and OPG is concerned with locking up key suppliers;
- **Multiple Planning Deliverables**: SNC/Aecon is late in preparing and providing to OPG its suite of processes and procedures for developing the Class 3 Estimate, Tool Quantification, Project Controls and Project Execution.

With respect to Tooling, SNC/Aecon reported on October 7, 2013 that its procurement and engineering were significantly behind schedule, such that SNC/Aecon's cumulative SPI was 0.80. Moreover, SNC/Aecon was projecting that its SPI will bottom out at 0.70 for several months and rise slowly well into next year. SNC/Aecon is projecting to be approximately 11% behind schedule as of May 2014 even with some substantial improvements over its current performance.

[redacted]

OPG's RFR Management Team, now led by Roy Brown, has demanded a recovery plan from SNC/Aecon that will close this significant gap and return to the plan by May 2014 (the due date for the Class 3 Estimate and the next major project gate for RFR). In addition, in a Senior Project Management meeting with SNC/Aecon on October 25, 2013, OPG's team required and SNC/Aecon agreed to provide its target schedule as the baseline for the C&C Schedule going-forward. This will substantially increase SNC/Aecon's transparency. The Team has requested SNC/Aecon to support its recovery plan with meaningful data showing how it will obtain and utilize the necessary resources. The RFR team is also increasing its presence in Oakville and is probing SNC/Aecon's progress to ensure greater accountability.

BMcD/Modus draws the following conclusions from the review of project data:

- Management's recent actions with SNC/Aecon have set the proper tone of accountability. This is a very positive step, as OPG's senior project leadership recognizes the importance of working with the contractors to overcome challenges. It was also timely, in that catching these trends now at this early stage allows for course corrections at an opportune time before the teams become entrenched. [redacted]
- The current SNC/Aecon situation shows the importance of tracking contractors based on earning rules that have interim steps based on tracking ongoing physical progress and key commodities. Placing too much importance only on deliverables and completion milestones will result in tremendous peaks and valleys, making forecasting and accurate progress reporting very problematic. BMcD/Modus recommends earning rules to be structured based on a combination of physical progress and milestones, utilizing earned work hours and commodities bought/installed as the basis for earned value.
- The DR Project's reports should have more emphasis on period-over-period performance so that negative trends are more easily discernible from the project's data. The monthly Project Status and Program reports show monthly variances but the metrics focus on cumulative results which can easily mask the velocity of performance changes. Correcting these trends requires their visibility.
- OPG should not hesitate to request the contractors to provide the information it needs to properly manage the work. As an example, OPG will be hampered in gauging SNC/Aecon's recovery plan if it does not receive actual work hours and costs for every activity, regardless of whether the work is part of a fixed-price component. SNC/Aecon will likely have to commit significant resources for recovery and the only way OPG can be assured of SNC/Aecon's commitment will be if SNC/Aecon is transparent in all aspects of the plan and execution.
- Since the RFR Project consists of approximately 45% of the DR Project's overall measured earned value, these poor indices have, and will continue to, drag down the entire Project's earned value until or unless this performance trend is corrected by SNC/Aecon.

BMcD/Modus is closely monitoring this situation, and has been invited to attend progress meetings with SNC/Aecon's management.

2. SNC/Aecon Class 3 Estimate Plan

SNC/Aecon is required under the contract to submit its next phase of estimate on May 15, 2014. This estimate has been termed a "Class 3 Estimate" though, as with the earlier SNC/Aecon Class 5/4 estimates, the AACE-based definition for this estimate is imperfect at best. While this Class 3 Estimate will turn the focus from OPEX gathered at other stations to DNGS, it will still not account for risks, nor will it strictly adhere to other AACE requirements. The DR Team recognizes the need to monetize risks in concert with the Class 3 Estimate and will seek visibility to these risk items. The SNC/Aecon and OPG Teams are meeting weekly to reach an agreeable Class 3 Estimate Plan which should put the concerns over the basis of the estimate to rest.

SNC/Aecon's team announced at the October 28, 2013 project meeting that the Class 3 Estimate development has no float through May 15, 2014. BMcD/Modus identified that SNC/Aecon's Monthly Report for September 2013 showed SNC/Aecon had earned extremely little time (only 335 hours) in preparing the Class 3 Estimate to date. SNC/Aecon believes that there is an anomaly or error in this report, though the amount of work apparent to date on the Class 3 Estimate suggests that SNC/Aecon needs to significantly ramp-up this effort. This also bears close monitoring over the next quarter.

B. Scope Rationalization Process / Unlapping of Unit 2

In 2Q 2013, the DR Team's Senior VPs initiated a process to review, scrutinize, and rationalize the DR Project's scope. This process was performed by a "Tripartite Review Team" drawn from the Project Team, the station and a team of independent reviewers including VPs external to the DR Project who have knowledge of the plant. The Tripartite Review Team evaluated the DR Project's scope with a view of the Project's objectives as well as requirements/commitments that have been made to the CNSC. The Tripartite Review Team's results were aggregated and presented to the DR Project and DNGS station representatives for future review and disposition by the Project Scope Review Board ("PSRB").

In all, the Tripartite Review Team reviewed 579 DSRs with an estimated value of $4.865 B and determined that 210 DSRs with an estimated value of $212M should be removed from the DR Project's scope. In addition, 22 DSRs totaling $125M are slated for further review and potential future action. The chart below summarizes the results of the Tripartite Review Team's evaluation:

Tripartite Review Team Recommendations

Funding Stream	Total DSR Database	Confirmed To Perform in Refurb.	Not Reviewed[1]	Further Review Needed/Potential Further Reduction	Recommended to Cancel
Nuclear Refurbishment	$4,827	$4,468 M	$32 M	$125 M	$202 M
Other	$70 M	$60 M	$0	-	$10 M
Total	**$4,897 M**	**$4,528 M**	**$32 M**	**$125 M**	**$212 M**

BMcD/Modus has followed this process from its conception and found it to be robust. In fact, the DR Team should review OPEX from this process to improve the gate process. We have the following observations:

[1] These DSRs were not considered by the Tripartite Review Team and thus remain the DR Project's scope.

- The Tripartite Review Team's findings indicate that significant scope reductions can be achieved in order to reduce risk in certain aspects of the DR Project. In addition, the process has reduced the Project's budget, though not necessarily as much as was initially anticipated.
- The process also challenged the value and overall scope of items that remain in the DR Project, and provided additional guidance for contingent scope items and future potential reductions.

BMcD/Modus has reviewed the documentation and related analyses supporting the scope recommendations and decisions made by Tripartite Review Team and found them to be acceptable and generally complete. There will be considerably more documentation needed for PSRB presentation and disposition, though the preparation of this documentation should not be a cause of delay for the PSRB to render its decisions.

Simultaneous to the Scope Rationalization, the DR Team was instructed by Management to change the planning assumptions for the Project's refurbishment schedule, resulting in the unlapping of Unit 2 from Unit 1. As noted in our Initial Project Assessment, BMcD/Modus sees this change as a positive for the Project so long as the there is a strong technical basis for life extension of the remaining units. The revised schedule should substantially reduce the overall risk of the Project and result in valuable lessons learned for the performance of the remaining units.

C. Campus Plan

The Facilities and Infrastructure Projects that are part of the Campus Plan remain a significant risk to the DR Project. The projected 4 week delay to the D20 Storage Facility's excavation and another one month delay to the building's engineering are just the latest in a series of events. In addition, current estimates have put this sub-project's cost at $20M above the $130M budget. While the D20 Storage Facility differs from much of the Campus Plan work in that it is inside the security fence, the risk of this portfolio is its sheer volume and the multitude of tasks that must get done prior to opening breaker on the Unit 2 Outage.

The DR Team's senior leadership is taking action to turn the performance around, including:

- Additional focus on helping the ESMSA vendors' design partners' efforts by co-locating with OPG resources;
- Developing a plan to integrate all of the pre-requisite work into a large project with an integrated schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance.
- Completion of work allocation to each of the vendors so that the ESMSA can properly plan their work.

The Campus Plan work will require close monitoring over the next several months.

D. Balance of Plant

In the Initial Project Assessment, BMcD/Modus expressed concerns over the plan for the BOP work, which we believed could have impacted the quality of the RQE. Specifically, we believed the BOP plan had unnecessary steps for procurement and assignment of work that would deprive the ESMSA vendors with requisite time to perform the detailed design, which in turn would increase the risk and variability around the BOP work at RQE.

In our last report to the NOC, we noted that the DR Team's Senior Leadership was fully aligned with our observations and was in the process of moving forward with streamlining the BOP work. The DR Team is planning to direct-assign work to the ESMSA contractors on an equitable basis in keeping with the principles in the ESMSA contracting strategy. In parallel, the BOP Team has been preparing plans for this split of work and Engineering is preparing to support the ESMSA in the engineering phase. Now that this work is moving forward and in the right direction, it will be critical for the DR Team to learn from the OPEX from the D20 Storage Facility and work hand-in-hand with the vendors to produce a quality design product. In addition, many of the changes initiated with the Campus Plan should benefit the BOP work, as this work can

be used as a beta test for many of the processes put in place. The DR Team's actions are encouraging and should lead to a better result.

III. Vetting of 4c Cost Estimate

A. Summary of 4c Cost Estimate

As noted, the DR Team finalized its 4c Cost Estimate and 2014 Business Plan input and presented the results to the Board for its approval. The 4c Cost Estimate was not a full reforecast of the DR Project's costs; instead, it was developed to show variances from the predecessor 2013 Business Plan ("4b Cost Estimate") which the Board approved. A summary of the 4c Cost Estimate and the results of the variances from the 4b Cost Estimate are summarized in Attachment B. The DR Project's cost estimate currently stands at $10.8 B including contingency and management reserve.

As the Project progresses toward RQE, the DR Team is working to reduce the Project's cost estimate to $10 B. This goal appears to be reasonable and can be achieved through: (1) continued maturation of the Project's planning; (2) corresponding reductions of both the Project's overall point cost estimate and related contingency, and; (3) locking down or further reducing scope and determining that results from the remaining scope defining inspections are favorable. The DR Team has currently identified approximately $158 M of cost reductions that will be specifically scrutinized over the next year. In addition, there are other opportunities for cost reduction and re-allocation that OPG may consider, in particular, the characterization of Operations & Maintenance ("O&M") support costs, which currently total $871 M. The DR Team is studying the projected "value add" cost that O&M will be providing directly to the Project. OPG should investigate whether it can characterize the remaining O&M cost as a regulatory asset and not burden the Project with that cost.

In reviewing the 4c Cost Estimate, BMcD/Modus focused more on the processes that the DR Team used in developing this estimate than the actual results. In our Initial Project Assessment, we recommended that OPG consider the 4d Cost Estimate that the DR Team will be presenting for next year's Business Plan a "dry run" for RQE, and that recommendation has been embraced by Senior Management. With that understanding, we have looked at the development of the estimate as a way of testing certain key assumptions that OPG has put forth and we will provide recommendations for improving those processes, as necessary.

BMcD/Modus's vetting exercise has focused on the following with respect to the 4c Cost Estimate:

- Reasonable sampling of the 4c Cost Estimate to validate the underlying basis of the estimate;
- Assessing the efficacy of the processes that the DR Team has put in place for scope control, most notably the Gate Process;
- Review of methods used for contingency and management reserve derivations; and,
- Review of systems that the DR Team is developing to report on cost development.

The results of our review and related recommendations for the next phases of cost estimating are summarized below.

B. Sampling and Validating of 4c Cost Estimate

In our August 12, 2013 report to the NOC, we emphasized the importance of the Project Team properly characterizing the basis of the cost estimates it was putting forward for Board approval. In the case of the 4c Cost Estimate, the DR Team has characterized the estimate as one that generally meets the AACE's definition of a Class 5 or Class 4 estimate. Typical expected accuracy ranges for Class 5 estimates are (-20% to -50%) on the low side, and (+30% to +100%) on the high side, and Class 4 estimates range (-15% to -30%) on the low side, and (+20% to +50%) on the high side.

BMcD/Modus performed some reasonable sampling of the 4c Cost Estimate including:

- Detailed vetting of the current SNC/Aecon cost estimate for the RFR work;
- Review of six DSRs in the BOP scope that total $67 M, or 14% of the BOP Basis of Estimate cost;
- Review of one DSR in the Turbine Generator sub-project scope that totals $119 M, or 17% of the projected turbine Basis of Estimate costs.

In all, we considered approximately 64% of the project bundle costs. In this review, we vetted the nature of the driving aspects of these cost estimates, including: work hour derivations, labor and productivity modification factors, allowances, and the like. Our purpose in doing so was to confirm the basis of the estimates' components and the level of maturity underlying the information. In addition, we reviewed the development of the OPG costs for project management and support, which are essentially drawn from head counts of staff and flowed-out over time. This analysis essentially confirmed that the DR Team has prepared and presented an estimate that generally conforms to the AACE Class 5/4 definitions. This characterization is generally confirmed by the DR Project's current overall status at this time.

As noted in our Initial Project Assessment, the 2015 Business Plan ("4d Cost Estimate") will need to reflect an expected leap in Project maturity that will occur over the next 8 to 10 months; thus, we would expect that the quality of OPG's estimate would parallel that increase. BMcD/Modus has the following additional observations and recommendations for development of the 4d Cost Estimate and 2014 Business Plan:

- With the expected ramp-up of the amount of information needed to support estimates, the DR Team should focus on improving traceability, sourcing, vetting and suitability of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.
- Quality control will be critical as the estimates move from ranges to point numbers. The DR Team may consider migrating to a standard estimating platform such as SNC/Aecon is now utilizing for its Class 3 cost estimate.
- Many of the tools Finance and Project Controls developed for reviewing of the 4c Cost Estimate should find their way into the metrics the DR Team uses in an attempt to increase cost consciousness.
- Vetting of OPG costs was impacted by the timing of the 4c Cost Estimate effort, which began in the middle of the summer months. The next phases of estimating should have a schedule of activities and begin earlier in the year, particularly considering the increased complexity expected for the 4d Cost Estimate.

Attachment C provides more details regarding our review of the 4c Cost Estimate. Our comments and recommendations are geared toward helping OPG to strengthen its review of costs for this next critical phase of estimating.

In summary, BMcD/Modus found that the processes the DR Team used to develop the 4c Cost Estimate were robust and generally conformed to customary practices for an AACE Class 4/5 estimate. The DR Team has also properly characterized the nature of the estimate that it has advanced for approval. The DR Team has also conceptually accepted our recommendations regarding its going-forward activities, though implementation of those recommendations will require focus and attention over the next 10-12 months, as development of the 4d Cost Estimate will be an ongoing effort.

C. Evaluation of Gate Process

The DR Team is utilizing the Gate Process for evaluation of cost, scope and schedule [Nuclear Projects Gated Process, N-MAN-00120-10001-GRB-R001]. Each portion of the work as it matures is subject to a "gate" review in order to obtain full funding for the successive phase of the work. To date, majority of the gate reviews have been for projects in early planning stages, though over the next 12 months, passing through gates will require considerably more rigor. Thus, the Gate Process represents an interim step between the cost forecast efforts to evaluate and vet key elements of the Project's cost and maturity level.

BMcD/Modus has evaluated the Gate Process in concept and in practice, as well as participated in a number of Gate Review Board ("GRB") meetings. We have also sampled multiple "gate packages" that the Project Team has prepared.

The process itself is well-formulated and should serve the intended purpose. However, the DR Team's execution within the process should be addressed. From our sampling of the process, we have found the DR Team is not consistently developing the materials needed for the GRB's evaluation. Some comments and recommendations are as follows:

Observation from Gate Review Process	Recommendations
Quality and consistency of the materials in Gate packages should be addressed. Gate review packages are often hastily assembled by the project teams and provided to the GRB only shortly before the gate review meetings.	➢ Gate package development should follow the existing schedule and key documents should be delivered well in advance of the GRB. ➢ The quality of the gate packages presented to the GRB would be improved by timely delivery of materials prior to pre-vetting sessions within the Project Team.
Within gate packages, there are requirements for explaining variances in cost estimates, there is no formal controlled process for presenting these changes. We have generally found little consistency between the various files kept on the bundles, and in some cases, the estimates used for gate reviews were not preserved.	➢ Improve record keeping and chain of document retention. ➢ Provide a reconciliation of the estimates presented with the gate package to prior estimates (i.e., 4b, 4c) and the basis of estimates so that changes can be traced and sources are identifiable. ➢ Provide an estimate reconciliation within the standard gate package template. ➢ The estimates developed for evaluation at the gates should follow the same general vetting methodology and adhere to the same quality and consistency standards described in **Attachment C**.
Although designed to provide a forum for challenging scope and cost estimates, the gate review process has thus far had mixed results for that purpose.	➢ In addition to Project Controls, the DR Team should consider utilizing a 3rd Party (e.g., Finance and the Controllership) to provide an independent analysis and examination of the sufficiency of the gate packages. The 3rd party can report to the GRB its findings and concerns.

Now that the Project's scope has essentially been determined, the Team's focus should turn to fully supporting the work that will be done in the Gate Process. We have recommended to Management the need to drive down to the lowest levels of the DR Team the importance of schedule and cost consciousness. Senior Leadership has accepted these recommendations and is implementing changes to the process that should address these concerns.

D. Assessment of Contingency and Management Reserve

BMcD/Modus undertook a review of contingency to determine how discrete risk elements are accounted for in the 4c Cost Estimate. Our review found that while risks are being identified and analyzed in a reasonable manner, the value of individual risks are not directly traceable or otherwise transparent all the way through the estimate to the bottom line. Instead, management has made a decision to carry Monte Carlo Output risk amounts at a more global level, namely, at the project bundle level only. As a result, discrete risks and associated amounts are merely subsumed into a single contingency number with no tractability back to the individual risk elements.

BMcD/Modus has the following observations regarding the methods the DR Team is using for establishing and managing contingency and management reserve:

- As noted in our Initial Project Assessment, the DR Team needs wider and increased appreciation of the importance of accurately identifying risks and related parameters. Furthermore, as evidenced by a review of the risk register, more than a few DR Team members do not understand the distinction between management performance issues and true project risks. Senior management needs to continue to focus the DR Team on weeding-out unnecessary risk items that take up management time and attention.
- The risk group needs to be more involved and empowered as part of the initial risk identification efforts. Challenge meetings would help to identify true project risks and proactively eliminate false risks and duplicate inputs.
- OPG's choice to aggregate risk at the bundle level is not without precedent in the industry. However, given this choice, OPG will lose transparency as well as the ability to focus on and manage individual post-Monte Carlo risk amounts, which is particularly important for addressing the Project's most significant risks. Without having a discrete risk basis for formulating contingency, project managers will need to request individual Monte Carlo analyses on selected risk items and expend extra effort to track those risks. In addition, such retrospective calculations will not be consistent with the results of bundled-level analyses.
- The distinction between Management Reserve and Contingency needs further definition as do the rules for allocation of funds.
- Future cost estimates should include a composite roll-up of contingent scope so that the extent of the "unknowns" in the estimate are transparent.

At this time, BMcD/Modus have not undertaken an analysis of the specific amounts of contingency and management reserve being held or the adequacy of this reserve. However, as the estimate progresses toward RQE, the derivation of contingency will become increasingly important. Going forward, BMcD/Modus would expect to see contingency dollars for the Project's most significant known risks developed on a deterministic basis with stochastic modeling limited to chances of occurrence. Future reports will focus on how well contingency and management reserve is defined, calculated, managed, and released to the Project.

IV. Functional Group Update

A. Schedule

In our Initial Project Assessment, BMcD/Modus identified several concerns with the DR Team's plan for the development of the Project's Execution Phase schedule. The DR Team is currently populating the schedule utilizing the Coordination & Control ("C&C") Schedule. We questioned the application and efficacy of this approach, particularly for the Execution Phase. Our chief concern with the C&C Schedule was the point of integration between the contractors and other work groups. Per the Team's original Schedule Management Plan, this integration would occur at Level 2 and not at the detailed Level 3, which we saw as problematic, as the determination of a Project's critical path relies on linkage of detailed activities. We also saw that developing the C&C Schedule was diverting the Team's attention from the integration, assessment and reporting of the Level 3 pieces of the schedule. We articulated additional concerns in our Initial Project Assessment regarding earned value tracking and schedule performance.

Subsequent to our Initial Project Assessment, in further examination of the schedule, we noted some additional issues in the DR Team's plans for integration of the DR Project's Execution Phase—including the fact that the Project Managers' expressed preference to integrate and otherwise use the Level 3 schedule as the tool for day-to-day management during the Execution Phase. Additionally, the DR Team's ability to resource load and manage the work force will be an issue of growing significance, as doing so requires the Level 3 details. Since future contracts (most notably RFR and BOP) are based on target price arrangements, it is essential that the operative schedule is resource loaded; otherwise, the Project Team will lack an essential tool for holding the contractors accountable to their budgets. Thus, the DR Team has now recognized that the best use of the C&C Schedule is for developing the plan during the Definition Phase while the integration of the execution schedule should occur at Level 3.

In consultation with the Project Controls Team, we have made certain recommendations related to the path forward for schedule development, including:

- The Master Schedule the Project Team will use to manage the Execution Phase of the DR Project should be populated with fully integrated Level 3 schedules to form the Project's critical path. This Master Schedule should be the primary tool for determining the status of the Project, and include comprehensive critical path and sub-critical paths, as well as full resource loading. The Level 3 activities will be coded to roll-up to Level 2, thus eliminating duplicative effort.
- OPG will continue utilizing the C&C Schedule but not for its originally intended purpose. The DR Team will consider the C&C Schedule as the "Plan for the Plan" that it will use to detail and track the Project Team's efforts to populate the Level 3 schedule. Currently, there are only a small number of executed contracts so fully integrating at Level 3 is not currently possible. As the maturity of the schedule increases, the DR Team can explore further integration at the detailed Level 3. The C&C Schedule will be updated through RQE on a monthly basis, though operative Level 3 execution work, such as the RFR Mockup, Campus Plan and Fuel Handling, will be updated at Level 3 as necessary. This will provide an opportunity for the DR Team to test the schedule well in advance of breaker-open on Unit 2.
- For areas of work for which there is currently no submitted schedule by a contractor, OPG should develop placeholders to the extent necessary. Such placeholder schedules should include enough detail that nature of the work, key milestones and integration points with other work groups are apparent.
- Commercial contracts should reflect specific schedule requirements that govern such things as resource loading, activity durations, float patterns and banning schedule devices that keep a schedule from calculating. To the extent that certain contracts have already been negotiated, OPG should, if necessary, incorporate its expectations for obtaining earned value, including contractor's budgets and actual work hours per schedule activity, as well as schedule development into existing contracts.
- Project Controls will need management support to hold the work groups accountable for developing and utilizing the Master Schedule, including developing forums for discussion of the Execution Phase Master Schedule status and preparation.

To the extent OPG agrees with these recommendations, the Program Schedule Management Plan and related processes will require revision to explain these changes. OPG will also need to address and simplify the WBS coding structure as necessary.

B. Engineering

Engineering continues to make progress in performing the MDR/MDP work that is needed for completing the procurement and scoping of the Project. Engineering reported in October that it had met an interim goal of completing 75 MDRs two months earlier than the milestone date. Engineering's focus on MDP's has resulted in a number of improvements since the start of our engagement:

- Closer working relationships between OPG and the two OSS vendors, AMEC and WorleyParsons;
- Improved quality of the MDP packages;
- Risks are being more closely evaluated, which ultimately will require less contingency in estimates for work;
- Efficiencies have been gained from collocating staff and the 'leaning-out' of the administrative process.

Whereas there is room for further gains in each of these areas, maintaining the current pace of MDP package development will satisfy the schedule needs of the DR Program. There are still 51 remaining MDRs, of which 20 are currently in process. All of these MDRs will need to be completed by April 1, 2014, which means that Engineering will have to continue its focus on producing MDRs/MDPs.

The next challenge for Engineering will be to morph into an organization that can manage the next phases of work, and here remains some concern. Engineering will have multiple roles, from design authority to reviewer of the various EPC contractors' work-product to developing the restart plan for the units. This will require a significant planning effort. However, because the effort needed to produce MDPs has sapped Engineering to such an extent, the knowledge and experience of DR team members is not currently being applied to a forward-look at this next phase of work.

BMcD/Modus has advised the Engineering team to embrace active management of the engineering effort and look for solutions to help the EPC vendors navigate the detailed design phase. We have advised the team to examine certain of the principles in the Construction Industry Institute's (CII) Front End Planning for Revamp and Renovation Projects.

The Engineering Team has completed its review of the phases of engineering and has prepared a new tool for tracking progress and claiming earned value. This work should also help with the Engineering team's attempts to further plan and execute the work.

C. Risk

In our Initial Project Assessment, BMcD/Modus provided our views regarding certain deficiencies in the DR Project's risk program. Since that time, and in concert with the 4c Cost Estimate effort, the DR Team has made an effort to vet the risk database and increase the quality of its content. There has also been an increased effort to adequately train the DR Team on proper Risk Management techniques. This work is ongoing and will require greater focus as the DR Team begins the full reforecast of costs in the next business plan cycle. BMcD/Modus will provide a more detailed status of these efforts in our next report to the NOC.

D. Project Team Development

In the Initial Project Assessment, we stressed the need for the DR Team to recognize the role OPG plays in managing the work, begin to break down the Project-based silos and begin developing the Construction team upon whom the day-to-day management of this Project will reside. Since our last Report, we have seen some steps in this regard, and the Project's Senior Leadership is moving in the right direction. Many of the changes the DR Team is initiating with its scheduling methodology will foster greater focus and a more cohesive view of the Project's development and execution. The DR Team's integration will be of significant focus through RQE and into breaker-open of Unit 2.

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CANADA

Attachment A

4Q Risk Perspective

Report to Nuclear Oversight Committee

4th Quarter 2013

Darlington Nuclear Refurbishment Project

MODUS Strategic Solutions CANADA

Attachment A – 4Q 2013 Risk Perspective

Burns & McDonnell CANADA

Area	Observations	Low / Medium / High	Current Status / Mitigation
RFR	**SNC/Aecon Performance**: Largest Program risk due to overall risk to the DR Project and OPEX		▸ Recent performance trend in tooling, procurement and engineering of the mock-up is well below plan ▸ Working to late finish milestones, leaving no room for error or delay ▸ Project Team has ordered recovery plan by May 15, 2014
	Class 3 Estimate: Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted		▸ Class 3 Estimate preparation is significantly behind schedule ▸ Completing estimate to OPG standards by May 15, 2014 will be challenging ▸ OPG team actively engaged in vetting plan and estimate
	Schedule Development: Level 3 schedule based on payment milestones; task durations and float unrealistic		▸ Project Team has taken action and required SNC/Aecon to provided resources loading and measure progress via target schedule ▸ Implementing the recovery plan and schedule changes will take transparency and focus
BOP	**Contracting Strategy**: Alterations needed to advance work to detailed design as quickly as possible		▸ Final approvals for contracting strategy have been obtained ▸ Project Team is already working to move work forward ▸ Needs final sign-off from all stakeholders ▸ More focus by management on engineering and scope coordination
	ESMSA Performance Issues: Concern over ESMSA contractors' performance and ability to execute BOP work		▸ Allocation of work from revised contracting strategy will emphasize each contractor's strengths ▸ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed
Scope	**Review Period**: Urgency mounting for scope review; planning/prep underway for work that may be eliminated; concerns regarding scope		▸ Tri-partite review followed a deliberative process and netted positive results ▸ Scope removed from DR Project will be engineered and planned ▸ Needs final close-out
Campus Plan	**Project Status**: D20 Storage Facility work is behind schedule and causing critical path to the TRF		▸ Lessons learned are being collected and disseminated ▸ Management is taking appropriate action to schedule and plan work ▸ Vendor performance/unforeseen issues remain risks
	Engineering and Planning: D20 provides key lessons learned for remaining Campus Plan and BOP		▸ Engineering is co-locating with ESMSA vendors ▸ Clarification of RFPs and process ongoing ▸ Modifications to planning and scheduling underway
Schedule	**Unlapping and Reduction of Risk**: Performance of Unit 2 as a stand-alone will reduce risk		▸ Risk avoidance and decision-making prudence have been further quantified ▸ Impact on Project plan is being considered ▸ Commercial planning and strategy is being developed awaiting BOD
	Continued Schedule Development: Schedule approach was unproven; integration at appropriate level at risk		▸ Project Team has generally accepted BMcD/Modus's recommendations ▸ Revised schedule should reflect organizational change to flatten "silos" and manage as a single project

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Attachment B

Variance Report 4b v. 4c Cost Estimates

Report to Nuclear Oversight Committee

4th Quarter 2013

Darlington Nuclear Refurbishment Project

OPG CONFIDENTIAL AND COMMERCIALLY SENSITIVE - NOT FOR RE-DISTRIBUTION Date: Oct 2, 2013

Refurbishment Estimate - Variance -Release 4c - Release 4b

Categories			Description of Work	Definition Phase				Execution Phase											Total Program (Variance)	Comments
				LTD 2013	2014	2015	Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total	
Overnight Costs	DPP EPC	Retube & Feeder Replacement	Contract Award, tooling and Mock up	(42)	(76)	24	(94)	(19)	(29)	(131)	(159)	(80)	26	43	141	11	88	-	(108)	(202)	
		Fuel Handling	PM, Engineering and some Materials	(4)	(4)	(26)	(34)	(6)	(12)	(12)	(10)	(10)	(7)	(9)	(1)	-	-	-	(67)	(101)	
		Defueling	PM, Engineering and some Materials	4	4	6	14	1	1	-	0	0	-	-	-	-	-	-	3	16	
		Specialized Projects	SDS/ Vault Cooler	5	4	14	24	12	1	2	1	1	1	1	1	-	-	-	21	45	
		Steam Generators	PM & Engineering only	-	(23)	(16)	(39)	(13)	(11)	(9)	(23)	(11)	2	(3)	11	14	0	-	(42)	(81)	
		Turbine Generators	PM, Engineering and some Materials	(1)	(18)	8	(11)	20	5	5	5	13	17	42	29	26	29	6	197	186	
		Balance of Plant	Pre requisite, PM, SIO and Eng'rg Projects	(27)	(20)	(16)	(63)	24	(11)	(10)	(9)	(5)	(2)	(5)	4	2	8	-	(5)	(68)	
		Islanding	Engineering and ordering of Materials	(9)	1	6	(3)	(4)	8	(13)	1	4	6	6	24	1	7	0	40	38	
		System Shutdown	Engineering and ordering of Materials	(3)	8	15	20	4	(4)	(3)	(1)	(1)	3	5	3	3	3	3	15	34	
		Infrastructure Projects - Refurbishment In-Station	Facilities inside protected area required to support Refurbishment	(3)	(6)	(6)	(15)	(3)	-	-	-	-	-	-	-	-	-	-	(3)	(18)	
		Infrastructure Projects - Holt Rd	Holt Road improvements	(7)	2	6	1	-	-	-	-	-	-	-	-	-	-	-	-	1	
		Total DPP EPC		**(88)**	**(128)**	**15**	**(201)**	**16**	**(53)**	**(170)**	**(194)**	**(88)**	**46**	**80**	**213**	**56**	**135**	**9**	**50**	**(151)**	
	Operations/Maintenance Support		All costs (less Trainees)	**(2)**	**4**	**3**	**4**	**(4)**	**(15)**	**(19)**	**(20)**	**(19)**	**(9)**	**(7)**	**12**	**25**	**55**	**8**	**8**	**13**	
	Waste Management			**-**	**-**	**-**	**-**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**(0)**	**-**	**-**	**(0)**	**(0)**	
	New Fuel			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**(0)**	**(33)**	**33**	**(33)**	**33**	**(33)**	**33**	**-**	**(1)**	**(1)**	
	Facilities & Infrastructure Projects (CR Projects)			**14**	**(4)**	**35**	**46**	**(3)**	**(6)**	**(2)**	**(0)**	**-**	**-**	**-**	**-**	**(2)**	**-**	**-**	**(13)**	**32**	
	OPG Oversight and Support - DPP	Execution	Proj O/S, Proj Mgrs, Unit Exec., Matrix stf	28	23	17	68	5	(4)	(3)	(1)	(2)	(0)	1	1	10	22	8	38	106	
			Security	(0)	0	0	(0)	0	0	0	0	0	0	0	0	4	5	1	12	12	
			Facilty Maintenance	-	-	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	4	4	6	6	
		Engineering	Design, Projects, and VP	(2)	5	6	9	3	1	2	2	1	2	2	2	2	5	2	25	34	
		Ops/Mtce Trainees	Operations Trainees	(1)	(1)	1	(1)	3	0	-	-	-	-	-	-	-	-	-	3	2	
		Proj Planning & Cntls		1	(2)	(2)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(3)	(2)	(0)	4	3	(22)	(25)	
		Supply Chain & CS	(include Matrix)	(7)	(0)	(1)	(8)	(1)	(2)	(1)	(1)	(0)	(0)	(0)	(0)	0	3	1	(2)	(10)	
		Quality Management		2	4	4	10	2	2	2	2	2	2	2	1	1	2	0	17	28	
		Program Support	Includes HR, Finance, Public Affairs, External Oversight. Admins	(3)	(4)	(5)	(13)	(6)	(6)	(6)	(6)	(6)	(5)	(5)	(4)	(3)	2	2	(41)	(54)	
			Liability Insurance	-	2	7	9	10	7	3	1	(4)	(4)	(4)	(4)	(2)	2	-	3	12	
			Facility Costs	0	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	5	4	8	8	
			Licensing (Reg Office and CNSC Fees)	(1)	2	1	1	1	1	0	(4)	(5)	(0)	(0)	0	(4)	3	1	(6)	(5)	
		Preliminary Planning (excluding F&IP)	Release #3	14	(0)	-	14	-	-	-	-	-	-	-	-	-	-	-	-	14	
		Nuclear Safety	Excludes ISR	(2)	2	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-	-	(10)	(11)	
		Total DPP Oversight & Support		**29**	**30**	**27**	**86**	**12**	**(6)**	**(9)**	**(12)**	**(19)**	**(11)**	**(8)**	**(6)**	**8**	**57**	**26**	**31**	**117**	
	Reserve	Contingency	Includes F&IP	(35)	32	21	18	(295)	(234)	(153)	(175)	3	212	243	243	139	98	-	82	100	
		Management Reserve		-	-	-	-	(38)	(38)	(96)	(96)	(38)	(38)	(15)	(4)	(4)	(4)	-	(371)	(371)	
				(35)	**32**	**21**	**18**	**(333)**	**(272)**	**(248)**	**(271)**	**(35)**	**174**	**228**	**239**	**135**	**94**	**-**	**(289)**	**(271)**	
				(82)	**(67)**	**101**	**(48)**	**(312)**	**(351)**	**(448)**	**(497)**	**(194)**	**232**	**261**	**491**	**188**	**374**	**43**	**(214)**	**(261)**	
	$ of Year	Interest		(7)	(5)	(8)	(20)	(16)	(30)	(49)	(62)	(30)	10	40	8	22	36	9	(62)	(82)	
		Escalation	Mgmt Reserve not escalated	(14)	(5)	2	(16)	(16)	(25)	(35)	(49)	(22)	47	54	108	47	100	13	223	207	
				(21)	**(10)**	**(6)**	**(36)**	**(32)**	**(55)**	**(84)**	**(110)**	**(52)**	**57**	**94**	**116**	**69**	**137**	**22**	**161**	**125**	
Subtotal Request to BoD (NR Program)				**(103)**	**(77)**	**96**	**(84)**	**(345)**	**(406)**	**(532)**	**(607)**	**(246)**	**290**	**354**	**607**	**257**	**511**	**65**	**(52)**	**(136)**	
Incl. CS Projects	F&IP CS Prj.	F&IP CS Projects	Overnight Costs	0	15	9	24	(31)	(33)	(6)	(1)	(1)	(1)	(0)	-	-	-	-	(73)	(49)	
			Contingency	(5)	(5)	1	(9)	(3)	(3)	(1)	(0)	(0)	(0)	(0)	-	-	-	-	(6)	(15)	
			Interest	0	1	1	2	(1)	(2)	-	-	-	-	-	-	-	-	-	(4)	(2)	
			Escalation	(1)	(1)	(1)	(3)	(5)	(5)	(1)	(0)	(0)	(0)	(0)	-	-	-	-	(12)	(15)	
				(5)	**9**	**10**	**15**	**(40)**	**(43)**	**(7)**	**(1)**	**(2)**	**(2)**	**(0)**	**-**	**-**	**-**	**-**	**(95)**	**(81)**	
Grand Total (including CS Projects)				**(108)**	**(68)**	**106**	**(69)**	**(385)**	**(449)**	**(539)**	**(608)**	**(248)**	**288**	**354**	**607**	**257**	**511**	**65**	**(148)**	**(217)**	
FAC		OM&A		(11)	3	2	(5)	(136)	(13)	(9)	(11)	(15)	(13)	(12)	113	(11)	5	4	(98)	(104)	
		Capital (Including Interest)		(97)	(71)	104	(64)	(249)	(437)	(529)	(597)	(233)	301	366	494	268	506	61	(49)	(113)	
		(Excludes Provision)		**(108)**	**(68)**	**106**	**(69)**	**(385)**	**(449)**	**(539)**	**(608)**	**(248)**	**288**	**354**	**607**	**257**	**511**	**65**	**(148)**	**(217)**	
Prvsn.		Retube Waste Containers	Provision	(1)	(3)	2	(1)	(22)	(23)	(15)	(29)	8	39	49	22	31	-	-	61	60	
				(1)	**(3)**	**2**	**(1)**	**(22)**	**(23)**	**(15)**	**(29)**	**8**	**39**	**49**	**22**	**31**	**-**	**-**	**61**	**60**	
Grand Total (including Provision & CS Projects)				**(109)**	**(70)**	**108**	**(70)**	**(407)**	**(472)**	**(554)**	**(637)**	**(240)**	**327**	**403**	**629**	**288**	**511**	**65**	**(87)**	**(157)**	

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Attachment C

Detailed Observations from 4c Cost Estimate Review

Report to Nuclear Oversight Committee

4th Quarter 2013

Darlington Nuclear Refurbishment Project

Attachment C

DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

Overview

As summarized in our 4Q 2013 Report to the Nuclear Oversight Committee, BMcD/Modus's review of OPG's 4c Cost Estimate consisted of testing and sampling of approximately 64% of the DR Project's costs to determine whether the DR Team followed accepted standards in developing and characterizing the estimate for Management and Board of Directors review and approval. The portions of the 4c Cost Estimate we reviewed were:

- Detailed vetting of the current SNC/Aecon cost estimate for the RFR work;
- Review of six DSRs in the BOP scope that total $67 M, or 14% of the BOP Basis of Estimate cost;
- Review of one DSR in the Turbine Generator sub-project scope that total $119 M, or 17% of the projected turbine Basis of Estimate costs.

This document describes the process utilized for our review and the detailed recommendations we have provided to the DR Team for future estimate preparation.

Process for Review

A. Estimating Process for Project Bundles:

1. The estimates for Release 4c were based on a "refresh" of the Basis of Estimates (BoE) prepared for Release 4b.

2. The BoE's were adjusted to reflect changes resulting from increased definition of the scope of work (SOW), updated vendor quotes, relevant approved Darlington Refurbishment Decision Record and Analysis Summary Forms (DRAS), approved Change Control Forms (CCF's) and the costs impacts resulting from the scope rationalization effort.

3. The BoE's are prepared as independent assessments of costs to meet AACE Class 5/4 classification for use by the Project Team as they advance through the Gating process. Estimators have met with Project Team members and challenged them to refine the DSR scope in an attempt to achieve a Class 5/4 estimate classification.

4. BoE's were prepared according to the following governance documents:
    a. N-PROC-LE-0011 R000: Nuclear Refurbishment Cost Estimating Procedures.
    b. N-INS-00400-1001 R000: Nuclear Refurbishment Cost Estimating Instruction
    c. N-PROC-LE-0017: Darlington Refurbishment Discovery, Contingency and Management Reserve Procedure.
    d. AACE Recommended Practice No. 17R-97.

5. Typical expected accuracy ranges for Class 5 estimates are (-20% to -50%) on the low side, and (+30% to +100%) on the high side. For Class 4 estimates (-15% to -30%) on the low side, and (+20% to +50%) on the high side.

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DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

6. Estimates are prepared on excel based spreadsheet templates which are slightly modified as necessary to accommodate the SOW involved for each DSR line item.

7. The primary driver of hard costs is direct "norm" labor hours which are sourced from an F+G library of data bases and OPG Model Work Orders held in Passport. When in-house data was not available, third party sources were used as appropriate; such as international standards, OPCA (Oil and Petroleum Contractors Association), DACE (Dutch Association of Cost Engineering) and RS Means.

8. When the SOW was similar to historical norms, labor hours were sourced directly (un-factored) from data bases. However, when SOW's differed from historical norms, labor hours were "normalized" (i.e. adjusted) by applied factors (% or formula) in the cell of the respective line item.

9. Once labor hours are established they are further adjusted by productivity and height factors and multiplied by the hourly rate to arrive at labor costs.

    a. Productivity factors (PF) are unique to OPG and have been complied over the past 3 years while estimating projects. The PF's are generated by analyzing a basic 10 hours shift and breaking out the amount of downtime or non-productive time to determine the actual productive time. For BOP, the productivity ranged from 35% to 45%.

    b. Height factors are unique to OPG and used to account how ascending/descending from scaffolding effects labor hours. Generally, the height of work is broken down to (4) parameters; greater than 30ft, between 21-30ft, between 11-20ft and less than 10ft.

10. Once labor hours and costs are established, "estimating metrics" in the form of % of costs or $/hr are applied, again as factors within a given range, to determine the respective cost elements for Project Management, Engineering, Indirect Costs, Construction Plant, Scaffolding, Training, Commissioning, Small Tools and Profit.

11. The estimating metric factors are a range of values expressed as $ per labor hour ($/hr) or percentage (%) of labor costs. The factors were developed based F+G and OPG historical information.

12. Based on the complexity of the SOW, the estimator selects the value of estimating metric (subject to approval of the Lead Estimator) and applies it to each line item of the DSR.

13. All DSR line items have been assessed without any allowance for rework.

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DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

a. All assumptions detailed in the BoE for labor hours and costs are based on one (1) unit. Experience factors for lessons learned resulting from repeat work advancing from the first unit to the last unit are applied on the first unit; 1st Unit – 1.00; 2nd Unit – 0.975; 3rd Unit – 0.970; 4th Unit – 0.965

B. Testing/Sampling – Project Bundles

1. Sampled cost elements (Labor, Material, Construction Plant, Small Tools, Scaffolding, etc.) from six (6) DSR line items totaling $67M or 14% of total Balance of Plant bundle. For the Turbine Generator Basis of Estimate, one (1) DSR was sampled totaling $119M or 17% of the TG bundle.

2. Since labor hours are the primary cost driver, the estimating team walked through the labor hour entries. Generally, when the scope of work was similar and lined-up with scopes in the estimating data bases, the labor hour entries were hard keyed with no adjustments. However, in circumstances when scope differed from estimating data bases, a factor (judgment call) was applied to the historical norm labor hours to best approximate the given scope.

3. In regard to applying estimating metrics to the labor hours and labor costs, the Team explained that the selection process of the applied factor was based primarily on the complexity of the DSR line item.

4. Several material costs were also tested. Costs were primarily sourced from Work Orders in Passport and adjusted for inflation. Other material costs were validated by vendor quotes.

5. Profit (10%) is applied only to Material Cost and also included in the labor rates per OPG MSA Contracts.

Recommendations for Future Estimating

The 4d Cost Estimate will need to reflect an expected leap in Project maturity that will occur over the next 8 to 10 months; thus, we would expect that the quality of OPG's estimate would parallel that increase in maturity. BMcD/Modus provided high-level observations and recommendations for development of the 4d Cost Estimate/2014 Business Plan in the 4Q Report that are based on the following detailed observations.

Observation from 4c Cost Estimate	Recommendations
The primary driver of hard costs in the 4c Cost Estimate is direct "norm" labor hours which are sourced from an F+G library of data bases and	• With the expected ramp-up of the amount of information needed to support estimates, the DR Team

Attachment C

DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

Observation from 4c Cost Estimate	Recommendations
OPG Model Work Orders held in Passport. When in-house data was not available, third party sources were used as appropriate; such as international standards, OPCA (Oil and Petroleum Contractors Association), DACE (Dutch Association of Cost Engineering) and RS Means.	should focus on improving traceability, sourcing and vetting of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.
Platform for Cost Estimate: At the heart of the 4c Cost Estimate, the DR Team has utilized a series of spreadsheet the in the 4c Cost Estimate is direct "norm" labor hours which are sourced from an F+G library of data bases and OPG Model Work Orders held in Passport templates. These spreadsheets utilize a large number of "hard-keyed" entries rather than "lookup" or "reference" functions that refer back to the source data. In addition, many cell formulas are unprotected. This method works but can be inefficient and requires extensive QA/QC as the estimate becomes more detailed.	➢ DR Team may consider migrating to a standard estimating platform such as SNC/Aecon is now utilizing for its Class 3 cost estimate. Such platforms allow for greater consistency among estimators, though there is a learning curve for effective implementation. ➢ If the DR Team does not adopt a standard estimating platform, it should consider utilizing comment boxes and/or text cells to reference the source data or utilize lookup functions to directly refer to input data. ➢ In any event, the team will need to dedicate resources and time for running ongoing QA/QC checks, particularly when including linked spreadsheets and contractor-produced database.
The 4c Cost Estimate relies on a number of estimating factors, some of which are a product of the current level of Project definition (i.e. Class 5/4). Factors have been used to approximate the result that will come with greater Project definition.	➢ Utilizing such factors in estimating is common industry practice. However, OPG should increase the level of documentation regarding the factors that are used so that these are traceable when used. ➢ Going-forward, OPG will need a more organized set of estimate templates for vetting of Class 3 estimates and target price proposals from contractors. Utilizing a standard estimating platform (like Timberline) could provide an acceptable alternative.
Labor estimates used in the 4c Cost Estimate are generally based on productivity and include:	➢ Traceability of the source of such factors is critical. Industry-based studies for developing productivity factors can be

Attachment C

DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

Observation from 4c Cost Estimate	Recommendations
• a crew sheet that analyzes process flow and work series and • height of operations These factors are unique to OPG and have been developed over the past three years.	distinguishable, as can a contractor's experience when work is not entirely similar. ➢ Vetting of these factors and record-keeping related to the source will be critical for Class 3 estimate reviews.
OPG Costs: the major drivers the DR Team examined for the 4c Cost Estimate were: • Impact of unlapping of Unit 2 • Scope rationalization and impact on overall size of the Project and associated level of effort. The different work groups were given a blank template for defining their staffing needs; this was later changed to variance reporting against 4b when it was apparent the work groups were exceeding cost boundaries. Costs were eventually brought in line via vetting and challenge meetings with RPET and the efforts of the Finance and Project Controls groups.	➢ Finance and Project Controls developed metrics for showing cost flows and variances over time that were extremely helpful in determining the right-sizing of the team. These (and similar) tools should be incorporated into the metrics the team is reviewing in an attempt to increase cost consciousness. ➢ Vetting of OPG costs was also impacted by the timing of the 4c Cost Estimate effort, which began in the middle of the summer months. The next phases of estimate should have a schedule of activities and begin earlier in the year, particularly considering the increased complexity expected for 4d.

Exhibit 1 to Attachment C – Sampling of 4c Cost Estimate

No.	Bundle/Sub Bundle		DSR Line	Title	AACE Class	Base Scope ($K)	Contingent Scope ($K)	Total ($K)	Component ($K)	Bundle Sampling (%)	BUNDLE TOTAL ($K)
1	BOP	Common System	TS0510-11	DNGS Structures: Perform Inspections For Civil Structures in the Reactor Auxiliary Bay (RAB).	5	563	-	563	4,647	12%	494,724
2	BOP	Common System	TS0510-18	DNGS Structures: Repair / Replacement of Civil Structures Located in the Reactor Auxiliary Bay (RAB).	5	-	2,400	2,400	16,900	14%	
3	BOP	Conventional	SIO390-1	Install Flash Tank and Treatment Skid	5	4,887	-	4,887	48,020	10%	
4	BOP	Pre- Refurbishment	TS0630-6	Service Water System	5	13,085	-	13,085	15,527	84%	
5	BOP	Reactor Systems	TS0320-1	Refurbish all PHT Pump Motors by sending them to a repair shop.	5	36,751	-	36,751	56,050	66%	
6	BOP	Reactor Systems	SIO300-31	Dual power supply for Vault Vapor Recovery Dryer	5	793	-	793			
7	BOP	Safety & Control Systems	TS0350-6	Replacement of SDS Computers (DSR's TS0350-1 to TS0350-18) Installation Costs	5	8,350		8,350	62,691	13%	
8	Turbine		SI0010-1		4	119,246		119,246	716,183	17%	716,184
9	Fuel Handling		TS0410-6	Replace all trolley pumps	5	18,341		18,341	151,666	12%	177,078
10	Unit Islanding		TS0810-1	Reactor Building Containment Bulkhead Isolation: Containment Bulkhead Installation	5	84,507		84,507	303,003	28%	303,003
11	Steam Generator		TS0050-4	Assess Ports Installation	4	12,424		12,424	118,629	10%	309,031
12	Shutdown & System Layup		TS0890-2	Unit Layup Modification for Nuclear Systems: Drying of Main HT Circuit	5	5,155		5,155	81,998	6%	132,601
				Total				306,502		14%	2,132,621

MODUS Strategic Solutions CANADA

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Report to Nuclear Oversight Committee

1st Quarter 2014

Darlington Nuclear Refurbishment Project

ONTARIO POWER GENERATION

Burns & McDonnell
Modus Strategic Solutions

March 4, 2014

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of February 21, 2014. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015.

In this report, we provide current updates regarding the DR Project's most significant risks. In addition, we provide a high level assessment of the DR Project's compliance with the principles set forth in the Minister of Energy's December 2013 Long Term Energy Plan ("LTEP"), and identify recommendations for strengthening OPG's planning for completion of the Release Quality Estimate ("RQE"). We would also like to note that pursuant to the Project's Assurance Plan approved by the Audit Committee, BMcD/Modus has prepared independent reports documenting the DR Team's status as well as further recommendations for improvement. This quarter we have issued an Assurance Report based upon our detailed review of the DR Team's Risk Management Program. Next quarter we will issue three other Assurance Reports relating to: 1) DR Project schedule process and development; 2) the 2013-2014 Business Plan as it relates to the latest project estimate (the "4C Estimate") and 3) scope status and process. These full reports will be available for the NOC's review at its convenience. With respect to our ongoing involvement in the Assurance Plan, we will continue to work at the NOC's direction.

The following is a brief summary of the Project's most significant developments over the last quarter:

- **Retube & Feeder Replacement Project Risks**: The RFR project remains the DR Project's most notable risk, though it appears that SNC/Aecon's progress on the tooling portion of the work is improving. Through January 2014, the contract remained underspent by $32.7 M, and SNC/Aecon's SPI for tooling was 0.81, which reduced its cumulative SPI to 0.88. SNC/Aecon's original plan to complete tooling delivery by June 2014 will not be met; it has implemented a tooling recovery plan that has recovered some of its earlier delays and mitigated some future deliveries that cannot be fully recovered. Based on its current plan, it will take until August 2014 for SNC/Aecon to return to its baseline schedule. Failure to do so will put stress on OPG's RQE date. The DR Team is closely monitoring SNC/Aecon's progress and has recommended SNC/Aecon increase schedule reporting and supplier surveillance.

  In addition to the tooling set, SNC/Aecon's other major activities in the Definition Phase focus on the development of the Execution Phase cost estimate and schedule. [redacted] Through February 10, 2014, SNC/Aecon had completed only 32% of the work needed to develop the Construction Work Packages ("CWPs") that form a key part of the estimate, while expending nearly 70% of the allotted schedule time. SNC/Aecon has instituted a recovery plan for the CWPs and remains committed to completing the Class 3 Estimate on time. However, BMcD/Modus is concerned that accelerating the preparation of the Class 3 Estimate may only result in weakening the quality of the product. Regardless of the success of SNC/Aecon's recovery plan, BMcD/Modus recommends that OPG consider giving SNC/Aecon more time if quality is an issue with the deliverables, and pursue SNC/Aecon developing and monetizing its contingency as a part of the Class 3 Estimate. Under its Contract with OPG, SNC/Aecon is not required to provide any contingency amounts until the Class 2 Estimate phase. As we have stated in previous reports, we are concerned that this increases the risk of a "surprise" in the final Class 2 Estimate and could complicate target price negotiations with SNC/Aecon. Furthermore, OPG could use this information to provide a more mature 4d Cost Estimate in the fall of 2014.

- **Commercial Risks:** We have encouraged the DR Team to evaluate its major contracts to ensure that the proper incentives and disincentives are included in light of the LTEP. As an example, the RFR Contract includes certain incentives and disincentives that were focused on improving performance unit-over-unit. However, the LTEP and OPG's decision to "unlap" Unit 2, puts more focus on the success of the first unit. The DR Team should therefore

revisit these contract incentives and disincentives to ensure such success. Future negotiation of the SNC/Aecon target price for the Execution Phase should include re-examination and clarification of certain elements that could not have been contemplated at the time the parties negotiated the Contract. Similarly, the ESMSA contracts should be evaluated in light of current considerations.

- **Campus Plan Performance Project Risk**: Performance of the Campus Plan work remains a significant risk. The D20 Storage Facility foundation work has been impacted by subsurface conditions and ongoing engineering challenges and is now projected to complete in April 2016. Based on the current schedule, there is now a 3-month delay to the critical path, impacting OPG's ability to open the Unit 2 breaker in October 2016. Additional work on other key Campus Plan facilities is tracking behind schedule and/or over budget. In addition to recovering the schedule delays to the D20 Storage Facility, it is critical for the DR Team to increase the predictability of this work and identify any lessons learned that could impact the Balance of Plant ("BOP") work that will be performed by the same contractors under the ESMSA terms and conditions.

  Both Projects & Modifications ("P&M") and the DR Team are increasing their focus on the remainder of the Campus Plan scope. Project controls (schedule and cost) are currently under intense review, as is the process for engineering oversight. BMcD/Modus recommends that as part of its review, the DR Team refresh its understanding of required end dates for these Facility and Infrastructure ("F&I") projects and examine what appears to be poor schedule logic and unrealistic float that could be masking further delays and performance issues. In addition, BMcD/Modus is engaged in a root cause analysis of the systemic budget variances that have become apparent for this work.

- **RQE Preparation**: RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs. It is essential that the DR Team carefully plan and manage the RQE development process. The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE. The team is developing an RQE planning schedule and further definition for expectations for deliverables. The Blue Ribbon Panel assigned to review the DR Project's scope has completed its work and its final recommendations have resulted in $179 million of work being removed from the DR Project, some of which has been cancelled entirely.

Other ongoing challenges to the DR Project include the continued development of the BOP work, further refinement of the Risk Management Program and completion of pre-requisite F&I and Fuel Handling work. Attachment "A" provides an update regarding the DR Project's risks.

II. Project's Conformance to LTEP

A. LTEP Principles

The LTEP identifies priorities for OPG and Bruce Power to follow in their respective mid-life refurbishments of DNGS Units 1-4 and Bruce Units 2-8. The LTEP supports the refurbishment of DNGS Unit 2, but states that "the province will proceed with caution to ensure both flexibility and ongoing value for Ontario ratepayers," and "(f)inal commitments on subsequent refurbishments will take into account the performance of the initial refurbishments with respect to budget and schedule by establishing appropriate off-ramps." In addition, the LTEP identifies seven priorities for OPG and Bruce Power to follow in their respective refurbishments:

1. Minimize commercial risk on the part of the ratepayers and the government.
2. Mitigate reliability risks by developing contingency plans that include alternative supply options if contract and other objectives are at risk of non-fulfillment.
3. Entrench appropriate and realistic off-ramps and scoping.
4. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.

5. Make site, project management, regulatory requirements, supply considerations, cost and risk containment the primary factors in developing the implementation plan.
6. Take smaller initial steps to ensure there is an opportunity to incorporate lessons learned from refurbishment including collaboration by operators.
7. Hold private sector operator accountable to the nuclear refurbishment schedule and price (*not applicable to OPG*).

In addition, the LTEP states that "(t)he government will encourage the province's two nuclear operators, Bruce Power and OPG, to find ways of finding ratepayer savings through leveraging economies of scale in the areas of refurbishment and operations. This could include arrangements with suppliers, procurement of materials, shared training, lessons learned, labour arrangements and asset management strategies." We are aware that OPG's management has engaged in such discussions with Bruce Power but to date no progress has been reported.

B. BMcD/Modus Assessment

The following is our assessment of the extent to which the DR Team is currently in compliance with the LTEP's principles. We have also identified gaps that may currently exist and recommendations for strengthening OPG's compliance with these requirements. In this assessment, we have focused solely on the DR Project's readiness, as BMcD/Modus has not been retained by NOC to assess each of the considerations in the LTEP. In addition, there are LTEP principles that have commonality, which we identify below.

1. Minimizing commercial risks	
Current Initiatives:	The primary commercial risks to the Province from mid-life refurbishments emanate from the potential for unplanned significant cost and schedule overruns. OPG has recognized these risks and others from prior nuclear projects (Pickering A RTS and Pickering A&B Retube) and has implemented an extensive planning effort with its prime contractors during which OPG is: • Locking down project scope well in advance of starting construction; • Engaging in a robust pre-outage inspection campaign that utilizes the units' maintenance and Vacuum Building outages; • Executing refurbishment and improvements to the reliability of the fuel handling machines that service the station; • Planning and executing pre-requisite work that will support the refurbishment as well as unit life extension prior to the start of Unit 2's outage; this should provide a testing ground for the Execution Phase; • Building a full-scale mockup of the DNGS reactor and vault that will be used for training and proving the tools needed for the removal and replacement of the reactors' internals; • Fully developing engineering and planning of the work so that it is 100% complete prior to the start of construction; • Developing a Release Quality Estimate (RQE) in phases that incorporates a high-confidence budget and schedule for the work; • "Unlapping" Unit 2 from Unit 1 so that the focus can be entirely on the planning and construction of a single unit and so that OPG can gain confidence and lessons learned in completing the work;

	• Utilizing target price contracts for the Execution Phase that are based on developing cooperation and transparency with key vendors; • Negotiating various off-ramps and stages into the RFR contract with SNC/Aecon, such that SNC/Aecon securing the Execution Phase contract depends on its performance in the Planning Phase and the quality of its estimate and schedule for execution; and • Changing its procurement practices for the Balance of Plant ("BOP") work that increases the chances of meeting schedule via direct award of work packages to the ESMSA vendors.
Potential Gaps:	➢ Incentives in the RFR contract were developed and established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the urgency of a success on Unit 2. ➢ F&I work is behind schedule and is diverting management attention. The ESMSA contractors may require additional review of incentives and conditions for performance on BOP work.
BMcD/Modus Observations and Recommendations:	With respect to the SNC/Aecon RFR Contract, we recommend revisiting the contractual incentives that were negotiated in 2011-12. The LTEP represents a major strategic revision for the DR Project, such that emphasis on unit-over-unit improvement is much less of a consideration that optimizing performance on Unit 2. Moreover, with the award of the Turbine Generator performance to SNC/Aecon, there are additional opportunities to increase the efficiency and lower the overall cost of SNC/Aecon's work. Similar reviews should be undertaken with the ESMSA vendors to ensure all performance incentives are aligned with the current DR Project goals.
2. **Developing contingency plans to mitigate risks**	
Current Initiatives:	OPG has considered and developed what appear to be reasonable contingency plans needed to mitigate project risks[1] including: • OPG's decision to "unlap" Unit 2 from the other units' refurbishment, which predated the LTEP, was intended to mitigate the risk of performance and provide the DR Team with singular focus on one unit's refurbishment at a time. • OPG's significant investment in engineering and planning the work in the Definition Phase is the direct result of OPEX from Pickering Unit 4. • OPG has made a sizeable investment with the reactor mock-up, during which SNC/Aecon will perform full integration and commissioning testing of the tools needed for refurbishment. The results of those tests will be incorporated into the Tooling Performance Guarantee with SNC/Aecon. • The DR Team has developed and implemented a Risk Management Program that is being used to evaluate and prioritize project- related risks and management issues.
Potential Gaps:	➢ SNC/Aecon contract was set-up with the intent of monetizing contingency as part of the target price and not before, and there is currently some ambiguity regarding the pricing of risk in the target price.

[1] BMcD/Modus has been asked by NOC to evaluate or otherwise assess any aspects of supply.

	➢ OPG's project risk management identification requires additional leadership, visibility and focus. ➢ OPG's transition to actively managing the EPC contractors' engineering work will require significant focus.
BMcD/Modus Observations and Recommendations:	Our recommendations regarding risk and contingency have been discussed in prior reports. The DR Team's senior management is acting on these recommendations.
3. Entrench appropriate and realistic off-ramps and scoping	
Current Initiatives:	• OPG has engaged in a deliberate process with numerous off-ramps for the Definition Phase. This process includes significant BOD oversight and approval of yearly releases of funding, and these funding releases and related details are being vetted by Independent Oversight. • The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team. • The contract with SNC/Aecon includes provisions that allow OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase. • OPG has fully examined the scope of the Unit 2 refurbishment project and redistributed or cancelled work based on OPG's regulatory commitments. • As part of scope review, OPG has designated scope in AISC programs for the station which will be performed over a longer period of time. • OPG simplified the scope of the Turbine Generator work by delaying the installation of the turbine controls for Unit 2 until a future outage.
Potential Gaps:	➢ Finalizing the scope recommendations of the Blue Ribbon Panel and fully documenting those decisions for future prudence review. ➢ Ensuring the scope that is required for refurbishment, though performed outside of the DR Project, is staffed, funded and executable.
BMcD/Modus Observations and Recommendations:	In general, we see that OPG has set up the Project with appropriate measures to reduce or eliminate scope depending on the Shareholder's future needs. Unlapping Unit 2 also provides the DR Team an opportunity to incorporate lessons learned into subsequent units.
4. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price	
Current Initiatives:	• Contracts with major vendors are being developed and vetted utilizing a deliberate, staged and gated process with requirements for budget, schedule and scope identification at each gate. • The terms and conditions of OPG's contracts generally conform to the industry, and the contracts have specific negotiated incentives and disincentives that are calculated toward promoting the contractors' (and OPG's) responsible management of the work. • OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise.

	• OPG is implementing a detailed, integrated Level 3 schedule that will encompass all of the contractors' and OPG's work, as well as a rolled-up Level 2 C&C Schedule that is used as a higher level interfacing tool. The schedule allows for planning and coordination of the work. • OPG has implemented cost control systems that are geared toward holding contractors accountable. These systems include earned value and budget controls through the gate process. In addition, OPG's Corporate Finance has increased its focus and resources to handle the volume of the DR Project's work. • OPG performs analyses of all pricing and check estimates for the contractors' work. These estimates are provided by an independent vendor with experience in the industry. • OPG's senior management has established separate regular steering committees with each of the major vendors' executives which provide senior leadership with a forum to discuss progress, potential and real issues impacting performance and commercial issues. These forums are an essential ingredient in managing contractors' work. • OPG has an opportunity through the Campus Plan work to test many of its core processes and controls.
Potential Gaps:	➢ The gate process is very good in principle although it would benefit from some additional focus and attention in practice. BMcD/Modus's recommendations in this regard were part of our 3Q 2013 report to NOC. ➢ The estimating process may require some changes depending on the result of the root cause evaluation of Campus Plan budget variances. ➢ DR Team's project controls are in an early stage of development and require testing and adherence by the major contractors. In particular, the earned value system will require significant testing and oversight as different pieces of the DR Project progress. ➢ F&I work is not using all of the DR Project's core processes, and those it is using lack consistent adherence.
BMcD/Modus Observations and Recommendations:	The DR Team has struggled with defining its "oversight" role of the contractors. As we have noted in prior reports, since OPG is ultimately responsible for the Project's outcome, it must actively manage the work of its contractors, which requires a detailed understanding of the contractors' work status and the removing of any barriers to performance as quickly and prudently as possible. Active management, however, does not include interfering with or re-performing the work for the contractors. Finding this balance is a difficult task for an owner, particularly an owner such as OPG who has self-performed and self-managed so much of its past large capital projects. The tools the DR Team will rely upon, including the P6 schedule and Proliance, will need significant attention and ongoing maintenance.
5. **Make site, project management, regulatory requirements and supply considerations, and cost and risk containment, the primary factors in developing the implementation plan.**	
Current Initiatives:	• OPG's plan for RQE assumes that all of the factors listed will be fully considered, planned and budgeted in advance of execution of the work. OPG will invest $2.4 billion in upfront planning and site preparations prior to the breaker of Unit 2 opening in October 2016.

	• Taking lessons from Pickering A, the DR Team has committed to completing the identification of all regulatory requirements well in advance of final design and construction. • OPG has also committed to the completion of design, proving of the RFR tools and completing procurement of all necessary components one full year before breaker open. • OPG has implemented project controls and risk management programs and will continue to refine these tools as the outage nears. • OPG has established hard dates for procurement and delivery of all long lead items. • OPG has retained external oversight and engaged other corporate functions in providing input and assurance that the DR Team is meeting its commitments.
Potential Gaps:	None at this time.
BMcD/Modus Observations and Recommendations:	While OPG's plans for the Definition Phase are robust, execution of these plans will require significant and ongoing effort.
6. Take smaller initial steps to ensure there is an opportunity to incorporate lessons learned from refurbishment including collaboration by operators.	
Current Initiatives:	• OPG management approved the unlapping of Unit 2 in advance of the LTEP. As noted, the revised plan will allow for a more measured approach and singular focus on one unit refurbishment at a time. • OPG has filled key positions in its project management team with individuals with direct experience of prior CANDU refurbishments. • OPG has contracted with SNC/Aecon, whose subsidiary, CANDU Energy (formerly AECL), has been associated with each of the prior refurbishments. • SNC/Aecon has invested in studying lessons learned and OPEX from these prior projects and incorporated those into the RFR project. The basis of SNC/Aecon's estimate for DNGS is these past projects with specific understanding and elimination of the issues that caused prior cost and schedule overruns. • The scope rationalization and elimination of Turbine Generator controls installation for Unit 2 should allow the DR Project to establish considerable construction float for BOP work. • OPG has initiated contact with Bruce Power.
Potential Gaps:	None at this time.
BMcD/Modus Observations and Recommendations:	OPG's management has taken reasonable steps to ensure that the DR Project is proceeding along a deliberate path for success. Execution to that plan is not guaranteed but will be enhanced by the work that OPG has done to date. OPG should continue to explore ways to collaborate with Bruce Power that will be beneficial to both organizations.

In summary, BMcD/Modus believes that OPG is taking prudent steps in fulfilling the LTEP's principles, and these steps largely predated the LTEP's publication. Management also appears to understand the challenges ahead.

III. Major Projects – Summary of Key Risks

A. Retube & Feeder Replacement

1. Work Status – Tooling, Definition and Mock-up

SNC/Aecon remains behind schedule in the Definition, Tooling and Mock-Up phases of its work, though it has reversed some of the trends apparent in the 3Q 2013 when it earned only 70% of its planned work. Through the end of October 2013, SNC/Aecon's cumulative SPI was only 0.80, and its CPI was a mere 0.51 for 3Q 2013. Since our last report, SNC/Aecon has improved both its earned value and actual progress. SNC/Aecon's cumulative SPI is now 0.88 and in both December and January, SNC/Aecon earned more than planned for the first time since the schedule was baselined in June 2013.

The following is the current performance trend for the three major procurements that BMcD/Modus began tracking in 3Q 2013:

- **RT Platform**: Originally planned to complete June 13, 2013, it is now scheduled to be complete and delivered on July 25, 2014 and commissioned thereafter; this is the critical path for the tooling prove-out in the mock-up. SNC/Aecon has increased source surveillance at the Rolls Royce's facility and Rolls Royce has subsequently improved its scheduled completion by 4-5 weeks since our last report.
- **Procurements of Feeder Tube and Retube Waste Containers**: Originally planned for 2Q 2013, these procurements slipped to 4Q 2013. SNC/Aecon has ramped-up the design and communication with the suppliers. There is an additional risk from the D20 Storage Facility project's construction, which may cause an access issue.
- **Multiple Planning Deliverables**: SNC/Aecon is late in preparing and providing to OPG its suite of processes and procedures for developing the Class 3 Estimate, Tool Quantification, Project Controls and Project Execution. Part of this delay was caused by SNC/Aecon not claiming sufficient progress on this work due to contractual earning rules that kept them from accurately assessing its status. The DR Team and SNC/Aecon are reviewing these and other earning rules that could fog the contractor's progress.

In our last report, we noted that SNC/Aecon initially claimed it was not behind schedule because it was still meeting its late finish "Contract Milestone Schedule." However, OPG's management has corrected this misconception, and SNC/Aecon is now using its reasonable target schedule as the basis of its schedule reporting. OPG has increased SNC/Aecon's accountability by requiring SNC/Aecon to report on its schedule progress more often and with greater focus on realistic target dates. OPG has also communicated to SNC/Aecon needed criticism of the contractor's project reporting which was minimizing its performance deficiencies. SNC/Aecon has responded by improving its metrics and reports, though this is an evolutionary process. In addition, SNC/Aecon has added experienced resources in key positions and those individuals have made a significant impact to date.

As noted, even with these improvements, SNC/Aecon's original plan to complete tooling delivery by June 2014 will not be met. SNC/Aecon's tooling recovery plan has recovered some of its earlier delays and mitigated the impact and sequence of future sub-vendor deliveries that cannot be fully recovered. SNC/Aecon has also re-prioritized some of its work on the feeder assemblies to partially mitigate the impact of these delays. Based on its recovery plan, SNC/Aecon will now complete tooling delivery by August 2014, meaning that the schedule will require successive improvements to avoid causing compression and delays to the completion of the Definition Phase work.

In our 3Q report, BMcD/Modus stated our concern with SNC/Aecon's progress and many of the behaviors that its team was projecting. In the last quarter, we have seen the immediate positive impact from OPG increasing its management of SNC/Aecon. While the recovery will take several more months, SNC/Aecon has accelerated its progress and has increased the level of its accountability. BMcD/Modus is closely monitoring this situation, and has been invited to attend progress meetings with SNC/Aecon's management.

2. SNC/Aecon Class 3 Estimate Status

SNC/Aecon's May 15, 2014 milestone for completing the Class 3 Estimate is significantly challenged at this time. As of February 10, 2014, SNC/Aecon was 32% complete in preparing its "Stage 1" CWPs, which are a needed predecessor to development of the Class 3 Estimate. SNC/Aecon reported that it had earned approximately 5% in the prior week, which was its best single week to date. If SNC/Aecon were to continue CWP preparation at this rate, it would complete this work in approximately 13 weeks, or *two months later* than its March 14, 2014 milestone. Moreover, the CWPs SNC/Aecon has prepared to date have focused largely on pre and post-outage requirements and not on the critical work, which could be even more time intensive to prepare. Regardless, SNC/Aecon's Class 3 Estimate recovery plan actually assumes it will prepare CWPs at a rate 50% faster than its best single week performance to date.

BMcD/Modus is concerned that SNC/Aecon's attempts to recover its progress on the Class 3 Estimate could be ineffective and that these delays could: (1) degrade the quality of the Class 3 Estimate; (2) impact downstream estimating activities; and/or (3) further complicate SNC/Aecon's preparation and OPG's vetting of the Class 2 Estimate. OPG's management understands and shares these concerns and is maintaining the pressure on SNC/Aecon to complete on time.

The DR Team will have a better idea of exactly how late SNC/Aecon will be in its Class 3 Estimate preparation in the next 4 to 6 weeks. Assuming the recovery of the estimate target remains difficult to attain, BMcD/Modus encourages OPG to:

- Maintain the level of focus on SNC/Aecon's progress and refresh the projected completion dates based on that progress;
- Review mitigation for receiving the Class 3 Estimate later than planned, which could impact the DR Team's initial preparation of the 4d Cost Estimate;
- Request SNC/Aecon to provide all needed resources from its team OPG will need for its review and vetting of the Class 3 Estimate so that OPG's work will not be an excuse for SNC/Aecon's delays; and
- Have SNC/Aecon provide its assessment of project contingency, which is currently not required under the RFR Contract until the end of Class 2.

SNC/Aecon's Class 3 Estimate is an important step for OPG's ability to provide a strong RQE. It is likely that the DR schedule could absorb receiving the Class 3 Estimate 1-2 months late, in particular if that estimate provides a better baseline for the 4d Cost Estimate and SNC/Aecon's Class 2 Estimate. However, the quality of the estimate needs to be fully vetted.

3. RFR Commercial Risks

As noted above, at the time OPG and SNC/Aecon negotiated the RFR Contract, it could not have taken into account recent events—in particular the unlapping of Unit 2 and many of the principles identified in the LTEP. The major provisions that the DR Team should review include:

- Performance incentives for unit-over-unit improvement – to the extent that unlapping and the LTEP have increased emphasis on maximum performance in the first unit, the parties should weigh whether the provisions that incentivize SNC/Aecon to improve from one unit to the next will promote the proper focus on successfully completing the first Unit;
- Cost and Schedule incentives and disincentives should be reviewed under the same light;
- With the award of the Turbine Generator performance work to SNC/Aecon, there are potential economies of scale that could lessen the Project's cost and risk;
- OPG and SNC/Aecon also need to agree on the RFR project risks, which risks will be shifted to the contractor, and whether such risks will be covered by the base cost (including the target price neutral band), contingency or allowed contract changes.

Because the Execution Phase contract has not technically been awarded, engaging in these discussions should just be part of the final target price negotiations. OPG should consider the timing of starting these discussions so that the current Class 3 Estimate can incorporate the necessary considerations going forward.

B. Campus Plan

The F&I Campus Plan Projects remain a significant risk to the DR Project. Through January 29, 2014, each of the 15 refurbishment prerequisite projects that are underway (including SIOs), are behind schedule, over budget or both. Some of these projects must complete prior to the VBO outage; others are not essential until Unit 2 breaker-open. However, to date, these projects appear to have been impacted by a combination of poor upfront scoping, engineering delays, lack of planning, insufficient scheduling, and significant misassumptions regarding cost and budget.

The most notable of these projects is the D20 Storage Facility, which has been delayed by unforeseen underground conditions, incomplete scoping of the work, and engineering progress. The following highlight some of the issues the project has encountered:

- Engineering for the D20 Storage Facility was scheduled to be completed by spring of 2013; now that projection is July 2014, over one full year late.
- Late tie-ins to the low pressure service water line have already resulted in a 2 month delay to the Tritium Removal Facility ("TRF") Outage completion. The D20 Storage Facility's delays have the potential to ripple into the construction of the Retube Waste Processing Building, which is being impacted by the waste pile from D20 Storage Facility's excavation.
- All of the schedule float for D20 Storage Facility has been used and if the delays are not mitigated, it will delay breaker open on Unit 2 in 2016. The current completion date for the D20 Storage Facility is projected to be April 2016, which is 6-7 months later than planned and a 3-month delay to the critical path. The operations team needs to receive this building in January 2016 in order to complete commissioning in time for breaker open.
- The budget for the D20 Storage Facility will be exceeded due to increased costs for removal of the soil, delays to the start of the caissons and other scope issues; the DR Team is currently reviewing the extent of the budget overrun.

BMcD/Modus is currently examining the root causes of the significant challenges to the D20 Storage Facility and other F&I projects that are pre-requisites to the DR Project. We have discovered some significant facts that could explain why these projects are so far off their schedule and cost goals:

- The schedule for all the Campus Plan work was initially premised on a DR Project breaker open date of October 2015. When the DR Project's start was postponed one year, these projects had more time but didn't have an additional year of float. However, not only does it appear that some of the original scheduling assumptions were erroneous, the P&M organization did not take advantage of the additional time to improve its front-end planning and reduce the overall performance risk of this work. Instead, work packages and projects simply sat in place and were not aggressively advanced.
- The D20 Storage Facility was the first EPC ESMSA project and the learning curve has been particularly steep. The P&M team appears to have underestimated the impact of the new contracting methodology for performing the work, and has been over-reliant on the ESMSA contractors.
- Initial scope identification was very limited and left open key aspects of the design. The DR Team, having observed the problems with the D20 Storage Facility, changed the process for scope identification for the other modification work, resulting in the development of the MDP packages.
- P&M accepted vendors' quotes for the work that were widely disparate, without a full understanding of what was causing the price differences. Furthermore, even though the work ultimately was to be performed on a cost

reimbursable basis, P&M significantly weighted the bid evaluation towards the lowest priced estimate, discounting a bidder's experience, qualifications and understanding of the work.

- P&M assumed that the accepted vendor quote it received could be termed a "Class 2 Estimate" even though engineering had not for advanced commensurate with such a classification. Thus, the contingency released at the D20 Storage Facility's Gate 3b was insufficient [redacted] to cover the known risks, many of which have already materialized.
- P&M's management was not aggressive enough in requiring the ESMSA contractors to submit reliable Level 3 schedules for performance of the work. Currently there are only 4 schedules loaded into the C&C Schedule from F&I work that have sufficient Level 3 detail. Moreover, it doesn't appear that P&M looked at the composite workload on each of the ESMSA contractors until the DR Team required P&M to integrate its schedules in the fall of 2013.
- F&I schedules currently carry unrealistic float, are tied improperly to ending milestones, and utilize incorrect milestones.
- There may be commercial issues getting in the way of the contractors' efficient performance. The ESMSA contractors had initially complained that the secondary compete process made it impossible for them to plan for the proper size and scale of their operations. In addition, the incentives to manage the engineering process may be lacking.

In summary, BMcD/Modus has found that P&M has clearly struggled with how to manage the ESMSA contractors in an EPC arrangement. As noted above, BMcD/Modus is currently examining the root causes of these issues. We expect to arrive at more definitive conclusions by the next NOC meeting.

In the meantime, the DR Project's and P&M's senior management have taken the initiative to call a summit with the ESMSA contractors to further examine and clear barriers to success that are impacting both the F&I and Balance of Plant ("BOP") work. In addition, P&M's and the DR Team's senior leadership are taking action to turn the performance around, including:

- Co-locating OPG engineering resources at the vendor's shops to answer questions and oversee development of the detailed design work and institute regular Steering Committee meetings with project leadership to remove performance barriers.
- Continuing integration of all of the F&I pre-requisite work into a single schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance. As part of this schedule development, BMcD/Modus sees a critical need for the DR Team, P&M and Plant Operations to conduct a joint review to confirm the latest possible delivery dates for all F&I work. Such a review needs to incorporate requisite commissioning time and resources needed for completion of the work, as well as spread resources in an efficient manner.
- Complete the work allocation to each of the ESMSA vendors so that they can properly plan their work. The DR Team has attempted to allocate the work evenly, though it may become necessary to shift work based on performance and resource availability. This becomes a more complex issue with the BOP work scope also needing attention in the coming months.
- Provide additional and focused project management support from OPG to clear barriers to engineering and execution work.
- Engage in constructive high-level dialogue with the ESMSA's senior management.

OPG Management is taking action to turn around the Campus Plan work, including bringing in new leadership for P&M and fostering greater integration between the F&I and DR Project work. The visibility of the issues P&M has encountered will help the BOP, Islanding and Services projects work with the ESMSA contractors.

C. Balance of Plant and Other Projects

In our 4Q 2013 Report, we discussed the impact of the review by the Blue Ribbon Panel of DR Project scope. The final recommendations have been made and have been reviewed through the Project Scope Review Board process. As noted on our prior reports, the process OPG used for this review was robust and consistent with the DR Project's management processes. With scope essentially locked down, the attention of the BOP, Services and Islanding projects shift to allocating the work to the performing contractors (mostly ESMSA or SNC/Aecon), completing detailed engineering and establishing target price budgets for the work. Some early indications of scope/pricing from the ESMSA have been mixed. For one such work package, the contractor misunderstood OPG's requirements and submitted a bid premised on re-performing a significant amount of the engineering work that OPG had already performed. The DR Team has rejected these proposals and clarified its requirements, which is delaying the issuance of this work package. The DR Team has increased the time for verifying estimates (from one week to two weeks) to ensure the contractors' pricing and scope are properly aligned. We have recommended the DR Team further align this process by requiring the ESMSA provide its detailed estimates in a manner that facilitates comparison with the internal check estimates from Faithful & Gould. These actions should improve the quality of future ESMSA estimates, though this bears close attention.

IV. Functional Groups Update

A. Engineering

1. Scope Definition

The DR Team has placed significant emphasis on defining scope well in advance of RQE and has set critical milestones for measuring scope definition. One such goal is achieving "Health of Scope" to support detailed design work. The DR Team reports that it is on target to achieve Health of Scope 4, in which all modification work will be known, by the October 2014 milestone. The team's ability to meet this milestone was greatly enhanced by the work of the Blue Ribbon Panel.

Through the end of January, 2014, Engineering had completed 112 Modification Design Packages with 27 known packages remaining. This represents excellent progress over the last year, and the May 2014 milestone for completing MDPs should be met.

2. Planning of Engineering Work

As recommended in the BMcD/Modus 4Q 2013 report, OPG's Engineering attention has shifted from the Definition Phase to planning the next design phases, utilizing the Construction Industry Institute's ("CII") ***Front End Planning for Revamp and Renovation Projects*** as a source of industry best practices. OPG's focus on planning has initiated a 'bottom-up' work hour estimating process for engineering activities that will lead to a more precise resource forecast. Engineering also initiated the use of an engineering deliverables-based blackout chart, the development of which has identified additional issues with the integrated Level 3 schedule that should enhance the coordination of interrelated activities.

Engineering's focus on planning has also brought attention on the engineering partners of the ESMSA vendors who are responsible for the detail design phase for BOP and F&I work. As noted, ESMSA engineering performance on the F&I projects has been lagging. The DR Team is now taking a much more active role in the management and execution of the F&I projects, and has sought alignment between OPG and the ESMSA's engineering companies' senior management.

The EPC requirements in the ESMSA contracts have compelled constructors and engineering companies who were not previously partnered, to join forces. In our experience, joint ventures of this nature can take several years and several project cycles to mature. The ESMSA joint ventures are still on the early part of this learning curve. The shift within OPG to greater reliance upon external service providers has resulted in some duplication of work effort, churn and mistakes by the ESMSA vendors along with OPG's late recognition of its essential role in managing these vendors. OPG Engineering is moving away from a culture of "observation at a distance" to a much more proactive engagement and active management of the engineering service providers. We continue to encourage this shift in role and perspective.

B. Project Controls

1. Schedule

As discussed above, the DR Team's project controls staff has developed a plan for integration of the prerequisite F&I work, calling for full development and integration of the Level 3 schedules for all sub-projects by the responsible ESMSA vendor. This integrated schedule, database in combination with the DR Project integrated schedule, will allow for timely project status and schedule analysis as well as a more cohesive decision making process regarding work flow and resources. This technique is being put in place and utilized by P&M for all of the F&I projects allowing for composite resource analysis, most importantly by the ESMSA vendor resources. Because this process is vitally important to the success of the DR Project, compliance by the P&M organization (including the ESMSA vendors) is imperative.

Until this quarter, the P&M organization has had little success accomplishing the development and integration of the ESMSA vendor schedules. In fact, the number of vendor-developed Level 3 schedules has lagged significantly behind the work. The lack of properly developed, integrated and resource loaded Level 3 schedules has made it impossible to evaluate ESMSA resource needs critical to the DR Project. Furthermore, the lack of an integrated schedule has made critical analysis of the potential impact of delays to the DR Project milestones impossible, and perpetuated the assumption that the F&I work had months of float.

Recent success by the teams working to implement the schedule integration plan has been encouraging and ESMSA scheduling work is improving. P&M and DR Team leadership are now providing clear and concise definition of the division of responsibility between the DR Team, P&M project management and the ESMSA vendors and improving the working model. Meanwhile, the DR Team has identified the points of impact at which the F&I projects could cause delay or changes in execution methodology. These points are now set in the Refurbishment schedules awaiting work ties by the ESMSA vendors so that impacts can be evaluated.

To further facilitate the schedule development, BMcD/Modus recommends that a composite team (DR Team, P&M and Plant Operations) review the F&I schedules developed to date in conjunction with a re-evaluation of the impact points and milestones critical for delivery of the prerequisite projects. This analysis will comprise a review of individual project logic combined with an evaluation of the proper inter-project and milestone logic, sometimes termed a "backwards pass" analysis. This review should also develop a prescriptive plan for final F&I schedule development aligned with the current Level 3 DR Project compliance requirements. The project controls team should prepare a follow-up analysis that focuses on resource loading by the ESMSA vendors. Studies determining regional resource availability requisite with the project needs shall be conducted parallel to this development. Prompt identification of issues related to resource availability have to be quickly identified and fact based in order to properly address and/or provide mitigating actions to alleviate.

2. Project Cost/Estimating

As noted, BMcD/Modus is currently examining the root causes of the budget variances apparent in some of the F&I work. As part of this analysis we will review the initial pricing responses on BOP work to see if they suffer from some of the same noted deficiencies. The DR Team prepares independent estimates of the work for planning and budgeting, as well as providing a check against the contractors' pricing. For the BOP work, these estimates will form the first check against the completeness of the contractor's budget; thus if these estimates are wrong, this would greatly complicate development of the 4d estimate and RQE. We are also examining the commercial risks present in the ESMSA contracts to test if there are provisions that are causing poor behavior by the two contractors. We expect to arrive at more definitive conclusions by the next NOC meeting. The project controls team and the estimating vendor (F&G) are performing their own series of self-assessments and quality reviews on the estimating process.

3. Risk Management Program

As a part of our commitments under the 2014 Assurance Plan, we performed a detailed assessment of the Darlington Refurbishment's Risk Management Program in the fourth quarter of 2013. The purpose of this assessment was to review

the status of the areas identified for improvement in our August 13, 2013 comprehensive Project Assessment Report. From Mid-July through the end of December, BMcD/Modus monitored and assessed the DR Team's actions regarding the Risk Management Program and note progress in line with our initial observations and recommendations. Although the DR Team still has work to do to effectively implement the program, numerous improvements have been initiated that address matters such as:

- Greater emphasis on risk identification clarity and the progressive elimination of "business as usual" items from the Risk Registers;
- Some formal training has been conducted;
- Improvement to the Risk Register Reports;
- Consolidation and clarification of the applicable risk procedures; and
- The Risk Group has taken a more aggressive role in managing the Risk Management Program.

However, the DR Team has not completed implementation of these essential improvements. The DR Team needs to continue to scrub and clean the risk registers in order to make them an effective tool. The risk reporting tool is somewhat cumbersome and is difficult for end users to sort and analyze information; thereby hindering the effective development and management of mitigating actions. The DR Team has commenced some formal training on the Risk Management Program, however, there needs to be more as evidenced by the current state of the Project Risk Registers. While we have seen some evidence that the Planning and Controls Risk Group has taken a more active role with respect to the implementation and management of the Risk Management Program, we would recommend much more attention in this regard. Additionally, we have not seen much improvement with respect to the identification of opportunities or the development of useful metrics. **Attachment B** to this report is a table which shows the trending on the various areas of the Risk Management Program.

V. Other Project Risks

A. Project Team Development

Some of OPG's procedural and process changes in response to the Auditor General's Report have increased the risk of key personnel leaving the project and will make the hiring and retention of experienced resources more difficult for the DR Project. Enterprise Risk Management carries the retention of key personnel as the biggest program risk to the DR Project, and we would agree that it is certainly among the DR Project's biggest challenges.

BMcD/Modus has pulsed the succession and workforce planning as well as the current and projected staffing levels and found that the DR Team's management is properly focused on this risk. However, the team could benefit from more formal procedural guidance. The unlapping of Unit 2 has also relieved some pressure for immediately staffing the Project Team for the next units.

B. Program Management Plan Development

BMcD/Modus monitored the 4Q 2013 update of the DR Team's Program Management Plan ("PgMP"), the primary purpose of which is to demonstrate how the project will be planned, executed, monitored, controlled and closed. A well-constructed PgMP provides a descriptive link between the Project Charter and the lower level procedures; thus, it should be an informative guide for team members and stakeholders alike and subsequent revisions should provide a progressive elaboration of the program management team's plans as they continue to develop.

We found the current state of the DR Team's PgMP to be lacking in detail and clarity. The individual work plans within the PgMP were of inconsistent quality and depth, and these plans were not integrated in a comprehensive fashion. Moreover, the PgMP did not eliminate many of the procedures that are no longer needed or applicable for this work. We would recommend that management make completing the PgMP a priority.

Attachment A

1Q Risk Perspective

Report to Nuclear Oversight Committee

1st Quarter 2014

Darlington Nuclear Refurbishment Project

MODUS Strategic Solutions CANADA

Attachment A – 1Q 2014 Risk Perspective

Burns & McDonnell CANADA

Area	Observations	High / Medium / Low	Current Status / Mitigation
RFR	**SNC/Aecon Performance**: Largest Program risk due to overall risk to the DR Project and OPEX		▸ Tooling milestone (June 2014) will be missed; approx. 2 months late ▸ Tooling and procurement recovery plan in place, showing improvements ▸ Mock-up is substantially complete
	Class 3 Estimate: Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted		▸ Completing estimate to OPG standards by May 15, 2014 will be challenging ▸ Ultimate goal of delivery by August 2014 is acceptable ▸ Monetizing contingency remains a risk
	Schedule Development: Level 3 schedule based on payment milestones; unrealistic task durations		▸ SNC/Aecon's progress is measured via the target schedule, not payment milestones ▸ SNC/Aecon has added resources and improved schedule, reduced float
	RFR Commercial Risks: Contract provisions currently in place may not drive desired performance		▸ Negotiation of the Execution Phase target price should revisit incentives and disincentives
Campus Plan	**ESMSA Performance**: D20 Storage Facility work is behind schedule and causing critical path to the TRF		▸ Lessons learned are being collected and disseminated ▸ Project costs are increasing and likely to exceed budget ▸ Vendor performance/unforeseen issues remain significant risks ▸ DR Team is reviewing extent of D20 budget overruns ▸ Similar trends are being observed with several other F&I projects; budgeting process is being investigated
	Engineering and Planning: D20 provides key lessons learned for remaining Campus Plan and BOP		▸ Engineering is co-locating with ESMSA vendors ▸ Clarification of RFPs and process ongoing ▸ Modifications to planning and scheduling underway
BOP	**ESMSA Performance**: Concern over ESMSA contractors' performance and ability to execute BOP work		▸ Allocation of work underway; some issues with cost/scope estimates ▸ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed
Engineering	**Scope Review**: Urgency mounting for scope review; planning/prep underway for work that may be eliminated; concerns regarding scope		▸ PSRB has approved final scope recommendations ▸ Final scope closure report has yet to be issued
	Planning of Engineering Work: Engineering work was not well understood and is poorly planned		▸ "Bottoms-up" estimating process initiated for engineering activities ▸ Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place ▸ OPG has fostered alignment with the senior management levels of the ESMSA engineering vendors

Attachment A – 1Q 2014 Risk Perspective

MODUS Strategic Solutions CANADA

Burns & McDonnell CANADA

Area	Observations	High / Medium / Low	Current Status / Mitigation
Project Controls	**Continued Schedule Development**: Schedule approach was unproven; integration at appropriate level at risk		▸ Project Team is moving toward industry-wide recommended practices for scheduling ▸ Substantial work remains to populate detailed level 3 schedule
	Progress Towards RQE: The plan for developing RQE is being developed.		▸ RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs. ▸ The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.
	Risk Management Program: Risk registers require scrubbing; monitoring tools are cumbersome		▸ DR Team is cleaning up the risk register and improving reporting ▸ Risk Group is taking a more active role in managing the Risk Program ▸ Risk training is being conducted

Attachment B

Summary Table from Risk Assessment Assurance Report

Report to Nuclear Oversight Committee

1st Quarter 2014

Darlington Nuclear Refurbishment Project

Attachment B

Summary Table From Risk Assessment Assurance Report

Area	Observation No.	Comments	Change from Previous Assessment
Risk Register Reporting Limitations	1	Migration to SharePoint and Excel reporting tool have increased reporting functionality, but there are still limitations.	⇧
Lack of Clarity of Risk Titles and Descriptions	2	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	⇧
Numerous Entries in the Risk Registers are not "Risks", but Business as Usual "Issues"	3	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	⇧
Lack of Appropriate Risk Management Program Staffing & Leadership	4	There will be some significant changes to the Risk Group in January. This issue will have to be monitored once the new team is in place.	⇔
Risk Management Program Training	5	There has been a concerted effort to implement formal training by the Risk Group	⇧
Missing Identification of "Opportunities"	6	There has been no effort to identify opportunities within the risk register.	⇔
Weak Risk Responses	7	The key to a successful Risk Management Program (and overall project success) includes the thoughtful development of effective Risk Responses (e.g. mitigating) actions. Based solely on a review of the Risk Registers, many risk responses appear to be perfunctory and ineffective.	⇧
Long Periods Between Risk Register Reviews and Updates	8	Efforts to update all risks have caused more frequent review of risks. OPG should consider having ROC meetings more frequently than once per quarter.	⇧
Risk Oversight Committee Effectiveness	9	Three meetings have been held to date and, as the risk program matures, they are progressively improving by focusing less on process and more on substance.	⇧
Lack of Trending and Other High-Level Metrics	10	There was no change as of the end of December. However, we have noted some improvement in this area in the last couple of weeks. New metrics are being developed, but not yet rolled out.	⇔

Legend: ⇧ = improved, compared to Project Assessment
⇩ = weaker, compared to Project Assessment
⇔ = no change, compared to Project Assessment
⇔ = no change

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Report to Nuclear Oversight Committee

2nd Quarter 2014

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

May 13, 2014

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of April 30, 2014. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015.

BMcD/Modus has continued to stress the importance for OPG to embrace its role as the integrator of the work and to actively manage the multiple contractors. To this end, the DR Team has made a significant shift in engineering strategy and will now directly manage and supervise the engineering service providers, rather than continuing the previous "hands-off" oversight approach. This is a bold but necessary move and one that is endorsed by BMcD/Modus. If OPG manages this transition well, we would expect a significant increase in engineering efficiency.

Pursuant to the Project's Assurance Plan approved by the Audit & Finance Committee, BMcD/Modus has prepared independent reports documenting the DR Team's status as well as further recommendations for improvement. This quarter we have issued Assurance Reports based upon our detailed review of: 1) DR Project Schedule Process and Development; 2) the 2013-2014 Business Plan as it relates to the latest project estimate (the "4c Estimate") and 3) Scope Status and Process. Upcoming reports will focus on our review of the Campus Plan cost and schedule overruns, 4d Cost Estimate vetting and RQE preparation. These full reports will be available for the NOC's review. In addition to our regular, everyday contact with the Project Team, we will continue to meet periodically with the Refurbishment Project Executive Team ("RPET") to discuss our reports to NOC and our Assurance Reports in order to clarify any recommendations and engage in discussion of appropriate actions. We are also coordinating our efforts with Internal Audit so that we meet our assurance commitments in an efficient and effective manner.

Much of our focus in this quarter's report was on evaluating the performance of the pre-requisite Facilities and Infrastructure projects ("F&I" or "Campus Plan Projects"). The Campus Plan Projects remain a significant risk to the Refurbishment Project, and provides important lessons learned for the DR Project.

The following is a brief summary of the DR Project's most significant developments over the last quarter:

- **Campus Plan Performance Project Risk:** Many of the Campus Plan Projects are forecasted to complete significantly beyond the approved budgets and schedules. In fact, schedule adherence is so poor that the Campus Plan work poses multiple threats to the start of Refurbishment. Over the last quarter, BMcD/Modus has engaged in a thorough review of several key Campus Plan projects in an attempt to identify trends and understand the causes of these cost and schedule overruns. Our findings show that the predominant cause was OPG's Projects & Modifications ("P&M") organization, who is managing this work for the DR Project, incorrectly applied an "oversight" project management approach for its EPC contracting strategy, leading to a series of cascading management failures and contractor performance issues, including misunderstandings of scope, uncontrolled scope creep, poor quality cost estimates, unrealistic and incorrect schedules and an inability to manage known risks, additional costs and delays. For multiple reasons described herein, P&M was completely overwhelmed in trying to manage Campus Plan Projects – in particular, the two largest of these projects, the D2O Storage Facility and Auxiliary Heat Steam Plant ("AHS") which were the "pilot" projects for this new contracting model.

  Simultaneous to our review, the P&M team's new leadership has taken aggressive action to correct as many of the major issues as possible. In acknowledgement of many of our recommendations and as a result of its own findings, P&M, the performing Extended Services Master Service Agreement ("ESMSA") contractors and the DR Team are developing more realistic project schedules for each scope of work that will account for need dates, available resources and optimal work flow. Senior management has committed to a full reforecast of the cost of each of the Campus Plan Projects, starting with the two most notable problem projects, the D2O Storage Facility

and AHS. P&M's and the DR Team's senior leadership instructed their managers to actively manage the work henceforth through increased collaboration with the contractors. In particular, OPG's engineering team will be taking on a much more active role in directly managing the remaining engineering work. While these measures are much more likely to be successful, the damage to a certain extent cannot be fully mitigated, as the affected Campus Plan Projects will cost more, finish later and pose a much greater threat to Refurbishment than management initially realized; this is in large part due to the unrealistic nature of P&M's initial project budgets and the way in which scope crept into these projects after these initial budgets were approved. We recommend that OPG look at the impact of these Campus Plan Projects on the Definition Phase budget as soon as possible. Moreover, P&M can only hope to recover these Campus Plan Projects if it receives support from OPG's corporate functions, from whom P&M will require fast action and some needed modifications to processes. Our team has been engaged in closely monitoring the recovery plan and will continue to report on P&M's progress. Our observations and recommendations with respect to the Campus Plan performance to date are summarized in this report and will be the subject of an Assurance Report we intend to issue at the conclusion of the 2nd Quarter.

- **RQE Preparation**: RQE development remains essentially on schedule, though the development of the 4d Cost Estimate will be a good test of the DR Team's preparation. Senior management has introduced two new controls to the Project to aid in this endeavor: 1) an Options Review Board chaired by the Senior VP of Refurbishment that is vetting the maturing plans for each scope of work, and 2) a Readiness Schedule and related process which will hold the project managers accountable for meeting interim preparation milestones. These are good measures that will provide additional confidence for RQE. In addition, all of the major Project Bundles except for the Steam Generator Project will be going through Gate 3 prior to the fall of 2015, which should provide the DR Team with an opportunity to re-examine these sub-projects' business cases including scope alternatives, status, methods of delivery, cost estimates, schedules and risks. Strengthening the gate process as we have recommended will provide further levels of vetting for the work planning and should streamline the DR Team's approach to the 4d Cost Estimate.

- **Retube & Feeder Replacement Project Risks**: The RFR project remains the DR Project's most notable ongoing risk, with respect to the Execution Phase as it represents the majority of the work on the Critical Path. SNC/Aecon's performance trends during the Definition Phase needs to be taken into account in the vetting of its Class 3 Estimate[1] (an estimate with an expected accuracy range of between -10% on the low side and +30% on the high side after the application of contingency) and OPG's confidence level for the Execution Phase. Through March 31, 2014, the contract is underspent by $9 M against plan, though this gap is closing. Additionally, SNC/Aecon's cumulative schedule performance index ("SPI") has improved to 0.94. As noted in our last report, SNC/Aecon's original plan to complete tooling delivery by June 2014 will not be met, and aspects of its recovery plan dates are being challenged by further supplier delays. SNC/Aecon has committed to recover these dates and is reassigning work to different suppliers, though the impacts of these delays could be felt in the tool performance guarantee period. OPG's RFR team is closely monitoring these events and holding SNC/Aecon accountable.

  With respect to the Class 3 Estimate preparation, SNC/Aecon met its internal goal of March 15, 2014 to produce construction work packages ("CWP's") and has progressed with its other key deliverables, including the detailed Level 4 schedule. However, the compressed time frame during which SNC/Aecon produced all of these estimate components has put the onus on OPG to review, comment and rationalize SNC/Aecon's estimate by June 15, 2014, which will take considerable effort and coordination. Ultimately, SNC/Aecon must provide OPG with comfort that the Class 3 Estimate meets its committed level of accuracy. Equally important is how the Class 3

[1] Estimate accuracy is classified per the Association for the Advancement of Cost Engineering International (AACEi) standards Class 1 through 5. Class 1 is the most accurate.

Estimate forms the platform from which the Class 2 Estimate (with an expected accuracy range of -5% to +20%) will be developed for RQE. As discussed below, there are some commercial opportunities OPG must weigh that could impact the cost estimate as well. Given its high importance to the overall project, BMcD/Modus sees OPG arriving at an appropriate comfort level with the Class 3 Estimate as essential to tightening the project's cost estimate, and we would recommend the team take any reasonable time and action needed to reach that level of comfort.

- **Commercial Risks:** The Project Team has taken our recommendation to review commercial incentives and disincentives in the Project's major contracts in light of some changed planning basis and assumptions—including the Shareholder's mandates set forth in the LTEP, the unlapping strategy and the evidence to date of contractor performance. The DR Team took an action to develop a negotiation strategy with SNC/Aecon that will take into account the impact on their work caused by the unlapping Unit 2, prioritization of Unit 2 performance, potential for economies of scale with the Turbine Generator work and other key considerations. Regarding the ESMSA, senior management is instituting a number of changes to managing and executing the EPC model that has proven to be ineffective at driving performance, cost and schedule compliance and reducing OPG's risk. [redacted] and OPG theoretically has both the expertise and the essential knowledge needed to more effectively manage this work. Going-forward, it is OPG's intention to take a much stronger role in managing and directing the engineering portion of the work. In doing so, it will be important to for OPG to understand and communicate the impact of the shifting of risk for this added responsibility as well as any impact to warranties provided by the contractors. The success of this new strategy will depend on OPG's ability to attract and retain talent and OPG's ability to drive change down through its organization to implement a new project management philosophy.

Other ongoing challenges to the DR Project include the development of the DR Team for the Execution Phase, further refinement of the Risk Management Program and Fuel Handling work. Attachment "A" provides an update regarding the DR Project's risks.

II. Summary of Campus Plan Root Cause

A. Overview

The Campus Plan Projects consist of 26 separate scopes of "pre-requisite" work that are needed to support the DR Project or the station's operations during construction. These projects are being managed by OPG's P&M organization. Prior to this Campus Plan work, P&M executed capital projects for the stations, with annual budgets of approximately $300M. With the advent of the DGNS Refurbishment Project, senior management sought to use P&M to develop and oversee all of the Campus Plan Projects, allowing the DR Team to focus on planning for the DR Execution Phase. The inclusion of the Campus Plan Projects caused P&M's portfolio to increase by four to five times, and the scale and technical complexity of this work was unprecedented for this organization. At the same time, OPG was under pressure to decrease its staff in line with the Shareholder's requests. As with many utilities in the US, OPG who had once had a very large construction unit that built the current stations and Bruce, and as recently as Pickering A Unit 1 RTS Project in the mid-2000's had considerable in-house construction, planning, procurement and engineering resources, was shrinking even further and the capability for managing and directing large capital projects was sacrificed.

From 2010 until July 2013, P&M was led by its former VP [redacted]. [redacted] ultimately succeeded [redacted] in January 2014. P&M's governance, including most of its business and management processes, were separately developed and maintained from those used by the Refurbishment Project. Also, P&M negotiated and utilized the Extended Service Master Services Agreement ("ESMSA") contract and the two "ESMSA Contractor" consortiums led by Black & McDonald and ES Fox. The ESMSA contract is actually a mix of multiple standard form agreements that could be used in combination depending on the circumstances – e.g. there are separate forms for engineering, procurement and construction that could be combined into an "EPC" contract. The business deals with the ESMSA Contractors were

the result of a competitive process which resulted in the contractors agreeing to some unique provisions that are used for all contracted work with these vendors. As an example, when used as an EPC, the contractors who lead these consortia are required to bid engineering work on a fixed-price basis with no profit for themselves. The construction work is all cost reimbursable target price, and the performance incentives include up to a 50% reduction of profit, though this and some other disincentives built into the contract have proven thus far to be much less effective in practice than concept at driving the contractors' behavior and performance.

The impetus for having P&M execute the Campus Plan work was that through the Definition Phase of Refurbishment, the DR Team was not assembled as an execution organization, but a planning one. P&M was an existing service resource with some experience in managing the ESMSA contractors. P&M's work on the Campus Plan Projects is funded by Refurbishment and it must report its progress to Refurbishment, though these business units are otherwise autonomous. Until recently, other than these approvals and the fact that both organizations use the ESMSA Contractors, there was very little else in common between Refurbishment and P&M, including the project management procedures utilized for their respective projects. P&M's project management procedures were not developed to manage multi-year projects of the size and scope of some of the Campus Plan Projects. Over the last several months, P&M has begun to manage the Campus Plan projects in accordance with the project management procedures developed for the DR Project in an attempt to implement industry-standard risk, cost and schedule controls. Additionally, the new VP has implemented a series of organizational and strategic initiatives with the goal of improving performance.

As of April 2, 2014, the Campus Plan Projects are estimated to cost in aggregate approximately $660M (an increase of $111.5 Million over the Board of Directors approved 2014 Business Case release for this work) and the work varies widely in size and complexity. The performance of the work is largely split between the two ESMSA contractors, Black & McDonald and ES Fox. Deadlines for completion of these Projects vary based on the project's and stations' needs; AHS is scheduled to be complete prior to the DNGS Vacuum Building Outage ("VBO") in mid-April 2015, while all the remaining work is scheduled to be completed one year later, in April 2016, to allow enough time for commissioning prior to the October 2016 Refurbishment Project's breaker open milestone. Many of these Campus Plan Projects involve the construction of commercial buildings that are made more complex because of their location on or adjacent to the nuclear island, which impacts their associated design requirements for such things as nuclear safety, security, and seismic requirements. Additionally, these are brownfield projects on a site where soil quality issues and underground interferences are the norm and coordination with the operation of DNGS must be managed.

Over the last quarter, BMcD/Modus has engaged in a number of activities related to the Campus Plan Projects. In this regard, we have:

- Reviewed the reasons for significant cost variances in five of the largest Campus Plan and Prerequisite Projects: D20 Storage Facility; Auxiliary Heat System Building ("AHS"); Water & Sewer; RFR Island Annex Building ("RFRISA"); and Retube Waste Processing Building ("RWPB"). Our goal was to determine the root cause of the Campus Plan Projects' variances so that past mistakes will not be repeated. We chose to examine the RWPB, which is being built by SNC/Aecon and managed by the DR Team, for a real-time direct comparison with the ESMSA-managed projects.
- Reviewed the Campus Plan Projects' schedules prepared by the vendors to identify any major gaps. This review led our team to make a series of recommendations to the P&M and DR Teams, and our subsequent monitoring of progress of the vendors' ongoing redevelopment of their detailed schedules for each of the major projects.
- Examined the risk management process within the P&M organization, including its ability to properly identify, avoid, mitigate and monetize risk.
- Reviewed the design and scoping process and identified the causes for the extreme inaccuracy of the vendors' engineering cost and schedule estimates.

- Reviewed the management structure and capabilities of the P&M team that started this work down the current path. We have also spent time with P&M's new VP and members of P&M's restructured leadership team to convey our findings and recommendations and gauge the effectiveness of P&M's current initiatives to improve performance and mitigate these earlier management failures.

As noted, these Campus Plan Projects have been plagued by myriad problems that have resulted in significant schedule and cost variances. Our findings show that the predominant cause of these overruns was P&M's original strategy to use a project "oversight" management model for the EPC contracting strategy utilized by OPG that was inappropriate in application and lead to a series of cascading management failures and contractor performance issues. The oversight management model employed a disengaged, "hands-off" approach by the P&M organization which caused the fledgling P&M organization to: (1) wrongly assume that the contractors understood the scope on the basis of performance specifications that outlined scope initial requirements; (2) utilize inexperienced project managers; (3) allow Operations & Maintenance and other OPG stakeholders to initiate scope changes to these projects long after the conceptual design period ended; (4) to accept the poor schedules and cost estimates by the contractors without appropriate vetting and challenge, and which were not updated to incorporate the impact of scope changes on a timely basis; and (5) to inaccurately or untimely report the projects' progress, risks and cost and schedule overruns to the DR Team and senior management.

B. OPG Contractor Management and Contractor Performance

1. Summary

Based on the information we have reviewed, it is apparent that P&M put excessive faith in the ESMSA Contractors' ability to perform this work and an over-reliance on the perceived ability of the EPC contracting model to shift project risk to the contractor and alleviate the need for active project management. As a result, OPG chose to provide oversight of the contractor's work at arms-length. In a recent self-assessment related to the D2O Storage Project's delays, the P&M Project team ("P&M Team") noted that at the onset of the Project, P&M believed "the EPC Process" would mitigate known risks via "project efficiency gains due to the expertise and autonomy of the contractor."[2] This exemplified OPG management's initial hands-off approach to project management that P&M piloted under which the contractor was given autonomy to develop its own scope requirements without process monitoring. As noted in P&M's self-assessment, this model resulted in "unclear expectations, re-work, frustration."[3] P&M's error was misunderstanding the essential nature of the ESMSA contracts, which are not fixed-price EPC contracts that shift all risk and responsibility for performance to the contractors (nor were they ever meant to be). The majority of the Campus Plan Project's execution cost is being performed on a cost-reimbursable target price, where contractors have only a portion of their fee at risk in the event that the target price is exceeded. In our experience, the nature of this work (refurbishment and construction of new facilities on an operating nuclear site) and the fact that the contract is cost reimbursable, require the owner to engage in active management of the contractors and coordinate interfaces. This means providing very specific instructions to lock down scope at the project's conceptual design phase and holding the contractors accountable on a daily basis to meet expected cost and schedule.

- Moreover, it is apparent that the P&M Team did not have the necessary experience, training or internal management direction to properly manage this work. Attachment B is a matrix that provides a summary of our observations regarding the five major ongoing F&I Projects. This matrix shows, among other things, that in the management of the work, P&M:
- Routinely accepted poor quality schedules and cost estimates without adequate vetting;

[2] SCR Number D-2013-19100, January 22, 2014.
[3] Id.

- Mischaracterized the nature of these estimates by assuming anything provided by a contractor was at a very high level of maturity (Class 3/2) when such estimates were based on conceptual (at best) engineering, meaning these estimates could not have been better than Class 5 (-50% to +100%) in nature;
- Failed to establish accountability standards for the contractors;
- Failed to identify or mitigate known risks;
- Did not effectively react to problems when they materialized and accurately and timely report the extent of cost overruns, schedule delays and scope increases to senior management;
- The P&M Team did not seek to lock down the scope at start of this work and allowed the "customer" – Operations and Maintenance – to make significant changes to the design that were not properly understood, quantified or captured in subsequent reports to senior management; and
- The ESMSA contractors contributed to the problem by not transparently reporting or timely identifying how these projects were evolving and failing to provide any reliable metrics—cost, schedule or otherwise – that informed OPG of these brewing problems.

2. Indicative Projects - D2O Storage and Auxiliary Heat

In our analysis, BMcD/Modus examined five separate projects in detail, and each exhibited some or all of the management issues to some extent. Attachment C is a brief summary of each of these projects' cost overruns.

The management failures we observed were most evident and acute with the D2O Storage and AHS projects. These projects were the "pilot" EPC projects for the ESMSA contractors—[redacted] In both cases, P&M sought the Board's full funding approval at a point when very little design was done, only to have to later seek additional funds from the Board once design had matured.

a. The Flawed Bidding/Estimating Process

P&M's management failures can be seen throughout the planning and execution phase of the project. Notable from OPG's initial negotiation and acceptance of bids for this work is P&M's mischaracterization of the vendors' estimates in the approved Business Case Summaries ("BCS"). In August 2011, OPG produced a BCS for D2O Storage that estimated its cost at $210.6M, [redacted] At the project's next gate in June 2012, the estimated cost had dropped from $210M to $108M. However, BMcD/Modus could not find any attempt by P&M to rationalize or otherwise explain how the cost estimate for this building was cut virtually in half from one approval gate to the next. Moreover, the estimate for design and construction was $52.2M, which P&M characterized as a "Class 2 Estimate" despite the fact that at the time of the estimate, Black & McDonald had little experience with this type of construction and had performed no engineering or scope definition. Thus, this estimate was more likely a Class 5 Estimate. In retrospect, it is likely that the initial $210M estimate was more accurate; however, it is certainly clear that the approved $108M estimate should not have had any greater accuracy attributed to it, since it was not based on a significantly greater level of project maturity. Likewise, the AHS BCS was termed a "Class 3" Estimate, though it was similarly immature.

This estimate classification drove P&M to vastly underestimate the amount of contingency associated with each package. There is no evidence that P&M engaged in the type of vetting of the estimates that we would expect on projects of these size and importance. From interviews with the current P&M staff and the contractors, it appears that these initial BCS estimates were poorly characterized as part of a deliberate management strategy directed by the former VP of P&M. P&M's managers told us that the contractors were challenged to reduce their bid prices and remove all contingencies for unknowns, despite the extreme immaturity of project definition underlying their respective bids. As

an example, for the D20 Storage project, Black & McDonald was told to remove from its contract price any contingency for unforeseen soil conditions, even though there was a high likelihood that there would be contaminated soil issues. Moreover, P&M clearly overvalued price as a consideration in the contractor selection process, especially in light of the fact that the work was going to be performed on a cost-reimbursable basis and the bid prices were not binding.

P&M gave only token consideration to determining which contractor had a better approach for executing the work. P&M chose the "low bidder" even though the other contractor's qualifications and project approach were viewed more favorably. Thus, P&M created the conditions for a perfect storm of cost and schedule overruns. Because the work is largely based on a cost-reimbursable target price with no caps on size, P&M's artificial beating down the contractors' prices in the bid phase was a Pyrrhic victory: P&M's actions did not reduce cost and only served to deprive senior management of realistic cost projections for this work. The budgets for these and other F&I projects were nothing more than paper barriers that were easily surmounted as the design work continued to generate more complex (and expensive) work.

b. Lack of an Integrated Schedule

Until April 2014, the P&M project teams for D20 and AHS were working without a reliable, integrated Level 3 Schedule. Many on the project and throughout the OPG organization were given a false impression that the Campus Plan Projects, and D20 in particular, had a year of float, and so on-going delays had no impact on the Project. The delays to D2O Storage's schedule were not forecasted by the project team and were simply reported after the fact. By this point, the schedule had already slipped so that engineering was on its way to an 18-month projected overrun of an original 11-month schedule. However, without a resource-loaded, level 3 schedule, it was impossible to assess the status of the project, let alone calculate with any accuracy any remaining float.

One of the strategic initiatives was implemented by the new P&M VP was to improve the projects' schedules. This endeavor allowed the project team to see that D20 Storage was actually projected to be completed on April 26, 2016, more than a year after the original April 15, 2015 deadline. Furthermore, once known risks are factored in, it is likely that the D20 project can only achieve this revised date if some of the schedule durations are accelerated—at an additional cost. Even then, these efforts will not improve completion of the schedule by much, but will increase the probability that the April 2016 date can be met. However, none of this would be known if efforts had not been made to improve the schedule.

c. Risk Management

Based on our observations, it appears that all P&M's identification of risks is a "check-the-box" activity due the fact that having a list of risks is a prerequisite to obtaining a funding release. P&M does not actively manage its on-going risks as a part of an effective risk management program. As an example, the risk sections of the D20 and AHS BCSs consist of lists of potential risks and some evaluation of their nature, but it is not apparent that these risks in any way influenced the calculation of these projects' contingency, nor are there any regular reviews or updates of these risks until required to do so in order to pass a gate and obtain a funding release. Once a project obtains full funding for execution, very little, if any, attention is paid to day-to-day risk management, including the ongoing identification of new risks and opportunities as well as the formalized implementation of risk mitigation strategies. Additionally, there is no structured or defined risk program management oversight (such as the NR Risk Oversight Committee).

A recent self-assessment performed by the NR Management Systems Oversight group (SA RF13-000855 dated January 20, 2014) identified perceptions (opinions) of several P&M managers that included the following: "[D]evelopment and use of a Risk Register is seen as purely administrative and not adding value to the Project Managers." This suggests a lack of understanding of the value of a risk management program or lack of acceptance, which can be addressed by effective training and indoctrination. However, risk management training is virtually non-existent in the P&M organization in distinct contrast to several years ago when quarterly workshops were regularly conducted.

d. The Gate Process and Failure to Report Cost and Schedule Increases to Senior Management

BMcD/Modus next explored the relative effectiveness of the gate process for this work, and found that while the process in concept is a good one, it suffers from problems in execution. The BCS documents for D2O Storage and AHS were inconsistent in presentation of key information on cost, risk and scope. As these projects progressed, P&M's management failed to provide visibility to OPG management of the extent or nature of project cost increases. Most notably, P&M failed to update its project reports during the design phase to reflect cost increases due to scope changes in the projects.

AHS provides a critical example. On November 12, 2012, P&M presented its Gate 3A package for approval and full funding release (except for a small portion of costs to be approved in 2014). The P&M Team's gate presentation characterized the AHS cost estimate as a Class 3 estimate in the amount of $45.6 M. P&M included [redacted] of contingency in the $45.6M estimate, of which [redacted] was identified as having a 100% chance of occurrence. P&M expressed an "85% confidence level" in this cost estimate and assessed there were [redacted] days of schedule contingency in the estimate—despite the fact that the full scope of the project was not known at that time because detailed engineering had not started. The option of building a new AHS was preferred over seven alternatives, based primarily on the projected cost. At the time of this gate, the project had spent $1.46M.

Between this gate and January 2014, ES Fox engaged in the design of the AHS, scope changes caused the cost to increase from the initial $45.6M estimate to $79.9M. This cost increase is largely attributable to two causes: (1) remediation of contaminated soil that as of the time of bid was known by both OPG and the contractor to be of poor quality; and, (2) prescriptive design requirements that served to make a stock steam boiler design follow nuclear Engineering Change Control ("ECC") processes, which caused an increase in the size, complexity and nature of the work. Moreover, these design requirements and the overall length of the design phase, coupled with the soil issues, has frittered away virtually every day of float.

The fact this project had so substantially changed from the original BCS was not accurately or timely reported to management. The failure of the gate process was that the Gate Review Board members did not provide adequate oversight in ensuring that the AHS project team had a reliable estimate, schedule, and well-defined scope prior to approving the gate and recommending a funding release. As of January 2014, P&M had already expended nearly $20M, or more than half the approved budget excluding contingency, even though the design was not complete and no construction had begun. However, during this entire time, P&M's estimate at completion ("EAC") in all of the DR Project's and Campus Plan reports ***never varied*** from the approved BCS amount. Moreover, the DR Project's Program Status Report for March 2014 showed the AHS at 49% spent with a CPI of 1.10 and an SPI of 1.0, clearly not an accurate representation of the Project's status. Part of this failure was based upon some of the P&M project managers' mistaken belief that the reported EAC amounts should not be changed until additional funds had been approved for the projects. This lack of accurate reporting has deprived senior management and the Board the option of revisiting the original BCS analysis in order to determine if building a new AHS facility continues to be the preferred option—and if not, change course. This is particularly true in light of the fact that as of November 2012, three of the competing options to building AHS were priced at less than $50 M.

D2O Storage provides a very similar example at a much higher overall cost. The cost variance progression from D2O Storage began with an original approved BCS of $110M, based upon estimated contractor costs of approximately $77.8 Million. The ES Fox team and design solution were both preferred but Black & McDonald was chosen entirely because its price was $30M less even before P&M further drove Black & McDonald's estimate down.

D2O Storage's engineering effort was originally scheduled for 11 months, and was supposed to be completed by July 2013. However, even today, engineering is not complete and is projecting to extend to a total duration of 29 months. The P&M team provided sporadic updates to the design milestones as they continued to be missed but failed to convey the potential consequence. In August 2013, P&M reported that CNO Milestone 73472M0015, "D2O Modifications –

Detailed Design Complete" was expected to miss its planned completion date of August 21, 2013 **by four months** though stated, "there is no impact to the critical path."[4] As of this same meeting, an action was recorded to "confirm the timing for integration" of the D2O Storage schedule into the master C&C Schedule, the follow-up to which indicated that the schedule would not be available for integration because "it falls short of our requirements for several parameters."

In September 2013, P&M reported in the Program Status Report that:

> Due to the change in design for the connection of the new tanks to the existing, significant additional design work is required. This change of design was required to address water hammer issues with the initial plans which could not be resolved without a significant change in design. A new underground tunnel connecting the two buildings will now be utilized to connect the two buildings.[5]

However, this "significant" design change was not highlighted as a major risk item in P&M's reporting, and P&M maintained the same EAC for D2O Storage despite having this information in hand. P&M also maintained that there was no impact to the critical path, even though P&M again admitted that the vendor had yet to produce a detailed schedule, which begs the question how could one arrive at such a conclusion regarding float without a reliable schedule.

P&M first reported a variance to the D2O Storage budget in October 2013, which coincided with months of mitigating adverse soil conditions and failing to meet the schedule for tie-ins for the TRF outage. Black & McDonald presented a high-level cost estimate that showed approximately $49M of increases in foundation work and engineering in October 2013, though this estimate was characterized as a work in progress. This estimate was increased by $5M in December 2013. P&M finally updated the D2O Storage EAC in the January 2014 DR Program Status Report from $95M to $122.7M, though simultaneously, P&M issued a report to the Nuclear Executive Committee ("NEC") showing a forecasted EAC of $152M. Thus, P&M's first reporting to senior management and other OPG stakeholders of any impact of the design changes that had been brewing for nearly two years was inconsistent at best.

In January 2014, Bill Robinson required Black & McDonald to update its costs. Black & McDonald committed to an estimate of $94M (compared to its original contract of $67M), which with OPG's costs was ranged by P&M at a total of $150-170M, including OPG contingency and financing costs. After coming on board, P&M's new VP required Black & McDonald to prepare a bottoms-up, high confidence schedule and budget based on the high level of engineering completion. Black & McDonald's output has trickled in. [redacted] Black & McDonald has broken down the cost increases into several categories, including: additional scope ($85.4M), changed assumptions ($14M), soil remediation ($17.3 M), delays to the schedule resulting in acceleration ($9.8 M) and inclusion of items that were either missed or misestimated in the original estimate ($31 M). Black & McDonald characterized this estimate as a Class 4 even though: (1) the design is 80% complete; and (2) Black & McDonald had just provided a Level 3 schedule for the remaining work which they claimed was comprehensive. Based on these two data points alone, Black & McDonald should be able to produce at least a Class 2 estimate at this time. [redacted]

Moreover, throughout 2011-13, P&M did not require Black & McDonald to timely update costs and provide visibility to the cost of these design changes as they were occurring; thus, as with AHS, P&M's management allowed the contractors

[4] DN Refurbishment Program Status Report Meeting, August 21, 2013
[5] DN Refurbishment Program Status Report Meeting, September 18, 2013

to run up the tab and incorporate a flood of OPG stakeholder generated late design changes without adequate checks and balances or understanding of the magnitude of these changes.

As a direct consequence of P&M's failure to report these cost and schedule variances, senior management was deprived of the ability to:

- Stop the design changes that led to these increases;
- Stop the project entirely and resort to one of the other evaluated options;
- Identify and characterize the cost increases that are not related to Refurbishment and subject these changes to the same value-enhancing criteria as the remainder of the DR Project's work; and
- Mitigate the impact of the schedule delays and overruns.

Thus, the consequences to OPG are two projects that may cause external stakeholders to question OPG's management prudence.

e. Vendor Performance Issues

[redacted]

[redacted]

3. Current Schedule Status

P&M's effort to recover these projects began with finally getting the vendors to develop resource loaded, integrated Level 3 schedules, with focus on developing template schedules for D2O Storage and AHS. These schedules are portraying the following significant challenges:

- The AHS project is currently projecting about 3 months behind schedule which will delay the VBO outage. The schedule is currently being impacted by late design, with some twenty outstanding design changes that ES Fox needs to process. This late design could impact the schedule to September 2014 and beyond and frustrate both procurement and construction, which have essentially no float. Based on our review of this schedule, attempts to accelerate the work to recover this time could be ineffective. Instead, BMcD/Modus recommends P&M, in concert with the Station, look to: (1) eliminate these multiple design changes; and (2) rationalize and potentially reduce the time needed to commission the AHS. If these upfront and follow-on tasks can be reduced in duration, the project will regain some much needed time for construction.

- D2O Storage is more complicated. The combination of underground utilities and poor soil conditions, design changes, engineering delays and contractor performance has pushed D2O Storage to a projected completion of April 15, 2016, which has no float to OPG's need date. In analyzing the current status of the work, we have determined that: (1) while engineering has driven significant delays to date, accelerating its final completion will not result in improvement to the overall completion date; (2) the current March 2015 completion date for concrete and foundation work, including drilling and setting caissons, needs to be improved by as much as possible and ideally to complete prior to the onset of winter conditions in 2014; (3) the current duration for building on top of the completed foundations, including structural steel erection, building enclosure and mechanical piping, is a scant 5 ½ months and needs to be substantially improved. Based on this status, we recommend OPG examine: (1) value engineer the foundations and structural design, with the goal to eliminate as much of the building's complexity as possible – the office space and associated concrete structure may be over-designed based on non-Refurbishment requirements added during the attenuated design phase; (2) value engineer the building's piping design, which similarly increased due to ASIC and Station needs; (3) accelerate the caisson drilling so that rebar and foundation work can recover essential lost time.

OPG should also examine other options in light of the overruns on these projects, as less permanent solutions that were narrowly rejected in the upfront BCS may now prove to be more economical solutions. At a minimum, we recommend OPG examine and parse the costs associated with non-Refurbishment scope that was added by OPG's other stakeholders and consider capitalizing those costs separately from Refurbishment for purposes of future rate recovery. In any event, whichever course OPG choses with these buildings, it is imperative that it act quickly and definitively.

4. Corrective Actions by P&M Team

OPG senior management has taken definitive action to turn around the Campus Plan work, including bringing in new leadership for P&M and fostering greater integration between the P&M Campus Plan and DR Project work. The visibility of the issues P&M has encountered will help the BOP, Islanding and Services projects work more effectively with the ESMSA contractors.

P&M's and the DR Team's senior leadership are fostering a more collaborative and cooperative effort between OPG and the contractors, known as the "Collaborative Approach." Essential parts of this Collaborative Approach include:

- For the remaining Campus Plan Projects and BOP work, the OPG teams and the vendors working "shoulder-to-shoulder" to develop project scope basis and corresponding cost estimates. The ESMSA vendors have agreed to perform the work on an open-book, split cost basis. Relieving the ESMSA of the secondary compete bidding

process through direct assignment of the work should expedite the process, though the funding for this phase of the collaboration has been slow to arrive.

- OPG's Refurbishment Engineering and Design Authority directly managing and supervising the engineering work to reduce scope creep, unnecessary management and supervision costs and delays due to churn. This will include co-locating OPG engineering resources at the vendor's shops to answer questions and involve themselves in the development of the detailed design work and institute regular Steering Committee meetings with project leadership to remove performance barriers.
- Continuing integration of all of the Campus Plan pre-requisite work into a single integrated schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance.
- Complete the work allocation to each of the ESMSA vendors so that they can properly plan their work. The DR Team has attempted to allocate the work evenly, though it may become necessary to shift work based on performance and resource availability. This becomes a more complex issue with the BOP work scope also needing attention in the coming months.
- Provide additional and focused project management support from OPG to clear barriers to engineering and execution work.
- Engage in constructive high-level dialogue with the ESMSA's senior management on a regular basis. P&M has established weekly meetings with each contractor that senior management attends to deal with any barriers and discuss status of the key projects. OPG has also established a monthly ESMSA Summit that allows for OPG to air and discuss issues with senior management of both contractors together. These meetings have had an immediate and measureable impact on both OPG's and the ESMSA's performance.

These changes will not fully recover the work in progress – in particular D2O Storage and AHS – but should provide some needed relief and better approaches for the remaining Campus Plan Projects.

For P&M, the recent changes in its senior leadership as well as the increased integration with the DR Team are taking root and providing visible benefits. P&M's VP is working through the multiple issues caused by the "hands-off" project management approach. The P&M staff has begun to accept the changes and is becoming motivated to correct its past problems, though the need for continual guidance and mentoring is evident. P&M will need corporate support to execute a full turn-around as discussed below. The DR Team's engineering organization is poised to take on active management of the ESMSA's engineering shops, which is diametrically opposite to how these projects were initially conceived. P&M's problems are now visible, as is the recovery the new team is trying to make, and the DR Team must recognize that P&M needs its support or the Refurbishment of Unit 2 is very much at risk.

5. Lessons Learned and Recommendations

Based on our root cause findings, BMcD/Modus's recommendations to OPG are somewhat different for P&M, which is in full recovery mode, versus Refurbishment, which has time (though not much) to incorporate lessons learned from the Campus Plan Projects into its program. For P&M, our recommendations focus on speeding the pace of the recovery, while for the DR Team, these Campus Plan Projects need to be a vivid reminder of what can happen if and when contractors are not actively managed. Ultimately, there are two major questions for the DR Project as a whole: (1) Can P&M succeed in completing the Campus Plan Projects on-time and within reasonable (though much higher than originally considered) cost parameters; and (2) whether the same issues we found related to the mismanagement of the Campus Plan Projects are a threat to the DR Project's BOP work and if so, to take strong and decisive action for eliminating the threat.

Regarding the Campus Plan Projects, we believe these can be turned around to support the VBO and breaker open, though at a higher cost that will require greater management focus than ever anticipated. Moreover, to facilitate this recovery, OPG will likely have to make some accommodations to its normal course of business:

- **Hiring practices will require increased flexibility** – P&M's ranks are filled with inexperienced personnel who need guidance. OPG needs to recognize that the P&M organization urgently needs qualified people to fill significant management positions in project management, project controls and field supervision that are open at this time. Moreover, because P&M is a business unit with an expected expiration date, it makes for a difficult sell to OPG employees. In our experience, business units such as P&M would not be subjected to the same rules as the company-at-large for the hiring of temporary or transitory employees. Moreover, companies usually provide incentives for employees to work in transitional project environments because it forms a valuable learning experience. Such moves are needed and, in our view, completely justifiable in light of industry best practices. It is likely that Refurbishment will need similar changes to allow the development of its Execution Phase team.

- **Operations & Maintenance's and other OPG stakeholders' ability to change project scope must be contained** – As noted, the processes in place for the Campus Plan Projects allowed Operations & Maintenance and various other OPG stakeholders to make scope and resultant design changes that caused significant increases to the Campus Plan Projects after the conclusion of the conceptual design phase. These changes have crept into cost estimates over time. The appropriate time to add scope to projects is the conceptual design phase, subject to the approval of the authorized stakeholders, not after the project has been approved and passed through multiple gates including approval at the Board of Directors level. The process needs change to eliminate the consideration of major post-award design changes that increase project costs or extend project schedules.

- **Scope of work for Campus Plan and DR Projects needs frequent re-examination** - As a general principle, management prudence requires that scope and objectives be periodically examined in light of current circumstances. Where OPG has information that shows projects trending above approved budgets and beyond schedule milestones, it is prudent to examine both the cause of the overruns and any reasonable alternatives that can be justified based on a renewed net present value calculation. Thus, we recommend that OPG senior management take a second look at the scope and question its value, including re-examining (as necessary) alternative ways to accomplish the originally intended scope of work.

  Similarly, where the root cause of the overruns appears to be the insertion of nuclear processes where such are not typically applicable or necessary (i.e. for commercial buildings), OPG senior management should take action to rescale and change the scope of such projects. This may require OPG's senior management to the CNSC to allow changes to its regulatory commitments if such commitments are so costly as to make them unreasonable.

  Finally, as noted, if there are reasonable and prudent costs for non-Refurbishment related enhancements that are being spent by Refurbishment, OPG should consider capitalizing such costs separately from the DR Project. As an example, many of the value enhancing changes to D2O Storage were apparently made to handle and process water for non-Refurbishment purposes. These costs may ultimately have been prudently incurred but are likely in the wrong cost bucket for purposes of cost recovery.

- **Supply Chain and Finance need to streamline controls to accommodate changes** – The potential for the Campus Plan and BOP projects to rationalize the scope, develop more realistic cost estimates and schedules and model risk depends on the success of the collaborative process. Initiating this process will require some changes in the Supply Chain and Finance processes to allow for timely award of the work and prompt payment to the ESMSA contractors during the concept development phase. The benefit of this collaboration should be seen as projects reach their subsequent gates, they should be in much better shape with better defined and controlled scope, more accurate cost estimates and more achievable schedule goals. The ESMSA vendors will need appropriate funding to meet these goals. Finance has already moved forward with some measures that will enhance the cash flowing of the contractors' work. Additionally, the Supply Chain procedures with respect to change orders or contract amendments are cumbersome, time consuming, and reduce the project teams' accountability for managing costs. We would expect the project team to have the ability to negotiate and approve change orders directly with the contractor with appropriate controls.

- **Risk Management needs immediate attention** – Risk management was not taken seriously in the P&M organization, thus many of the problems that have emerged were hidden below the surface. P&M needs a different approach which the DR risk management team is helping to facilitate: (1) the P&M team needs to monetize risks for future gates on a deterministic basis; (2) risks need to be managed on a day-to-day basis as a part of project management; (3) a better understanding of the ESMSA Contractors' risk management programs is needed; (4) formalized risk training is needed within the P&M organization. Most importantly, there needs to be a culture shift towards recognizing risk management as an important aspect of maintaining cost and schedule. This culture shift can only be driven from the top of the organization. Refurbishment has made many strides in improving the risk management program and their improvements should form OPEX for P&M.

- **Security and site access changes are urgently required** – The current time needed to in-process workers and management personnel alike is frustrating the OPG project teams and the ESMSA contractors. The reported average time it takes for clearance is upward of 6 weeks, and the contractors' cost per employee for the screening process is estimated at $8,000 to $10,000 per person. Moreover, there are security issues preventing or complicating the contractors' use of essential project-based systems - the P6 Schedule and the Electronic Document Management System (EDMS) are notable examples. BMcD/Modus certainly sees the need for maintaining the company's security, though in our experience with other nuclear utilities there are readymade solutions for these issues that OPG has been slow to adopt. These issues will cause continued risk to the DR Project if not fixed.

- **Contractor performance** – OPG needs to reconsider the scope of the work given to the ESMSA vendors on the Campus Plan and Refurbishment Projects in light of their current performance. OPG should examine the possibility of assigning Refurbishment BOP scope to other contractors performing on the DR Project where this makes economic and strategic sense.

- **Project estimating needs significant improvement** – As discussed throughout this report, BMcD/Modus has significant concerns that need to be addressed with the performance of project estimating by both the contractors and P&M's team. BMcD/Modus recommends that P&M should make changes, and Refurbishment should examine and potentially refine its processes for the following:

    - Check estimates be developed in the same format as estimates provided by vendors – the templates should be developed by OPG and provided to vendors prior to bid, and any submitted bid not utilizing the approved template is noncompliant;

    - All estimates need to be fully vetted and understood, regardless of whether the quoted price is more or less than the expected cost. Drivers of variances (both positive and negative) between bid and check estimates need to be investigated and understood by the Project Teams;

    - Contractors need to be trained in the method of estimating that OPG finds acceptable. The current process SNC/Aecon is using for developing its estimate includes upfront vetting by OPG of the contractor's specific processes and ongoing, real-time review of estimating product in a collaborative manner. These are principles that can be easily applied to the rest of the DR Project's work;

    - Estimates and project metrics/reports must incorporate accurate past, current and forecast cost information. The team needs to receive appropriately detailed contractor cost reports which, coupled with a resource loaded schedule, will enable them to properly status and forecast contractor performance;

    - P&M needs to standardize an EAC process so that all project teams follow the same basic procedures on a consistent basis. A seminar or workshop should be considered so that project team members are taught the fundamentals for preparing a reliable EAC; and

- OPG needs to examine staffing and resources. Currently, there is only one dedicated cost estimator for all of P&M's work. The DR Team has already taken action to increase staffing levels and add experienced personnel, and P&M needs to do the same.

- **Project Reporting must be accurate, timely and convey information critical to senior management for decision-making** – As noted, the reports P&M provided to senior management on the Campus Plan projects were inaccurate and not updated in a timely manner to enable prudent decision-making. Our examination of P&M's reporting shows a general desire to produce large volumes of surface-level reports that are completely inadequate for managing the work, all the while P&M ignored such critical metrics as an accurate Estimate at Completion (EAC) and detailed schedule of work. Any tendency to "turn everything green" when such is not the case must be resisted - prudent management of complex projects requires full transparency and visibility of anything that is not going well so it can be addressed and fixed. P&M and the DR Team need to increase the focus on accurate, concise reporting with an emphasis on forecasting.

- **P&M needs to break down the silos**—All of the Campus Plan Projects are being performed by two contractors. However all of the Campus Plan work has been managed as 26 separate projects. All of the project management functions—i.e. schedule, cost and risk need to be managed through an integrated approach so that resources and management focus can be applied appropriately. We recommend that P&M look at its organizational structure to optimize the ability of its project managers to have more direct accountability. This may require more and different resources.

- **Campus Plan Projects will require a full rebaseline of cost and schedule** – Irrespective of when these projects' next gates occur, each of the Campus Plan Projects and, likely, each of the P&M non-Refurbishment projects at DNGS and Pickering, will require a full, bottoms-up rebaseline of costs and schedules. With the examples cited herein, BMcD/Modus cannot ascribe any confidence to any project estimate that was developed by P&M's former regime. Bill Robinson has made this commitment and appropriate focus will need to be applied. P&M needs to perform this reforecast on an urgent basis.

With respect to the Refurbishment portion of the DR Project, BMcD/Modus's monitoring of the BOP work to date shows that OPG has spent considerable time and effort in a robust scope definition process that addresses most of the external OPG stakeholder-driven scope issues in a manner that is consistent with the DR Project's charter. The DR Team has embedded in the organization a Director of Maintenance and a team to work our operational concerns and has an independent Design Authority. Moreover, as stated, the DR Team had already acted to safeguard against some of the problems seen in the early Campus Plan Project, notably; (1) the DR Project's institution more thorough scope definition to contractors via the MDPs the engineering team developed was a direct consequence of the OPEX from D2O Storage from over a year ago; (2) it is also apparent to us that while the DR Team had started down the same management path as P&M, it was able to put on the brakes and change course at a much earlier stage. Nonetheless, in light of our review of the Campus Plan Projects, we recommend that the DR Team perform a detailed self-assessment that considers the ways in which the Campus Plan Projects management failures might apply to Refurbishment.

III. RQE Preparation

With this report, BMcD/Modus will begin a dedicated section for assessing the status of the DR Team's activities that specifically lead to the development of the RQE budget and associated schedule for the October 15, 2015 deadline. With respect to RQE planning, the DR Team has started its specific planning efforts, though soon there needs to be a greater focus on the specific deliverables, the timing of their preparation and a thorough understanding of how the many components will be compiled into a comprehensive estimate. Project Controls has named a manager for this effort and an activity schedule is being developed for incorporation into the Project's plan.

The most imminent upcoming RQE-related tasks relate to the development of the 4d Release Cost Estimate for the 2015 Business Plan ("4d Cost Estimate") that will be prepared for the Board's approval at the November 2014 meeting. The 4d Cost Estimate effort should also provide a template for many of the activities needed for RQE. In this section, we will

also report on the maturity of the DR Project's development of the project's integrated schedule, which is an important component to providing a reliable RQE.

A. 4d Cost Estimate

In our Initial Project Assessment, we recommended that OPG consider the 4d Cost Estimate as a "dry run" for RQE. This recommendation has been embraced by senior management. As part of our 4th Quarter 2013 Report, BMcD/Modus provided the DR Team with specific recommendations on the development of its cost estimates and lessons learned from last year's 4c Cost Estimate, which we refresh here with some additional observations:

- **Organization of the 4d Cost Estimate**: The DR Team is getting organized for the 4d Cost Estimate effort, which will be considerable. Project Controls has begun with the predecessor work the projects will need to develop their various estimates and is in the process of developing a schedule for these activities. Based on last year's approach to the 4c Cost Estimate, we see more activity occurring at a similar stage though we are still concerned that the development of 4d Cost Estimate will run into summer, during which time very little can be finalized due to the critical individuals taking vacation.
- **Projectizing Costs**: The DR Team is moving toward "projectizing" the functional costs, i.e. attempting to bucket as much of the cost of the functional work as a distinct part of the sub-projects' cost. This is an appropriate methodology and should provide a more accurate cost picture, though the DR Team needs to develop some clear guidelines for how this will be accomplished. Also, since this will mean functional cost centers from the 4c Cost Estimate will be distributed differently, the DR Team should provide traceability between the two phases of the estimate.
- **Bottoms-up Approach**: Given the increase in project maturity since the 4c Cost Estimate, a bottoms-up approach to many elements of the 4d Cost Estimate is appropriate. To the extent that projects have recently passed through a gate, the associated gate documentation should reflect this approach. However, a gate review should not be viewed by the DR Team as an opportunity to reset the clock and the budget on projects that are in trouble. The DR Team should review its processes for rebaselining at gates so that projects that are projecting to over-spend or run late are not given proverbial "get out of jail free" passes.
- **Re-examine Scope and Commitments**: As the Definition Phase has unfolded, it has become apparent that the cost estimates for many scopes of work have greatly exceeded the 4c Cost Estimate. In particular, F&I projects have changed in scope, execution strategy and cost, and many of the BOP projects are showing similar signs, such that the increases in cost would likely run at or above any alternative. The recently initiated Options Review Board (discussed below) has the potential to be a good control to catch projects with wide variances at an earlier stage. As noted above, BMcD/Modus believes that the periodic reexamination of principles on a project as an essential ingredient to prudent management. Thus, we recommend that OPG re-analyze any scope item with a wide cost variance over its 4c Cost Estimate budget allowance by re-reviewing the requirements and any alternatives, including canceling the scope entirely, on the basis of the least-cost alternative at this time. Had this methodology been followed with the F&I Projects, it is now apparent that OPG would have considered different alternatives for a number of projects. OPG should also review such alternatives when a regulatory commitment is at the root of a significant cost increase, as once the extent of the cost increases are fully known, it is possible the regulator would entertain alternatives as well.
- **Increase Efficacy of Project Estimating**: As discussed in the Campus Plan section of our report, BMcD/Modus is concerned that OPG's ability to develop check estimates is challenged by resources and work volume. To the extent that OPG's check estimates are intended to be a control mechanism, these estimates need to be executed with the same information and level of rigor that the contractors/project teams are developing. From our observations to date, the current method used for check estimates at Class 4/5 level: (1) includes the use of too many factors and factored values for check estimates at the Class 3/2 level; (2) suffer from a general lack of transparency of the root sources of information; (3) utilize non-standardized estimating templates despite OPG's investment in the US Cost estimating platform. As the DR Project moves to the next phase of maturity, so

should the estimating work. We have also observed that the check estimates have gaps and errors that should not occur if the estimates had been performed by qualified, experienced individuals. Moreover, it is becoming evident that estimating is becoming a choke point to the point of causing notable delays in the procurement schedule, and its importance will only increase as time goes on. Thus, we have recommended that OPG examine its vendor's (Faithful & Gould) resources, experience level and ability to support the increase in both the volume and efficacy of the estimates it is preparing. In addition, we recommend OPG utilize the collaborative estimating/vetting approach that it has initiated with the ESMSA vendors and with SNC/Aecon for each of the DR Project's other scopes of work. The DR Team is already acting on these recommendations.

Considering the increased focus on the DR Project from its external stakeholders, it is very likely the development of 4d Cost Estimate will receive significant scrutiny. Therefore, the DR Team needs to organize its efforts, develop appropriate expectations for the deliverables and intensify its efforts as soon as possible.

B. Schedule

A high-confidence RQE depends on a reliable integrated schedule. In our past reports, BMcD/Modus has identified several concerns and observations with respect to the development of the DR Project Schedule and the Project Schedule Management Program. Over the last few months, the DR Team has made significant strides in addressing many of the issues we have raised. While much work remains to be done, the DR Team has moved forward with a significant number of initiatives calculated to improve both the DR Schedule and the Schedule Management Program, including:

- The DR Team now sees itself as a project management team and is putting programs in place to properly manage its contractors;
- The DR Team has abandoned earlier questionable scheduling methods in favor of developing a fully integrated Level 3 resource loaded schedule that automatically rolls-up to form a Level 2 depiction of the work;
- P&M is becoming the "beta" group for testing the basic standards for managing the Level 3 with the Campus Plan Projects;
- OPG has developed standards for required resource loading of the Level 3 schedules by OPG and the contractors; and
- Detailed schedules for sub-projects that are not let are represented by placeholder activities to be replaced once a contractor is in place.

While these changes are positive, we have made additional observations that should be addressed by OPG in order to improve the reliability of the integrated project schedule, including:

- Development of an improved set of metrics for monitoring the schedule is imperative. As part of the effort to improve the Level 3 integrated scheduling process, a set of metrics needs to be established to categorically monitor improvements made by the Project Teams and their respective contractors.

- Currently, the DR Team is making manual adjustments the cash flows in Proliance, rather than having it be an automated function tying the cost estimates to the P6 dates for cash flow analysis. Ultimately, work hours in cost estimates and schedules must balance and the Work Breakdown Structure ("WBS") should be the binding mechanism. The DR Team is planning on automating this process though it will remain prone to error until that time.

- OPG needs to speed contractors' access to the scheduling network. The OPG and the contractors need to all work from the same network (preferably OPG's or an third party network) in order to operate in a common environment. However, OPG is not granting the contractors network access in a timely manner. Improvements in time and better standards for control of the databases need to be established.

IV. Major Projects – Summary of Key Risks

A. Retube & Feeder Replacement

1. Work Status – Tooling, Definition and Mock-up

Through March 31, 2014, the RFR contract is underspent by $9 M against plan, though this gap is closing. Additionally, SNC/Aecon's SPI during this time period has improved to 0.94. Although SNC/Aecon remains behind schedule in the Definition and Tooling phases of its work, the mock-up reached substantial completion in March and is ready to receive, test and integrate tooling.

The tooling recovery plan that was initiated at the end of 2013, however, is currently challenged to achieve its August 2014 target. Tooling engineering is now critical path and the tooling design complete milestone for June 15, 2014 will likely be missed while the follow-on milestones for prototypes complete and qualification complete are in jeopardy as well. Continued problems with SNC/Aecon vendors and sub-vendors are driving many of these delays. In particular, the RT platforms being fabricated by Rolls Royce have continued to slip and are now projected to complete 2-4 weeks later than the recovery plan completion dates of June 30 and July 15, 2014. Meanwhile, SNC/Aecon's supplier ATS is suffering from late delivery of parts from its sub-vendors, delaying assembly on its shop floor. SNC/Aecon has made repeated projections for delivery of these tools that have been further impacted by late deliveries, quality issues, and process missteps. SNC/Aecon has resorted to additional mitigation plans and is making reasonable attempts to recover the time lost. The OPG team continues to monitor SNC/Aecon's progress and is holding them accountable to meet the deadlines. The impact of SNC/Aecon's slippages will be felt in the development of the Class 2 estimate. To mitigate this potential delay, OPG's project team is requiring SNC/Aecon develop a clear plan for monitoring tool testing and productivity in the mock-up to ensure this process moves smoothly and that all the required information is captured and incorporated into the estimate.

In addition, the JV is trending over-budget for the target price portion of its Definition Phase work, which includes engineering, schedule and estimate development, and construction management planning. The fact the JV is projecting to complete this phase of the work 15-25% above its target needs to be considered in establishing the confidence level of the JVs Class 3/2 estimates for the Execution Phase. However, OPG's team plans to dispute any charges advanced by SNC/Aecon for the Definition Phase that were caused by SNC/Aecon's own actions.

Finally, the Definition phase shows signs of slow progress with an SPI at 0.91 as of the February 2014 SNC/Aecon Progress Report. Engineering and procurement dates are slipping, showing similarities with the tooling effort described above. These activities will require close monitoring as the Definition phase moves toward the Class 2 estimate over the next year.

2. Class 3 Estimate and Level 4 Schedule

In our 1Q 2014 report, BMcD/Modus expressed serious concerns with the ability of SNC/Aecon to provide Construction Work Packages (CWPs) and variance reports by March 15, 2014 to support the Class 3 estimate. As of February 10, 2014, SNC/Aecon was only 32% complete in preparing its "Stage 1" CWPs and variance reports. Over the next month, SNC/Aecon significantly increased its production in order to meet this date and, in the process, compressed delivery, creating a large bow-wave of work for OPG to review.

Since our 1Q 2014 report, OPG's estimating group has struggled to keep up with SNC/Aecon's pace and its review and analysis of the variance reports, estimates, and mini-reports that will ultimately comprise the Class 3 estimate is proceeding slowly. BMcD/Modus's concern is that the sheer volume of reports provided by SNC/Aecon, essentially all at once, will result in errors or that OPG will be challenged to make sense of the data. Ultimately, SNC/Aecon should be tasked with providing an explanation of how the products satisfy the requirements of a Class 3 estimate. Per the Class 3 Estimate Plan, SNC/Aecon's commitment for this Class 3 Estimate should include:

- Completed CWPs formulated for DNGS;
- Variance reports showing differences between the OPEX driven Class 4 estimate and the current estimate;
- A Level 4 execution schedule;
- Detailed reports characterizing how SNC/Aecon prepared the estimate; and
- A well-defined risk register.

All of these SNC/Aecon products will require time for OPG to review and in this case it is our opinion that it is better to provide an extension of time than rush the review of such important material in order to meet a previously set deadline.

Concurrent with the development of the Class 3 estimate, SNC/Aecon is developing its Level 4 execution schedule. The first draft of this schedule was delivered on April 15, 2014 and ongoing review sessions are being held to refine it. First impressions of the schedule were that SNC/Aecon had not brought the best possible schedule for Unit 2 forward. It appeared that SNC/Aecon presented a comfortable, achievable schedule rather than an aggressive benchmark. This created a longer schedule than what would be considered a "target" schedule. In addition, several examples of incorrect logic and misalignment with OPG's level 1 schedule were identified. OPG is continuing to review and recommend changes prior to the delivery of the Schedule mini-report for the Class 3 estimate on April 30, 2014.

Looking forward from Class 3, it is important for OPG and SNC/Aecon to align around the plan and start preparing for the Class 2 estimate. As we have noted in prior reports, after SNC/Aecon completed the Class 4 estimate, there was a long period with no activity that only served to compress the preparation time for the Class 3 estimate, and that compression is at the root of the current need to rush through its approvals. As the Class 3 report is being developed, the team should endeavor to complete the Class 2 estimate plan so that any opportunities or progression points are identified early. In addition, the tool testing and productivity plan should be incorporated with the Class 2 estimate plan so that results are properly incorporated into the schedule and estimate. SNC/Aecon and OPG need to maintain focus on the finished product and what it means to be Class 2 RQE ready.

3. RWPB Building

The RWPB is being performed under many of the same conditions as the Campus Plan Projects as a pre-requisite to Refurbishment but by SNC/Aecon, the contractor performing the RFR retube work, rather than the ESMSA contractors. RWPB is facing very some familiar issues to those described above for D2O and AHS. The start of work is currently being impacted by the soil that was excavated from D2O Storage. There is a possibility the soil is contaminated, which has resulted in additional testing. In addition, the building has or will encounter plant operation coordination, and seismic issues have delayed foundation design and pushed out engineering. As of this report, engineering design complete is showing 43 days of negative float and installation/commissioning is showing an October 24, 2016 completion date. Although this schedule is immature and based on very preliminary engineering, the original plan was completion in June 2016 allowing three months before breaker open. It is vital for SNC/Aecon to utilize the lessons that are being learned from the F&I work in order to keep this building within a reasonable cost and schedule envelope. In addition, if there are cost increases, the Options Review Board should test the decisions being made with regard to building design in light of the fact that it is a temporary building that will be housing heavily contaminated materials. Further, the building should avoid any element of gold plating or permanent design.

4. RFR Commercial Risks

We recommended in our last report that the DR Team review some major provisions of the RFR contract in order to ensure that it will drive the proper behavior from SNC/Aecon in order to achieve success on the first unit and that OPG will be able to establish that it adequately and prudently considered the principles set forth in the government's Long Term Energy Plan ("LTEP")—primarily success on the first unit and ensuring appropriate risk shifting. This included re-visiting: (1) the performance incentives for unit-over-unit improvement as an incentive to the contractor to meet an aggressive schedule for the first unit; (2) whether the cost and schedule incentives/disincentives would drive the right contractor behavior; (3) the treatment and monetization of identified risks; and (4) whether to negotiate a guaranteed maximum price ("GMAX") once engineering is complete. In addition, OPG and SNC/Aecon will need to incorporate the

maturing Turbine Generator work into the estimate where economies of scale in project management and other areas are identified. To date, DR senior management has acknowledged that this is an important exercise that must be done with some sense of urgency. However, this sentiment has not been communicated to those individuals tasked with performing the review, who appear not to understand its purpose and are reluctant to even consider the need to modify any portion of the contract.

B. Balance of Plant and Other Projects

The BOP work should be the direct beneficiary of any lessons learned from the Campus Plan/F&I work. The majority of the BOP work will be performed by the ESMSA contractors based on direct assignment of the work packages. This methodology should readily lend itself to a cooperative, interactive process between OPG and the vendors that should, in theory, eliminate many of the issues we have observed with the F&I work.

With the awards of the containment isolation and Turbine Generator performance work to SNC/Aecon, OPG should consider the benefits of SNC/Aecon treating its overall scope of work as one contract. There are certain economies of scale that can be achieved – plus benefits associated with workforce assignment flexibility and dose management. The DR Team would also benefit from consolidating all of the work in the vault into a single subproject to better manage the critical path and subcritical path interferences.

V. Functional Groups Update

A. Engineering

1. Revised Plan for ESMSA Engineering

Amongst other conclusions, the BMcD/Modus Initial Project Assessment (August 13, 2013) recommended improvements to engineering metrics and a close look at the turn-around times for the review, comment and approval cycles. The need for "active management" of the engineering work along with a greater focus on front-end planning was introduced in the BMcD/Modus 4Q 2013 report and expanded upon in our 1Q 2014 report. We continue to stress the importance for OPG to shift their role and perspective from the culture of 'observation at a distance' to a much more proactive engagement and active management of the engineering service providers. We also continue to stress the importance of thorough front-end planning.

Since our last report the DR Team's Senior Leadership has recognized a number of deficiencies with the ESMSA design process, including:

- The quality of planning and scheduling is insufficient. There are no integrated resource loaded schedules. Schedule adherence is very poor - the execution of most of the ESMSA project engineering (e.g. D2O Storage Building, Shield Tank Overpressure Protection, Auxiliary Heating Steam, and Containment Filtered Venting System) is consistently behind plan.
- Cost estimates for the detailed engineering phase are significantly higher than anticipated, particularly given OPG's development of detailed Modification Design Packages (MDP's) that were intended to provide the vendors with specific and prescriptive requirements.
- The actual costs to date are significantly above the original budgets (planned value) for all ESMSA projects. A significant portion of these increases are driven by engineering.
- ESMSA quality programs are not aligned with OPG's quality program. The result is multiple review and comment cycles which add significant cost and time.
- OPG's intent to shift risk to the ESMSA partnerships was misplaced. The risk associated with the execution of nuclear engineering work is limited by the application of detailed regulatory and OPG standards and procedures. The execution of nuclear engineering work needs to be under the direct control of the OPG Design Authority.

- Single-point responsibility for coordination of the engineering, procurement and construction elements of these projects through these ESMSA partnerships has not been realized, leading to inefficiency, confusion and rework. Moreover, significant OPG intervention has been required to achieve the results obtained to date.

The results of these deficiencies have become clearly apparent: an inability to predict engineering performance, significant churn, poor cost performance and frustration at all levels of the collective organization. These deficiencies have driven Senior Leadership to make changes to the remaining engineering effort for the ESMSA work. These changes include:

- Shifting to a culture of 'active management' of the engineering work;
- Utilizing a collaborative front-end planning methodology for the remaining work;
- OPG taking a leadership role in developing and monitoring the engineering schedules;
- For work in progress, OPG will increase monitoring and provide ready answers through embedded staff within the engineering vendor organizations; and
- For work that has not started, OPG will provide management and direction of the engineering work.

This is a bold but necessary move and one that is endorsed by BMcD/Modus. We will continue to monitor the progress made under this revised plan and provide additional recommendations for streamlining the design process as necessary.

2. Scope Definition

Overall, as mentioned in the BMcD/Modus Assurance Report on Scope, we believe that the DR Team has taken a balanced approach to the development of the DR Project scope. The initial scope identification effort incorporated scope beyond that of refurbishment and life extension, potentially increasing the budget and project complexity. However, to balance this out, the DR Team has continuously monitored and repeatedly tested the included scope through scope reviews and de-scoping exercises. Additionally, the team has monitored scope definition through the gate review process and Health of Scope (HOS) metrics. Through this extended process we believe that the DR Team has struck an important balance between overly limiting scope (and risking scope growth during execution) and being overly-inclusive (and risking excessive project budgets).

The resultant Darlington Scope Requests (DSR's) drive engineering. Through April 24, 2014, Engineering had completed 142 MDP's. While this met OPG's goal, the number of MDP's continues to rise and is now at 161 (as compared to 139 in our last report) with 19 known packages remaining. This is particularly important considering the new path OPG has chosen to take for ESMSA engineering.

However, whereas scope definition may be sound, the development of solutions is not. As the revised plan for ESMSA engineering takes root, the DR Team also needs to examine the assumptions and engineered solutions. The DR Team's Senior Leadership initiated a new control, a monthly Options Review Board ("ORB"), the intent of which is to re-review the approaches the project teams are taking and see if the means and methods in the plan are appropriate, cost effective and still required. At the first ORB, the BOP, Shutdown/Lay-up and Services projects identified initial plans for six different scopes that needed to be reconsidered. These different subprojects suffered from many of the same problems evident with the Campus Plan Projects discussed above, thought these problems are being exposed, escalated and resolved. The ORB found:

- OPG's design requirements can cause confusion, misalignment and very expensive solutions that defy common sense. As an example, based on the guidance from the original MDP, the dehumidification of the turbine deck would have cost upwards of ten times more than OPG has spent in the past performing the same work on laid-up fossil units.

- The performance specifications in some packages provided the vendors with limited guidance, and in such cases, vendors will usually take the most conservative route.
- OPG often relied on the vendors to suggest more creative solutions to their issues when OPG's team knew the best course to take all along. This was evident with the polar crane package inside the plant. OPG left it to the vendors to discern what was needed. The vendors decided to replace all of the cranes, even though OPG's team determined only refurbishment, not replacement, was required. OPG often relied on the vendors to suggest a more creative solution to their issues when OPG's team knew the best course to take all along. This was evident with the crane package for the polar cranes inside the plant. OPG left it to the vendors to discern what was needed, from which the vendors decided to replace all of the cranes, even though the needed scope determined by OPG's team was refurbishment, not replacement.

This initial ORB was a success and will be followed by further, similar reviews of planned solutions. From this and the lessons learned from the F&I work, BMcD/Modus recommends that OPG consider the aforementioned controls on scope, including: (1) reviewing the necessity of performing the work; (2) revisiting prior options; (3) refreshing the view of net present value; (4) questioning whether scopes of work that are driven by regulatory requirements and have experienced significant cost overruns are still cost effective.

In addition, the DR Team is instituting a Unit Scope Review Board that will examine each subproject's readiness at key intervals in the manner employed by the station for outage preparedness. This team will be led by the DR Team's senior management and will test whether a given project has key deliverables in place at required quality levels as it advances toward execution. We believe these tests are part of prudent management and necessary to meet the intent of the Minister of Energy's Long Term Energy Plan ("LTEP").

B. Project Controls

The DR Project's reports (namely the Program Management Report) needs attention. This report is difficult to read, contains multiple formats changes, and has, in the case of the Campus Plan Projects, erroneous and outdated information that is included without verification. The Campus Plan Projects' reporting discussed above provides a vivid example of how reports that lack accuracy and transparency mislead and deprive senior management the opportunity to make key decisions. The DR Team's Project Controls team is bringing needed QA/QC reviews and personnel to test and monitor this and other key reports' information. The tendency by the DR Team is to provide too much data in these reports so that important information is often obscured and lost in the "noise." Furthermore, metrics and reporting are supposed to provide an accurate snapshot of the status of a project. The current Project Reports need work to achieve these goals. . Project Controls is endeavoring to improve its reporting suite that both informs and allows for management focus. The team is working currently on revised versions of the "quad charts" that provide metrics and description of the projects' current focus areas. The DR Team has also agreed to abandon the quarterly produced "report card" which was ineffective at communicating the Project's status. This metric was a jumble of key performance indicators, dates, milestones, etc. and only serves to confuse rather than provide useful information.

Moreover, the DR Team's methodology for measuring earned value needs to be stress tested. The DR Project's schedule is now matured to include resource loading to allow OPG to test work hour productivity factors from information contained in the P6 schedule. As the schedule further matures, we will be providing additional focus to the coincidental development of earned value and productivity factors.

C. Supply Chain

Our observations of the P&M organization and the Campus Plan Projects have raised some concerns regarding the interface between Supply Chain and the project management team. In particular, the current procedures require that Supply Chain negotiate all change orders (also called contract amendments) on behalf of OPG. This appears to be a cumbersome process with a number of built-in walls that only cause for multiple review stages of the same information.

This process has the potential to cause delays to both the Campus Plan and DR Projects, but more importantly, it disconnects scope, schedule and cost accountability from the project team. We will be further examining these processes as the project progresses, including an upcoming Assessment of the DR Project's Change Management process.

VI. Other Project Risks

A. Project Team Development

As previously noted, Enterprise Risk Management carries the retention of key personnel as the biggest program risk to the DR Project, and we would agree that it is certainly among the DR Project's biggest challenges. The most urgent challenge in this regard is to ensure that the Project has sufficient skilled resources to manage and monitor all of the work that must precede Refurbishment, including supporting the F&I, ASIC and VBO work, while maintaining the pace of the Refurbishment's key developmental activities. In our view, the best way to address this challenge is to continue to ramp up the front end planning effort so that all the work that must be performed is known and identified by schedule window and priority. Once the total needs of the organization are better defined, OPG can address resource needs in a more comprehensive manner. BMcD/Modus also sees monitoring resources in the schedule via fully resource loaded, level 3 schedules and tracking work hours productivity factor indices as essential ingredients in understanding the resource needs for each work group, trade specialty and the like. Senior Leadership of Refurbishment and P&M have coordinated a monthly ESMSA Summit at which resource needs will be discussed in greater detail going forward.

As the DR Team focuses more on developing its team for the Execution Phase, OPG will need to obtain individuals with different skills and experience than it may have currently in-house. OPG's current hiring, banding, salary constraints and onerous, time-consuming onboarding procedures serve as a barrier to finding the necessary experienced and qualified personnel. BMcD/Modus recommends that the DR Team closely look at the optimal Execution Phase organization design so that it can properly cost-out the Execution Team in the 4d Cost Estimate and prepare to deal with the barriers to securing suitably experienced management and staff .

B. Program Management Plan Development

In our last report, BMcD/Modus identified some shortcomings with DR Team's Program Management Plan ("PgMP"). The DR Project's Senior Leadership has moved forward with our recommendations to progress the PgMP. Senior Leadership also led the first of what will likely be a series of meetings with key Project Team members to foster alignment of the functional groups into a "projectized" team in which the individual sub-projects will capture the majority of the cost and coordinate the activities in a more focused manner. This initiative exposed for Senior Leadership that it must go farther to communicate roles and responsibilities within this matrix organizational model.

As we noted in our last report, the PgMP is the key unifying document set for project execution; in our experience, it would be tantamount to the project bible that a new employee would use to understand his or her roles and responsibilities. In addition, with the 4d Cost Estimate beckoning, the project teams will need to know the breadth of their matrixed organization and related cost centers to properly allocate the different elements of the estimate. The Project's need for a solid PgMP is further heightened by Senior Leadership's attempts to evolve the organization for the Execution Phase.

In summary, BMcD/Modus recommends that the DR Team simplify the approach it is taking to develop the PgMP so that it is unifying document and increase collaboration across the team. We believe the current efforts of the Engineering team to provide its portion of the plan could establish a model for the other functions and projects to follow.

MODUS Strategic Solutions CANADA

Attachment A – 1Q 2014 Risk Perspective

Burns & McDonnell CANADA

Area	Observations	High / Medium / Low	Current Status / Mitigation
RFR	**SNC/Aecon Performance**: Largest Program risk due to overall risk to the DR Project and OPEX.		▸ Tooling recovery progressing; next tooling milestones will be missed but impacts are limited and mitigating actions are in progress ▸ Tooling and procurement recovery plan in place, some slippage continues ▸ RWPB and Definition Phase Engineering showing signs of slow progress
	Class 3 Estimate: Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted		▸ Completing thorough OPG review by May 15, 2014 will be challenging ▸ Ultimate goal of delivery by August 2014 is acceptable ▸ Monetizing contingency remains a risk
	Schedule Development: Level 4 schedule under development; requires challenge to total duration		▸ First draft of the Level 4 schedule lacked creativity and boldness ▸ Continued review required from OPG project team to push SNC/Aecon for a more aggressive but achievable schedule
	RWPB Delays: Facing similar problems that have plagued Campus Plan projects		▸ Contaminated soil, interferences, and seismic issues delaying engineering ▸ Minimize design aspects of gold plating or permanence ▸ Utilize/implement lessons learned from Campus Plan work
	RFR Commercial Risks: Contract provisions currently in place may not drive desired performance		▸ Negotiation of the Execution Phase target price should revisit incentives and disincentives/focus on success of the first unit
Campus Plan	**ESMSA Performance**: D20 Storage and AHS work is behind schedule and over budget		▸ Vendor performance/unforeseen issues remain significant risks ▸ Similar trends are being observed with several other F&I projects; budgeting process is being investigated ▸ Bids for remaining work are significantly higher then budgets ▸ Re-evaluation of business case required in light of new estimates
	Engineering and Planning: D20 provides key lessons learned for remaining Campus Plan and BOP		▸ Engineering is co-locating with ESMSA vendors and taking more active role in directing and managing the work ▸ Clarification of RFPs and process ongoing ▸ Modifications to planning and scheduling underway
BOP	**ESMSA Performance**: Concern over ESMSA contractors' performance and ability to execute BOP work		▸ Allocation of work underway; some issues with cost/scope estimates ▸ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed

Attachment A – 1Q 2014 Risk Perspective

Area	Observations	High / Medium / Low	Current Status / Mitigation
Engineering	**Scope Review**: New Options Review Board has increased scrutiny of design decisions		▸ Options Review Board has been effective in challenging scope decisions
	Planning of Engineering Work: Engineering work was not well understood and is poorly planned		▸ OPG engineering is taking more active role in directing and managing the work at the engineering studios ▸ "Bottoms-up" estimating process initiated for engineering activities ▸ Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place
Project Controls	**Continued Schedule Development**: Schedule approach was unproven; integration at appropriate level at risk		▸ Project Team is moving toward industry-wide recommended practices for scheduling ▸ Substantial work remains to populate detailed level 3 schedule
	Progress Towards RQE: The plan for developing RQE is being developed.		▸ RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs. ▸ The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.
	Risk Management Program: Risk registers require scrubbing; monitoring tools are cumbersome		▸ DR Team is cleaning up the risk register and improving reporting ▸ Risk Group is taking a more active role in managing the Risk Program ▸ Risk training is being conducted but more is required

Project Matrix
Campus Plan
Observations/Findings

REF.	OBSERVATIONS	PROJECTS				
		Water & Sewer	D20 Storage	Aux Htg Sys	RFR Annex	* RFR Waste Storage
1	Lack of scope definition.	√	√	√	√	
2	Insufficient effort and time in creating engineering requirements.	√	√	√	√	
3	Initial Project was deferred and then reactivated over a period of years (> 5yrs).	√	√	√		
4	3rd Party Estimates - Mixed results w/F+G being significantly over or under vendor quote.	√	√	√		
5	Change in contracting strategy with Vendor from a E-PC to EPC.	√	√	√		
6	Basis of Estimates do not conform to AACE Recommended Practices.	√	√	√	√	√
7	Project Team has failed to characterize the changes/progression to the estimates from gate to gate.	√	√	√	√	
8	Mischaracterized Estimate Classification - OPG is accepting vendor quote as a "Class 2" or "Class 3 estimate when such quote does not meet the threshold for a Class 2 or 3.	√	√	√	√	√
9	Contingency calculated at ~21% - not clear how contingency and risk assessment are linked, if at all.	√	√	√	√	
10	Risk shifting - Project Team does not fully understand the nature of target price work.	√	√	√	√	√
11	The process of bid evaluation scoring and metrics used varies among Project Teams.	√	√	√	√	√
12	The process of comparing bids and 3rd party estimates varies among Project Teams.	√	√	√	√	
13	Significant differences between Vendor Quotations (from 50% to > 100%).	√	√	√	√	
14	Vendor quotes and 3rd Party Estimates (Faithful + Gould) are not aligned for ease of comparison to facilitate a comprehensive review of differences.	√	√	√	√	
15	The contractor selection process compelled the contract to be awarded to the lowest bidder over other qualifying considerations.	√	√	√	√	
16	Risks materialized greater than expected during execution, i.e. underground utilities.	√	√	√	√	
17	Senior Management is reluctant to increase contingency on the front end despite selecting the lowest bidder.		√	√		
18	Project Manager is young and appears inexperienced to manage size of project.		√	√	√	
19	Project Team has difficulty in obtaining reliable cost and schedule data from contractor resulting in OPG's inability to effectively forecast costs to complete.	√	√	√	√	√
20	Contractor performance issues have increased costs	√		√	√	
21	OPG performance issue has increased costs, or has the potential to increase costs					√
22	Scope growth beyond what was anticipated for the project.		√	√	√	
*	*Project is in its early stages.*					

Attachment C – Summary of Cost Variances to Date for Campus Plan Projects
BMcD/Modus 2Q 2014 Report to NOC
May 13, 2014

In accordance with recommended industry practices, construction project costs should be periodically evaluated and updated in order to develop reliable estimate at completion ("EAC") forecasts. Planning for cost forecasting establishes the timing of forecasts, how forecasts are communicated or reported, methodologies and systems/tools to be used, and specific roles and responsibilities for forecasting. EACs should be prepared and issued on an established schedule that is appropriate for the pace of work on the project.

The development cycle of an EAC typically follows a set process with standard guidelines for the project team to follow. For instance, one step would be to review and rigorously vet contractor cost reports to understand the development of costs versus current budget, planned and actual productivity. Based on our review of five (5) Campus Plan Projects, it does not appear that Facilities and Infrastructure ("F&I") used a set process or guidelines to govern EAC development. When we interviewed the project teams, we discovered that each team was following its own EAC process, indicating that there was neither visibility to cost increases nor internal cost control.

To understand the impact to the project costs and EAC process, we compared the current EAC to the last approved BCS to identify the magnitude of cost increases. The following chart illustrates the cost increases on the projects[1]:

Overall Cost Variances between the Latest BCS and the Current EAC on F&I Projects

Project	Board-Approved Costs	Current EAC	Variance	% Increase
D2O Storage & Drum Handling	$ 110,015	$ 314,383	$ 204,368	186%
Auxiliary Heating System	$ 45,607	$ 85,102	$ 39,495	87%
RFR Island Support Annex	$ 32,504	$ 40,738	$ 8,234	25%
Water and Sewer	$ 45,703	$ 57,712	$ 12,009	26%

We then analyzed the project documents to identify the categories of costs behind the increases identified on each of the projects as described below. We also interviewed the project teams to understand their EAC process.

D2O Storage & Drum Handling

Our analysis of the RFR Island Support Annex estimates yielded the following summary highlights:

- On this project, nearly every cost category of work has increased considerably ranging up to +537% above approved gate funds, with the exception of Phase I engineering design and award long lead procurement which was contracted on a fixed price basis.
- Engineering work is 82% complete overall versus a planned completion of 100%; 48 of 84 ECs have been issued in Passport. Engineering is forecasting that all ECs will be completed by early November 2014.

[1] The chart contains only 4 projects because Retube Waste Storage is not included; this project has not progressed beyond the definition phase.

Summary of D20 Cost Variances between the Latest BCS and the Current EAC

Cost Category	BCS/Gate 3b	Current EAC (4/22/14)	Variance	% Increase
[redacted]				
TOTAL	$ 110,015	$ 314,384	$ 204,369	186%

Summary of D20 Storage Building Cost Variances

Cost Element	Variance ($K)	% Increase
Underestimate of Effort	$ 30,978	19%
Design Scope Growth	$ 46,466	29%
Underestimate PM Plant Materials	$ 33,654	21%
Client Requested Changes	$ 5,273	3%
Schedule Extension & Acceleration	$ 9,852	6%
Environmental Requirements	$ 17,439	11%
Pipe Chase	$ 4,326	3%
EPSCA	$ 1,569	1%
Building Relocation	$ 9,726	6%
Total	$ 159,283	100%

A brief explanation of the significant changes, as reported by B&M in its updated cost estimate, is provided below:

- *Underestimate of Effort* – This cost element represents the underestimated effort required to execute the project based on the original scope of work. The staffing levels required to manage the work, generate CWPs/ ITPs and integrate the project plans into the OPG work management system were much greater than the original budgets allowed.
- *Design Scope Growth* – Represents the increased construction cost of the project from the original concept. The design engineering was a fixed price. Bidding took place on preliminary design requirements and a conceptual design report with many assumptions that were later invalidated. The absence of the MDR at the time of bidding meant that it was impractical to estimate the project beyond an AACE Class 5 quality level.
- *Underestimate of Permanent Plant Materials*
    - 367% increase in the quantity of process and service piping from 3,000M of piping to >14,000M.
    - 340% increase in the quantity of valves from 250 valves to ~1,100 valves.
    - 40 % increase to the electrical load list including additional equipment such as a UPS and Diesel generator that were not previously in the design requirements.
- *Environmental Requirements* – The project was awarded on the basis that the soil and ground water were free of contamination, an assumption that proved incorrect. Soil testing revealed the presence of tritium above acceptable levels, requiring special soil storage and operational requirements to manage the water runoff.
- *Building Relocation* – The original design concept had a new building with a "shared wall" in contact with the existing west wall of the TRF Building. However, the new foundations for the D20 interfered with the existing foundations necessitating a seven (7) meter relocation of the building to mitigate the conflict. This meant that the building now required four (4) architecturally completed sides rather than the original 3-sided finishes. More significantly, the scant pile (caisson) foundation shoring system became significantly more complex.
- *Schedule Acceleration and Extension required for:*
    - Premium time expended to recover lost time on the critical path and meet outage requirements.
    - Premium time planned critical work and make-up days for inclement weather

Auxiliary Heating System

Our analysis of the Auxiliary Heating System estimates yielded the following summary highlights:

- The current EAC was provided by the contractor just after the 4c estimate effort was complete. The contractor's EAC was provided in a high-level letter and spreadsheet form, which the project team did not dive into or vet.
- On this project, nearly every category of cost has increased significantly. The overall project, including interest and contingency is projecting an overrun of 87%.
- As of the March 2014 Program Status Report, the project is reporting 60% complete ($24M earned on a BAC of $40M).

Summary of Aux Heating Cost Variances between the Latest BCS and the Current EAC

Cost Category	BCS/Gate 3	Current EAC	Variance	% Increase
[redacted]				
TOTAL	$ 45,607	$ 85,103	$ 39,496	87%

The primary cost driver behind the $9.5M increase in engineering costs include $5M of additional Phase III engineering $3M for items that were simply underestimated. For example, HSL underestimated the cost of working in accordance with OPG's review processes; OPG's design review and approval processes are more time consuming than HSL anticipated. The team explained that OPGs EC process is very time consuming as compared with a commercial process. In addition, lack of detail and definition of scope at the beginning impacted the quality of the estimates and bids, including F+G's estimates.

RFR Island Support Annex

Our analysis of the RFR Island Support Annex estimates yielded the following summary highlights:

- For the current EAC, the team relied on high level cost data provided by the contractor which the team did not vet. This information was used at Gate 3B in February 2014.
- The RFR Annex Project is currently projecting a project cost of $40M, or $8M over its 4c estimate of $32M at the last project gate, for an overall increase of 25%.
- As of March 2014, the project is reporting 20% complete ($7M earned of a BAC of $33M).
- The EPC portion accounts for 91% of the overrun, with engineering comprising half of the overrun, procurement and construction 40%, and OPG costs, contingency and interest making up the balance of the overrun. See the table below for additional details.

Summary of RFR Island Support Annex Variances between the Latest BCS and the Current EAC

Cost Category	4C Estimate	Current EAC	Variance	% Increase
Project Costs	$ 23,265	$ 31,280	$ 8,015	34%
Interest	$ 1,973	$ 1,966	$ (7)	0%
Contingency	$ 7,266	$ 7,492	$ 226	3%
Total Project Cost	$ 32,504	$ 40,738	$ 8,234	25%

The following table briefly explains and summarizes the cost increases by $ and % of the RFR Annex Project is shown as follows:

Cost Category	Variance	% Increase
Engineering		
[redacted]		
Total Project Cost Increase	$ 8,234	25%

This project team has done a better job of trying to allocate the cost increases between scope increases and contractor underestimates as shown above.

- The main driver of cost overruns on the current EAC is contractor cost, specifically engineering. The primary issue is that the engineer, HSL, is unfamiliar with OPG's internal processes for design review and approval. The project team feels that Engineering is approximately 80% complete though there are no metrics to confirm; 16 of 22 design packages are complete.
- Communication direction between OPG and HSL has been an issue driving up the engineering costs; OPG's and HSL's processes are not aligned. HSL bid the job assuming that it would be a typical "commercial" level job, i.e. would not require extensive owner review and signoff. Instead, OPG's review and approval process has required much more level of effort from HSL than originally bid.
- In other instances, HSL has over anticipated OPG expectations and burned hours performing unnecessary engineering that could have been mitigated by better communications (e.g. the replacing and redesigning pole supporting security camera. OPG expected to simply mount the camera on an existing pole while HSL anticipating camera vibration issues engineered a new pole replacement).
- The ESMSA contract process has caused more engineering cost by shifting more risk and liability to the engineer. The work is subject to more stringent codes and is performed by different trades which HSL did not anticipate. That also drives up the engineering cost. The work is subject to more stringent codes and is performed by different trades which HSL did not anticipate. As a result, cost overruns for engineering alone equate to an additional $100 per square foot in building costs.

Water and Sewer

As of December 2013 the project was reporting 81% complete ($36.9M earned on a BAC of $45.7M). The Water and Sewer Project is currently projecting a cost increase of $8.3M on a budget of $54.0M or an increase of $18% as shown below:

Cost Category	BCS/Gate 3	Current EAC	Variance	% Increase
OPG Project Management	$ 3,237	$ 3,764	$ 527	16%
OPG Engineering	$ 705	$ 688	$ (17)	-2%
OPG Other	$ 983	$ 2,298	$ 1,315	134%
[redacted]				
Total	$ 45,703	$ 57,712	$ 12,009	26%

- The major driver of this cost increase is in the cost of the construction contracts, due to contractor underestimating the value of change requests, additional change requests not identified or anticipated and increased contractor indirect costs due to schedule delays.

- On a pure percentage basis, the major driver is the OPG other costs which have proved to be higher due to underestimate of the level of effort needed from OPG's Operations Manager, Operations, Project Oversight and Field Support and Drawing Office.
- The EAC for this BCS was based on actual invoiced additional changes as well as internal OPG estimates of the cost of anticipated contract changes.
- Another increase in overall cost of these projects has been due to the nature of the underground work – unforeseen conditions, soil conditions, and undocumented actual conditions.
- Compared to the other projects, water and sewer is well underway. Phase I is 100% complete; phase II is 100% complete on engineering and 75% construction; phase III is scheduled to complete by November 2014 and construction is scheduled to complete by June 2015. However, the work is demolition of the old water treatment plant and is less complicated than the other earlier scopes.

Report to Nuclear Oversight Committee

1st Quarter 2015

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

March 12, 2015

MODUS Strategic Solutions CANADA

Report to Nuclear Oversight Committee – 1Q 2015
Darlington Nuclear Refurbishment Project

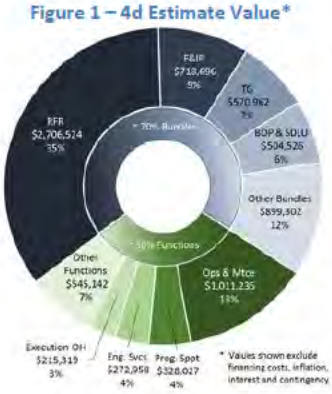
Burns & McDonnell CANADA

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of February 25, 2015. Our main focus for this report is the status of the DR Team's preparation of the Release Quality Estimate ("RQE") that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value*



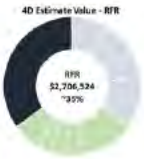
For purposes of evaluating the DR Team's progress in preparation for RQE, we have provided the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts. The following are the most notable cost elements of the DR Project at this time:

- **RFR** constitutes approximately 35% or $2.7B of the DR Project's estimated costs;
- **Turbine Generator** constitutes approximately 7% of the DR Project's estimated costs;
- **Balance of Plant and Shut Down/Lay-up** constitute 6% of the estimated costs; and
- **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the inputs to RQE progress, the DR Team will be comparing its revisions to the breakdown presented here from the 4d estimate.

Over the last Quarter, the DR Team has spent a significant amount of time evaluating its plan and processes for developing the components of RQE, including improving the data the team and management will need for analysis and establishing confidence. The following is a brief summary of the status of the major inputs to RQE:

Retube and Feeder Replacement:



SNC/Aecon's Class 2 Estimate is the single largest input to RQE. OPG's Project Team recognizes the importance of this estimate and had requested SNC/Aecon to advance the delivery date to April 10, 2015 (from its original plan May 15, 2015). [redacted] OPG has granted a 2-week extension to April 24, 2015 [redacted] The OPG team is preparing for this review period and intends to vet the various estimate components to ensure they meet the DR Project's needs. Also, [redacted] OPG's Project Team is mindful of the Campus Plan Projects lessons learned and thus rejected SNC/Aecon's estimate. The OPG team has a clear understanding of the issues that need to be resolved to arrive at final target price with SNC/Aecon, though significant work remains, thus the current risk level.

Turbine Generator:

SNC/Aecon is on pace to complete its Class 2 Estimate by late 1Q for Unit 2. Some commercial issues related to the phasing of the turbine generator work over the four units will need to be resolved.

Steam Generator:

No issues are apparent at this time; these estimates should be sufficient for RQE.

Low Moderate High
No Change
Decreasing Increasing

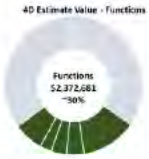
Balance of Plant/Shut Down-Lay-up:

Detailed engineering for these bundles will not be fully complete by the May 15, 2015 target date; thus, development of Class 3 estimates for this work will be challenged to meet the RQE milestone. However, as we previously noted, from a cost standpoint, these estimates in total constitute approximately 6% of the direct costs of RQE, and the non-modification work (approximately half of Balance of Plant) is not engineering dependent and should have mature estimates for RQE. Balance of Plant and Shut Down/Lay-up project teams are proceeding with developing estimates based on the best possible information. The team is committed to carrying appropriate contingency for remaining uncertainties within RQE.

Fuel Handling/Defueling:

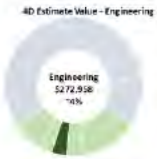
The DR Team is targeting Class 3 level estimates for RQE, and this appears to be an achievable goal, though some challenges remain with vendor submissions for non-critical path work. Defueling constitutes only about 2% of the direct costs of RQE, but it has a much higher risk profile due the reactor's defueling which occurs on the critical path. Therefore, careful planning, risk mitigation and adequate contingency are essential. Execution of the Fuel Handling Equipment Reliability plan is underway to ensure uninterrupted defueling operation.

Functional Groups:



Currently the DR Team is placing adequate focus on development of the functional group (indirect) costs. The DR Team has addressed a gap from 4d and is committed to developing detailed functional management plans that will allow management to fully vet all critical planning bases for the DR Project's management team. The functional groups must also follow-through on commitments for cost reductions included in the 4d Estimate by incorporating those reductions into their management plans.

Detailed Engineering:



The majority of the Project's detailed engineering should complete by May 15, 2015. While there are certain to be outliers to this milestone, the Project Team should be in substantial compliance with its goal to define engineering and scope sufficiently to support RQE.

B. Campus Plan Highlights

D20 Storage: As of this writing, the team is in continued negotiation with the ESMSA vendors over the D20 Storage Building's mechanical/electrical/plumbing ("MEP") completion package, and is evaluating the risks associated with this award. Construction of the foundation is ongoing though with some impacts from weather, and P&M is attempting to mitigate future delays by directly purchasing over 600 valves needed for construction.

ES Fox Resources and Capacity: ES Fox's field construction was impacted by two separate High MRPH safety incidents; these events plus ES Fox's overall support of the P&M and Refurbishment projects contributes to existing concerns regarding ES Fox's capability to support the volume of its Project work. OPG senior management has raised these concerns with ES Fox, and corrective actions are underway. ES Fox has committed to adding resources in key areas, including project management and project controls.

P&M Staffing: P&M has added resources at the Director level and is embarking on additional training and instruction for its management team, including inserting lessons learned to date from the Campus Plan Projects.

P&M's Project Controls: P&M's Project Controls will consolidate under Refurbishment. This means that common processes and procedures, including using work-hours for schedule performance tracking, should be employed for future work, including D20 Storage's completion. However, many of P&M's projects will not be fully standardized. P&M has several initiatives underway with the Project Controls team to track these projects, as discussed below.

II. Refurbishment – Areas of Focus

A. RQE Processes, Procedures and Team Alignment

The DR Team has formalized its RQE processes in conjunction with the RQE Roadmap presented to NOC in the January Meeting. These processes include a full re-examination of the requirements for each sub-project's Gate 3 submissions and Functional Management Plan ("FMP") submissions. In developing and finalizing these processes, the DR Team has addressed many process gaps BMcD/Modus identified in the 4d Cost Estimate regarding underlying documentation, quality checks, and assuring proper time and opportunity for management vetting of the results.

- **Schedule:** The RQE Roadmap has well defined milestones that have been fully vetted within the DR Team, and who is being held accountable to meet deadlines. The RQE Roadmap provides sufficient margin for developing program-level reviews for quality and contingency development. The DR Team has set goals for multiple RQE deliverables, including project playbooks, execution plans and improved functional management plans that are due in 1Q 2015. The detailed RQE working level schedule remains under development and will be completed in early March. The RQE team will conduct weekly meetings to review the schedule for adherence e with dates and quality of the products.
- **Estimating:** The team has rolled out new processes that will be applied to estimates for the projects and functions. The largest projects (RFR, Turbine Generator) are currently following estimating processes that conform to the new standards. This process moves the DR Team from parallel independent estimating used for validating bid proposals, which sometimes created confusion, to increasing focus on vetting of the estimates the contractors and work groups provide. This should provide greater confidence in the estimates underlying RQE. Moreover, previous quality concerns are being addressed with new processes.
- **Documentation of RQE**: The DR Team is preparing the following for RQE that will, when complete, provide a solid basis for vetting and a baseline for future comparison to actual project performance:
  - Data alignment to allow for transparency in support of project and regulatory reporting
  - Functional Groups are required to submit Functional Management Plans in advance of and in support of staffing estimates;
  - Project Teams are preparing "playbooks" that document execution method and other estimating considerations;
  - Project Teams and Contractors are engaged in "Day-in-the-Life" reviews to fully vet execution planning details, mitigate potential gaps, and consolidate similar common work scopes.

  We have additionally recommended the DR Team develop a formal division of responsibility ("DOR") matrix that clarifies goals, highlights potential gaps in performance and memorializes accountabilities.

- **Gate 3 Process**: The RQE team has re-evaluated and re-issued the process for the coming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has established clear rules for developing the documentation for Gate 3s, as well as a typical sequence of events so that both the Project Team and the reviewers can be adequately prepared. In addition, Finance is prepared to provide "Black Hat" reviews of the Project Team's gate packages to provide appropriate challenges to the information presented. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE.

B. Engineering Status for RQE

As of February 1, detailed engineering for the DR Project was 79% complete. The most significant design packages – RFR (~69% complete) and Turbine Generator (~90% complete) – have produced sufficient engineering product for their respective Class 2 estimates. Lagging behind are BOP and Shut-Down/Lay-up (~30% complete), and completion of the BOP engineering is a concern. However, the DR Team's overall engineering effort should produce sufficient output to adequately support RQE and reduce the risk that late engineering work presents. The engineering process has been

significantly aided by:

- **Front End Planning:** The DR Team and the vendors are working together, increasing the efficiency of engineering and providing a more complete product. In turn, the improved engineering product allows for better assessment for the purposes of developing RQE estimates.
- **Active Management:** OPG's leadership as design authority and proactive management of the engineering phase is driving more timely and appropriate decision making.
- **Collaborative Approach:** The placement of resident engineers in the offices of the engineering service providers is expediting the engineering process.

However, Projects & Modifications, who adopted these initiatives after the Campus Plan Projects were underway, continues to struggle with delayed engineering and problems masked by a lack of vendor transparency.

After considerable effort, the DR Project's engineering schedules are now almost completely integrated at level 3, many of these are also resource loaded. Consequently, the DR team now has insight into the resource demands created by the Project's design effort. The availability of the detailed design information is allowing for very tight monitoring of the completion of the detailed engineering design, and identification and resolution of remaining delays. This same approach now needs to be applied to downstream activities in order to forecast future critical resource needs in advance of the peak demand. The schedule and performance metrics and the quality dashboard deployed by Engineering allow the DR Team the opportunity to plan around and mitigate delays and issues with resources and the quality of the engineering product. With the possible exception of the pre-requisite projects (discussed herein), the slippage in the engineering schedules is not likely to affect the breaker open milestone, as more than adequate float exists for performance of most project work.

Other ongoing Engineering initiatives include the following:

- **Benchmarking**: A recent benchmarking exercise with Exelon, while validating the rigor of OPG's engineering change process, identified some areas worthy of further consideration including the benefits from self-performing procurement. Whereas the planned benchmarking with Bruce Power will support collaboration in the CANDU industry in Ontario, we also encourage OPG to pursue their involvement in INPO's planned nuclear engineering benchmarking exercise.
- **LEAN Process**: From an engineering efficiency perspective, we endorse OPG's LEAN evaluation of the engineering change process in order to identify areas where value can be enhanced. This goes hand-in-hand with Engineering's commitment in 4d to reduce its functional cost by 15%.
- **Quality Dashboard:** Project Engineering has created a quality dashboard, focusing attention on nine aspects of engineering quality. Data validity issues with these metrics continue to be addressed along with several process shortfalls that were brought to light by the creation of this dashboard. We view this quality dashboard as a proactive and innovative initiative by the DR team. The SCR process continues to be the vehicle of choice for identifying specific quality issues.

C. Areas of Focus - RQE Quality

RFR Project-Class 2 Estimate	Overall Risk Perspective

RFR represents approximately 35% of the total estimated DR Project cost. SNC/Aecon's progression to its Class 2 Estimate and the parties' ultimate agreement to a target price for performance of the work represents the largest portion, thus the largest risk to RQE. Moreover OPG is motivated to close the approximate $700M gap between SNC/Aecon's Class 3

Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. This gap was due to OPG's well-founded determination that SNC/Aecon's Class 3 estimate was very conservative and there were multiple opportunities that SNC/Aecon needed to realize and take into account in the Class 2 estimate and its planning for RFR's execution.

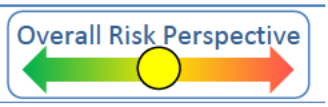
As noted, SNC/Aecon's work on the estimate is behind an agreed target of April 10, 2015, resulting in its request for a 2 week extension of time to complete its work. At present, based on the multiple deliverables that SNC/Aecon is required to provide OPG, SNC/Aecon claims its overall completion is **57%** at this time. The following are concerns that are indicative of this effort to date:

- Construction Work Packages ("CWP's") form the basis of the detailed estimate and schedule, and are a key tool in establishing the direct field labor component of the Class 2 estimate. To date, SNC/Aecon reports being 70% complete with CWPs, though OPG only recently received the majority of these for review.
- The Tool Performance Guarantee ("TPG") testing is ongoing at the DEC's Mock-up Facility, and these tests have produced good-to-excellent results that should reduce the estimated direct field labour from the Class 3 estimate. However, the OPG team has observed SNC/Aecon's attempts to re-introduce risk and uncertainty into the estimate that negates these results. The OPG team has strongly objected to SNC/Aecon's attempts to do so.
- SNC/Aecon intends to assemble the Class 2 estimate into "chapters" to allow for OPG and other stakeholders vetting. SNC/Aecon is 4-6 weeks behind its schedule for producing these chapters and other key material OPG needs to properly consider the quality of SNC/Aecon's estimate.
- We have observed that SNC/Aecon's earned value trend for the tasks associated with developing the Class 2 estimate is growing increasingly negative. SNC/Aecon has expended 50% to 75% more hours than planned each of the last 3 months in estimating; nonetheless, its deliverables are not meeting the schedule target. We have challenged whether SNC/Aecon has recognized that its original work estimates are under-estimated and whether they have appropriately staffed the work to finish the work on the Class 2 estimate.

The result of SNC/Aecon's delays is that the OPG team will likely receive a much larger quantity of material from the SNC/Aecon to review and vet at the completion milestone than it expected when the process began. This happened with last year's Class 3 estimate, though the consequences around approving that estimate were much less severe than this time. In a recent Executive Oversight meeting with the CEOs of each company present, Tom Mitchell asserted OPG's expectations for SNC/Aecon to submit a transparent estimate with high quality, and that the parties may need to have a discussion at the appropriate time to discuss apportioning risk in order to disposition the likely gap between SNC/Aecon's estimate and OPG's assessment of it.

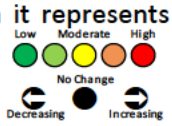
BMcD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG accelerating its review period. If current trends continue, RFR is unlikely to meet the current RQE milestones for its Gate 3 submission, at a minimum.

Refurbishment Waste Processing Building (RWPB)



SNC/Aecon submitted a proposal for the RWPB, which is where SNC/Aecon's waste processing and volume reduction machines for disposing of removed contaminated reactor parts will reside. This proposal was rejected by OPG due to its lack of detail and inadequate schedule, which showed this building completing in the 2Q of 2017, well after breaker open of Unit 2. Moreover, this proposal for $93M is approximately $11M more than what OPG carried in 4d, which was a red flag to the OPG team.

Recognizing lessons learned from the Campus Plan Projects, OPG's RFR team has engaged SNC/Aecon in a series of challenge meetings intended make SNC/Aecon produce a more detailed schedule and cost estimate that is properly supported. This should be achievable largely because this building is not very complicated, though it represents a



distraction to the RFR team at a critical time. The OPG team is seeking to avoid the kind of cost creep that has impacted many of the Campus Plan Projects by having a solid cost estimate and schedule in place for RWPB at the work's outset, and have transparency to SNC/Aecon's subcontractors' work. OPG's VP of Execution initiated a weekly focus meeting on RWPB's challenges with SNC/Aecon leadership, which has increased the visibility of the issues. In order to reverse prior trends established by the Campus Plan Projects, it is critical for OPG to obtain and vet a detailed, well-formulated estimate from SNC/Aecon for RWPB and hold SNC/Aecon accountable for performing to that estimate. In addition, OPG is considering potential work shifting and award of other ESMSA work to SNC/Aecon that could benefit the overall program, particularly if SNC/Aecon can establish economies of scale with similar projects to RWPB.

BOP / Shut-Down/Lay-up

As we have noted in prior reports, the BOP and Shut-Down/Lay-up projects will be challenged to produce Class 2/3 estimates for their modification work projects in time for RQE. The BOP and Shut-Down/Lay-up project managers are mitigating these delays to the extent possible by monitoring the completion of engineering and assessing and advancing development of estimates for this work. The result for RQE should be estimates for this work in the Class 3-4 range with more refined Class 2 estimates available for the Project's planned 2016 Unit 2 check estimate. Assuming the engineering and planning work proceeds as planned, the impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. BMcD/Modus is more concerned over ES Fox's capability for planning and executing this work, which we discuss in more detail below.

Functional Groups

The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE team has been working to develop processes needed to increase the amount of detail the functional groups develop for their RQE estimates, and as noted, we see significant progress in this regard. Each functional group was challenged by the Project's VPs to reduce or otherwise rationalize their estimated costs for the Execution Phase, resulting in commitments from each to do so. It is important that those commitments are tracked to completion to avoid re-hashing old ground for RQE, and so management does not have to issue across-the-board directives to reduce cost.

II. Campus Plan

A. P&M Management

P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

1. Vendor Performance Issues

We have ongoing concerns, shared by the DR Team, regarding ES Fox's bandwidth to support the volume of the upcoming work on the DR Project. These issues are acute at this time as ES Fox has a number of "in-flight" P&M projects while also being required to support planning efforts for multiple Refurbishment projects. Our comments regarding ES Fox's scheduling and cost estimating capability have been discussed in prior reports, [redacted]

In addition, ES Fox must prepare approximately 45 separate project estimates for BOP and Shut-Down/Lay-up Refurbishment projects prior to RQE and oversee the final development of the associated detailed engineering packages from its engineering subcontractors. The Refurbishment BOP and Shut-Down/Lay-up directors have tasked ES Fox with developing estimates and schedule pilots that will be used as a template for the remaining estimates; these pilot estimates and schedules are under review.

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. ES Fox's actions bear watching, as their ability to complete these critical Campus Plan Projects while simultaneously supporting the planning of BOP and Shut-Down/Lay-up work for Refurbishment is a growing risk to the Project. The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors.

2. Major Campus Plan Projects

D2O Storage Facility

The DR Team has prepared a Superseding Business Case Summary ("BCS") recommending an additional release of $270.9M, including [redacted] of contingency, with a projected total cost of $381.1M. The BCS examined four alternatives, including slowing down construction at different points and abandoning D20 Storage entirely. The BCS also considered and established the basis for an alternative plan to draining water from Unit 2 in the event that D20 Storage construction is further delayed, and the DR Team has established trigger dates for proceeding with the alternate plan in sufficient time to procure temporary tanks and other material if needed. BMcD/Modus believes the BCS has appropriately considered the reasonable options at this time and provides a basis for justifying the decision to proceed with the best available option, completing D20 Storage based on the original design in time for Refurbishment.

With $123.1M spent to date, the remaining cost to complete is estimated at $258M, of which approximately $140M is estimated for the new completion contract. As of this time, the award for the MEP completion of D20 Storage had not been made, as the OPG team is considering which of the ESMSA contractors should be awarded the completion of the work. In any event, the contract needs to be awarded and progressed by mid-March so that the selected contractor can begin piping prefabrication, procurement and further development of its execution schedule. The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.

Based on the current D20 Storage schedule, the revised plan appears achievable, though with all of the issues to date,

completion of the building will require close attention by the DR Team. Once the contract award is made, we recommend the P&M team: (1) re-evaluate the project risks based on the revised execution model; (2) fully vet the schedule and earned value set-up; (3) apply the project controls strategy to the completion of the foundation work.

Auxiliary Heat

As noted, the work on the Auxiliary Heat System Building ("AHS") was impacted by ES Fox's safety stand-down following two separate safety incidents. AHS is also impacted by the change to the Vacuum Building Outage ("VBO"). AHS was initially planned to be commissioned before the VBO in the spring of 2015, though its completion was later relaxed because it was determined that the building was not needed for the spring VBO. However, AHS now must be available for service for VBO in the fall. The AHS schedule had slipped by 2 months to October 2015 due to the Steam and Condensate tie-in window changing. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of $85.14M is being challenged by ES Fox, who has over $6M in change orders ($5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, in particular because ES Fox has spent 78% of its EPC contract value through February 1, 2015 and ES Fox's SPI continues to deteriorate. P&M needs to validate these figures, and needs to ensure that ES Fox is motivated to expend the needed direct field labour to complete this project.

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

Emergency Power Generator 3

EPG 3's current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date is at risk by as much as 2 months. ES Fox's performance indicators continue to deteriorate and the Project's EAC is $96M, an increase of $8M since 4d. Engineering completion has been delayed to May 2015 due to vendors' performance challenges. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox's additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M's management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox's performance. Given the short timeline to complete this SIO project, ES Fox will need to increase its effort and improve its performance.

III. Other Focus Areas

A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG's corporate units to support the DR Project. Among the Project Team's recent issues is highlighting its software needs for IT to implement needed changes, particularly for change project controls systems needed for project. Large capital projects often struggle using enterprise level business systems to support project needs, and recognition of the shortcomings of the current systems is timely. A similar approach should be pursued with other corporate policies; as previously discussed, tailoring hiring and talent retention processes for short-

term project needs often requires flexibility that is not advisable for normal operations.

B. Project/Station Integration

Integration between the Project and the Darlington Station needs to be addressed. P&M projects have missed or are projected to miss tie-in dates to the plant, in part due to vendor performance but also due to the Station demanding a level of precision from the Projects that is difficult to achieve from a project environment. BMcD/Modus will be advancing our timeline for a more detailed assessment of this integration and will identify any process or procedural gaps.

In addition, with the shifting of the VBO, the DR Team and the Station will need to re-assess their mutual priorities and assess any impacts to either cost or schedule.

Report to Nuclear Oversight Committee

2nd Quarter 2015

Darlington Nuclear Refurbishment Project

DRAFT

Burns & McDonnell
Modus Strategic Solutions

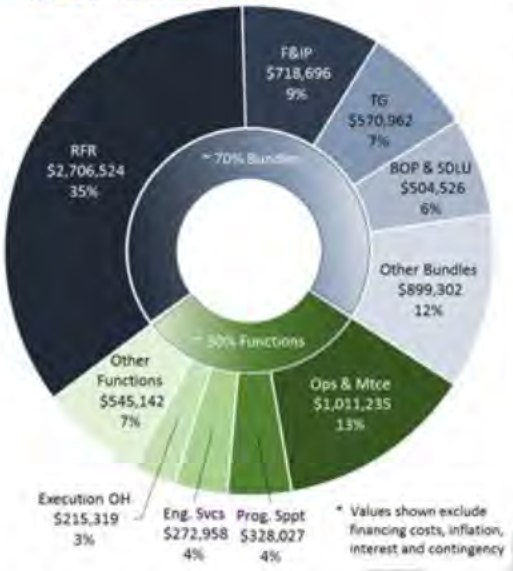
May 21, 2015

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of May 8, 2015. Our main focus continues to be assessing the status of the DR Team's preparation of the Release Quality Estimate ("RQE") that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value*



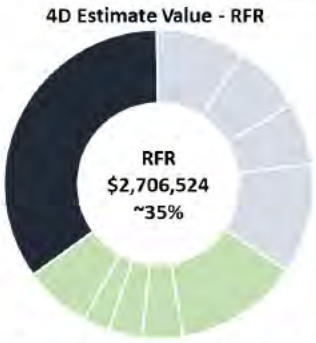
As with our 1Q Report, we provide the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts, as a basis for gauging the Project Team's RQE progress. The following are the most notable cost elements of the DR Project at this time:

- **RFR** constitutes approximately 35% or $2.7B of the DR Project's estimated costs;
- **Turbine Generator** constitutes approximately 7% of the DR Project's estimated costs;
- **Balance of Plant and Shut Down/Lay-up** constitute 6% of the estimated costs;
- **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the development of the inputs to RQE progress, the DR Team will be comparing variances based upon the breakdown presented here from the 4d estimate. Over the last Quarter, the metrics and the processes the DR Team has put in place to track its RQE progress have accurately depicted areas where the team is meeting its plan and other areas that have fallen behind. The largest components to RQE – the Retube and Feeder Replacement ("RFR"), Turbine Generator ("TG") and project functional costs - are capable of meeting their end milestones, as are Steam Generators, Islanding, and Fuel Handling/Defueling. However, Balance of Plant ("BOP") and Shutdown/Layup, which are an aggregation of smaller projects, are well behind, prompting the Project Team to reprioritize its efforts and approach with both the vendors and the basis for RQE.

The following is a brief summary of the status of the major inputs to RQE:

Retube and Feeder Replacement:



SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Over the last quarter, SNC/Aecon and OPG have made significant progress in the development of the Class 2 Estimate, identifying the major areas where the parties agree and distinguishing the issues that will need to be resolved prior to negotiating a Target Price for the execution phase. Significantly, the parties have agreed on the basic parameters of RFR's critical path schedule duration, and agreed to eliminate schedule contingency that had been built into SNC/Aecon's Class 3 Estimate. Thus, the agreed schedule that is at the heart of the Class 2 Estimate represents an aggressive, but reasonably achievable plan for Unit 2.

Nonetheless, considerable vetting work remains ahead over the next 4-6 weeks to confirm that the quality of SNC/Aecon's estimate is sufficient to qualify it as a Class 2 Estimate. On May 8, SNC/Aecon delivered its first full project estimate report for OPG's review. While the OPG team has been vetting the discrete sections of the estimate as it has been assembled, the team needs to now carefully consider how the various parts fit together.

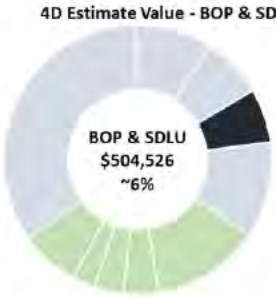
Simultaneous to the estimate development, the parties have commenced some high-level commercial discussions at the project executive and CEO levels in an attempt to identify any major contract or commercial issues that will need to be resolved before the Execution Phase contract can be awarded to SNC/Aecon. Primarily, there remains a sizeable pricing gap between the parties that needs to be narrowed to the extent possible. OPG has identified specific areas for possible negotiation and is planning to discuss these items with SNC/Aecon in stages through June 15th. We have urged OPG to take whatever reasonable time is necessary to properly vet the Class 2 Estimate and associated schedule, most notably the near critical path work, to ensure that the estimate represents an achievable plan and comports with Class 2 parameters.

[redacted] OPG's Project Team is mindful of the Campus Plan Projects' lessons learned and thus continues to challenge SNC/Aecon's estimate. Limited field work has been started in parallel with SNC/Aecon's further attempts to bolster its estimate. RWPB has a separate Gate 3 from RFR in early June by which SNC/Aecon must complete its estimate.

Turbine Generator:

SNC/Aecon issued its Class 2 Estimate for the Turbine Generator for Unit 2 on May __, and Alstom has completed its detailed design. SNC/Aecon still must complete its estimate for the TG control work for the subsequent units, and reports it is on track to meet its July 31, 2015 deadline. OPG used the TG estimate as a proving ground for its new estimate vetting process, and this was a significant success. The OPG estimating team sampled approximately 3,000 line items of cost, or over 50% of the estimate, and issued hundreds of comments that SNC/Aecon had to disposition. We believe this process should be repeated for each of the major units of cost on the project. In addition, the parties resolved the commercial issues related to the phasing of the turbine generator work over the four units. SNC/Aecon needs to meet its commitment to identify economies of scale across its entire portfolio of work (RFR, TG, D20 Storage) that should reduce Project overhead cost.

Balance of Plant/Shut Down-Lay-up:



Detailed engineering for the projects will not be completed by the May 15, 2015 target date. Based on current performance trends, BOP and Shut-Down/Lay-up will be challenged to meet the August detailed design complete milestone. Moreover, [redacted] This inability poses a significant risk to Refurbishment that the team is attempting to mitigate.

The BOP and Shut Down/Lay-up project teams are injecting collaboration into the estimating process to reduce potential gaps and misses that have been evident in the Campus Plan Projects. These bundles are attempting to overcome the lack of mature, detailed design to the extent possible and have directed the Contractor to develop estimates based on the best possible information at this time, though it is unlikely that these bundles will obtain estimates above Class 5 for the majority of this work prior to RQE. In addition, the team is taking appropriate action to re-prioritize those work packages based on the Execution Phase schedule's needs. OPG senior management has significantly ramped up project executive-level attention to the vendors' difficulties. The team is committed to rejecting work product of insufficient quality and intends to carry appropriate contingency within RQE. Refurbishment also needs to ensure that it is carrying program level contingency sufficient to account for the ESMSA vendors' known deficiencies in engineering progress, estimating and scheduling. In addition, [redacted] While from a cost standpoint, the BOP and Shut-Down/Lay-up estimates constitute approximately 6% of the direct costs of RQE, our concern is that the vendors' issues will drain a disproportionate amount of management attention and divert focus from the more significant scopes of work, which continue to be a risk to Refurbishment through the Execution Phase.

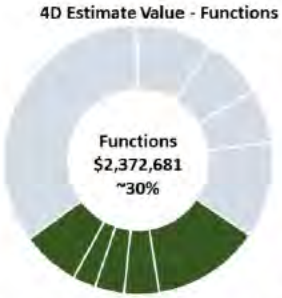
Fuel Handling/Defueling:

The DR Team is targeting Class 3 level estimates for RQE, and the team's work over the last quarter has improved the overall outlook for both the estimate and the technical basis for the work. While defueling constitutes only about 2% of the direct costs of RQE, it has a much higher risk profile due to the reactor's defueling which occurs on the critical path. Prior challenges with the vendor's supply of fuel handling equipment appear to be resolved, and the team is working to a more aggressive commissioning schedule to increase schedule float and reduce overall risk. The team has also worked to distinguish differences between Bruce Unit 1's defueling performance and its own planning for Darlington, and is focused on realistic opportunities for shaving time off the current estimated 113-day defueling cycle.

Steam Generator:

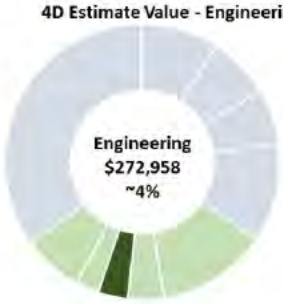
No issues are apparent at this time; these estimates should be sufficient for RQE. The team has addressed prior quality issues and its recovery plan has been successful.

Functional Groups:



The RQE Roadmap milestone for the DR Team's functional groups to complete their management plans and estimates by May 15th will not be met. The functions have developed initial management plans and related estimates which in aggregate are showing the potential to exceed the amounts provided in the 4d Cost Estimate. While it is still early in the vetting process and no firm conclusions should be drawn from this initial review, it is evident that management will need to devote significant attention to right-sizing the team, developing clear roles and responsibilities and locking down appropriate assumptions for RQE. We have recommended the team develop a detailed division of responsibility ("DOR") matrix to ensure there is no unnecessary cross-over or large gaps in the functional responsibilities within the Project. We have also provided some input to the team to increase the level and effectiveness of the vetting of these costs. Our team will be included in the "black hat" reviews led by Finance of the RQE estimates for the functional groups.

Detailed Engineering:



The Project's Detailed Design is 86% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE. However, BOP and Shut-Down/Lay-up engineering is delayed which is partially driving these bundles' cost estimates to miss current and downstream milestones. [redacted] these will require monitoring. The Engineering team's quality metrics highlighted some early warning signs, prompting the engineering VP to hold a brief stand-down of the vendors to examine quality and corrective actions. Thus, OPG management has visibility to the remaining engineering work and is timely managing those problems that manifest themselves.

B. Campus Plan Highlights

D20 Storage: P&M has issued a letter of intent ("LOI") to SNC/Aecon to perform the mechanical and electrical portion of the work for D20 Storage. The LOI's terms provide for $5M in funding and a 6-week time period for SNC/Aecon to refine its detailed estimate and schedule for the work, upon acceptance of which a final, conformed contract will be issued. P&M believes that the cost associated with the SNC/Aecon contract will be less than the $140M in 4d and will provide greater confidence in the overall cost and schedule. OPG is managing Ellis Don in the construction of the foundation, which is attempting to recover weather impacts. Ellis Don is currently working on its baseline schedule

for the remaining civil work. P&M is working with SNC/Aecon to mitigate delays in purchasing over 600 valves needed for construction.

- **ES Fox Resources and Capacity:** [redacted] OPG's senior management has escalated its concerns to ES Fox's executives, and secured Fox's commitment to add resources in key areas, including project management and project controls, [redacted] ES Fox has projected that it will exceed its baseline estimates on key P&M projects (Auxiliary Heat Building, EPG 3, RPO and RFRISA) and [redacted] In any event, OPG needs to perform adequate due diligence in vetting these cost increases and [redacted]
- **P&M Organization**: The focus on P&M's staffing, structure and capabilities for managing work for both the DR Project and the ASIC project portfolio is still under review. The additional senior resources that have been added to the team have had a positive impact on P&M's performance.
- **P&M's Project Controls:** P&M's Project Controls will continue to consolidate under Refurbishment and share processes and resources. The schedule for D20 Storage will be a transition point and allow for the team to establish appropriate metrics for tracking the work. In addition, the EPG 3 schedule for execution and cost estimate for completion is the next in line for detailed vetting, and should take into account the lessons learned from AHS.

II. Refurbishment – Areas of Focus

A. RQE Status Summary

In our 1Q 2015 report, BMcD/Modus noted that the team had put in place a processes for tracking RQE deliverables including a schedule and tracking metrics. The early milestones supporting RQE were generally met, though the underlying metrics are forecasting that a significant number of upcoming milestones will be missed.

The RQE Roadmap that provides all of the high-level RQE milestones has been augmented by a weekly report called the "Playbook #1 Weekly Execution Report". This Report measures the DR Team's progress against its plan for the Project-level cost estimates and schedules needed for RQE. The team has identified a total of 341 sub-project estimates and 226 sub-project schedules that are needed to support RQE. Of the estimates, 165 of the 341 (48%) and 156 of the 226 (69%) of the schedules are for numerous smaller projects under two project bundles – BOP and Shut-Down/Lay-up. Both of these project bundles' primary vendor is ES Fox. By comparison, the projects that represent the majority of the cost – RFR and TG – constitute only 10% of the number of individual estimates and schedules. Thus, these metrics are not intended to portray the weight of these deliverables to RQE but do provide a "bean count" of the remaining work and visibility to work that is falling behind schedule.

As of May 1, these metrics show that the smaller BOP and Shut-Down/Lay-up projects are lagging well behind the RQE Roadmap schedule. BOP estimating is 6% complete and 66% of its estimates are tracking behind schedule. The Shut-Down/Lay-up estimates are 11% complete, and 84% of these estimates are behind schedule. These delays mean that the estimates and schedules provided by these bundles in support of their upcoming Gate 3 meetings will be substantially below Class 3 quality. By contrast, the largest projects – RFR and TG – are generally on pace to meet the RQE milestones with Class 2 Estimates by the end of June.

Engineering maturity remains a leading indicator of the team's overall RQE development. The Project will miss the May 15, 2015 goal for completing detailed design, though its achievement of 86% complete at this relatively early stage is a nonetheless a major achievement. The larger packages – RFR and TG – are substantially complete and capable of supporting Class 2/3 project estimates. The remaining engineering work is predominantly in the BOP and Shut-Down/Lay-up bundles. The RQE metrics have highlighted the specific areas that are lagging behind, and using these metrics, the team has revised the engineering priorities for the Contractor to progress the more urgent packages to meet the August

engineering milestone. The Contractor's performance to date has been inadequate in managing its work and providing reliable cost estimates and schedules. This is causing the DR Team to devote considerable attention to the recovery effort.

The RQE team has re-evaluated and re-issued its process for the upcoming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has rules for developing the documentation for vetting the Project's Gate 3s. Each Project sub-bundle will be required to advance to Gate 3, even if that sub-bundle's maturity level is at a Class 4/5 level. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE. In addition, the DR Team's functional groups have submitted initial estimates and revised functional management plans which will also be vetted during 2Q 2015.

In summary, the major projects and functions, which comprise approximately 92% of the overall Project cost, are tracking on time to 2-3 weeks late with their RQE inputs while the BOP and Shut-Down/Lay-up bundles will struggle to complete Gate 3 with estimates more robust than Class 5 level. The DR Team will have to properly characterize the packages that are late and unlikely to mature beyond Class 4/5 level prior to RQE. A risk the DR Team needs to manage, among others, is devoting a disproportionate amount of attention to the BOP and Shut-Down/Lay-up bundles for the purpose of refining many of these estimates to a level not feasible prior to RQE.

B. Engineering Status for RQE

As of May 1, detailed design for the DR Project was 86% complete. While this falls slightly short of the 90% goal set by the Project Team, it is sufficient to support the estimating accuracy range for RQE. The most significant design packages – RFR (~__% complete) and Turbine Generator (~__% complete) – are enough to support their respective Class 2 estimates. BOP and Shut-Down/Lay-up engineering maturity (~__% complete) remains the primary outlier, and the team has reprioritized the work based on need.

The engineering team's schedule and quality metrics have matured and are being used to monitor vendor performance. These metrics have highlighted signs of certain adverse trends that the team is working to reverse:

- **Quality:** Project Engineering's Quality Dashboard has highlighted potentially adverse trends including: human performance errors; vendors employing under-qualified resources; over-specification of engineered materials and unique components; and other short-cuts that could result in downstream changes. To address these issues, the Project's Engineering VP initiated a quality "stand down" during which the results of multiple reviews and audits were shared and discussed with the vendors and OPG team. Each engineering vendor was challenged to provide an action plan to eliminate errors, rework and increase the quality of their work product.

- **Resourcing**: The metrics have highlighted the specific areas of focus for the remaining detailed design effort, and provide a basis for projecting the resources needed to complete this effort. In addition, these metrics have highlighted potential downstream gaps that require OPG resources, including the drawing office and TSSA registration.

Thus, the metrics tracking engineering are providing management with information it needs to actively manage the work. As engineering transitions to the next phase of supporting procurement and construction work package ("CWP") development, the tools developed during the design phase will need to shift focus.

The current Weekly Project meeting continues to focus on engineering, and remains a good forum for the team to work through issues and focus on the Project's schedule. The team is working to highlight gaps and develop management plans to resolve them. Over time, the team intends to expand this forum to include procurement tracking and construction readiness. The team is currently finalizing metrics for tracking procurement, and intends to introduce those metrics in June 2015.

Two issues that the DR Team needs to resolve in the upcoming examination of the Engineering functional cost include: (1) the level of support needed for replication engineering for the units subsequent to Unit 2; (2) the roles, responsibilities and level of effort needed from OPG Engineering and vendors in support of the field work and commissioning. There is valuable OPEX from Pickering Unit 1 RTS that should be reviewed in making these decisions.

C. Documentation and Data Alignment

The DR Team's data management group is working to align the Project's RQE and schedule data so that costs can be properly viewed and assessed over the entire Project's lifecycle at the work package/scope level. A key aspect of this work is properly mapping data so that the planned and actual cost of performing each element of scope can be baselined and then traced over time. The data management team is currently correcting flaws in data mapping present from the Project's inception. This work is essential to establish and maintain a proper Control Budget going forward from RQE. In addition, this data mapping is integral for future plant configuration control, and will be necessary for OPG to support rate recovery of its investment. If these issues are not resolved in the near term, the DR Team will risk struggling with data alignment issues throughout the entire Project. We have provided management with an assessment of current challenges in the Project's Cost Management system that provides further explanation of these problems in comparison with best practices. We recommend the DR Team make data alignment a priority for RQE so that further rework of these systems can be avoided and RQE has the data integrity necessary.

D. Areas of Focus - RQE Quality

RFR Project-Class 2 Estimate

RFR represents approximately 35% of the total estimated DR Project cost, and thus the largest single risk to RQE. Since receiving SNC/Aecon's Class 3 estimate for RFR in June 2014, OPG's challenge has been to vet SNC/Aecon's plan and pricing of this work to ensure it is achievable, accounts for the OPEX from past refurbishments, improvements to the tool set and the value of the planning effort to date, including the full-scale mock-up at the DEC.

Moreover, OPG is motivated to close the approximate $700M gap between SNC/Aecon's Class 3 Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. OPG believes that SNC/Aecon's Class 3 estimate was conservative and included opportunities for SNC/Aecon to realize in the Class 2 estimate and its planning for RFR's execution. OPG has made SNC/Aecon fully aware of its position relative to these opportunities.

SNC/Aecon's Class 2 estimate was initially targeted for delivery by April 10, 2015, though SNC/Aecon was unable to meet this deadline. OPG provided SNC/Aecon with an extension to May 8, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality[1]. The OPG team also recognized that while monitoring and vetting the SNC/Aecon's incremental progress was necessary and beneficial, the OPG team now needs to review and vet the estimate as a whole.

SNC/Aecon and OPG have agreed on a number of key areas that will ease the vetting of the Class 2 Estimate, including:

- The critical path duration of 1084 days, including OPG's responsibility of 186 days from breaker open to defueling and 223 days after RFR is completed to breaker closed. SNC/Aecon's schedule and estimate are premised on it controlling the critical path in the vault for the 676 days in the middle (the "RFR Duration"). SNC/Aecon's RFR Duration was determined on the basis of its Tool Performance Guarantee ("TPG") durations that were tested in the mock-up and modified by assumptions gained from OPEX of prior CANDU refurbishments. Importantly, SNC/Aecon's RFR Duration is shorter than the actual duration of Wolsong, which was the previous best

[1] SNC/Aecon's Class 2 Estimate was received concurrent with the preparation of this report; thus, we cannot comment on its content at this time.

refurbishment.

- A major sticking point in the Class 2 Estimate development was SNC/Aecon's conservatism toward potential owner-caused delays. By accepting the critical path in the RFR Duration, SNC/Aecon has agreed to remove contingency time in the schedule, which is a significant concession.
- While still higher than OPG's expectations, SNC/Aecon's initial Class 2 Estimate reflects modest reductions from the Class 3 estimate.
- SNC/Aecon has identified approximately $40M of additional opportunities to reduce the base cost that are different from those OPG had identified. OPG needs to consider whether these opportunities can be realized. In addition, there is a list of approximately 50 items that OPG has developed that are additional opportunities of varying size that can be worked down.
- The parties have agreed to revisit current assumptions around project risk allocation once the base cost is determined.

The OPG team's vetting process for the Class 2 Estimate is geared toward identifying any areas in the estimate that remain suspect from a cost perspective. While the vetting process will review all aspects of the Class 2 Estimate, the particular areas of focus for the team include: (1) right-sizing of SNC/Aecon's project management team ("PMT"); (2) right-sizing of SNC/Aecon's Support Services; (3) review of non-critical path direct field labor; (4) unit-over-unit resource leveling; and (5) productivity rates utilized for direct field labor. In addition, the parties will work to finalize the risk register and develop contingency.

Assuming there is agreement on the Class 2 Estimate, the parties will finalize target price parameters and seek resolution of any remaining commercial issues. The DR Team has been preparing options for performing the RFR project without SNC/Aecon in the event there is no agreement. However, coming to mutually agreeable terms with SNC/Aecon is clearly the best possible option for performing RFR, given the time investment the parties have made to date and the difficulties inherent with starting over with a new vendor.

BMcD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG through acceleration of its review period. OPG should weigh the risks of rushing the review and vetting process versus missing the RQE milestone.

Refurbishment Waste Processing Building (RWPB)

SNC/Aecon is continuing to develop its cost estimate for the RWPB. SNC/Aecon has submitted different iterations of the estimate and schedule that the OPG team rejected as having insufficient detail. OPG has made clear to SNC/Aecon that the schedule must provide adequate detail to ensure that sufficient float is maintained prior to the mid-2017 need date for this facility. SNC/Aecon has developed a schedule, which still requires full vetting, that pulls the completion date back to December 2016.

With respect to the cost estimate, SNC/Aecon and OPG have agreed on key aspects of the basis of estimate regarding the ability of the RWPB to withstand a seismic event. This agreement may have some additional cost impacts, but these changes will be necessary to support the nuclear safety case. The team has set-up a separate Gate 3 for RWPB from the RFR work with a deadline of June 6th. The OPG team has challenged SNC/Aecon to produce the cost and schedule based on final resolution of the design basis and benefits from the Campus Plan Projects' lessons learned in the planning of this work. In the meantime, SNC/Aecon continues to perform caisson work and site preparation to mitigate any further schedule issues. The project executive-level meetings will continue until such time that OPG has confidence in SNC/Aecon's plan for the work, and weekly construction progress meetings will continue through completion.

BOP / Shut-Down/Lay-up

Overall Risk Perspective

The DR Team has acknowledged that the BOP and Shut-Down/Lay-up modification work projects will be no better than Class 4/5 in time for RQE. However, the relative impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4/5 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. The BOP and Shut-Down/Lay-up teams continue to press the Contractor to develop the highest quality estimates based on the best information possible for RQE. ES Fox has set-up an estimating "war room" at its offices, and the OPG teams are actively collaborating with ES Fox to guide the process, provide answers to questions and highlight assumptions. OPG has established for ES Fox a seven-step vetting process and is tracking throughput. The team is committed to carrying sufficient contingency in RQE to compensate for the expected bandwidth around these estimates. BMcD/Modus recommends that these teams increase the level of documentation that is kept so that the actual basis of these estimates can be fully understood and vetted, and so that appropriate classification of these estimates can be applied.

[redacted] Refurbishment's answer is to ensure that it properly characterizes the nature and maturity level of the estimates at the outset. [redacted] We have recommended to the team to consider this history because it is the most relevant information OPG needs to establish truly appropriate contingency levels for these Refurbishment projects.

In addition, based on the experience to date, the DR Team should be examining other options for delivering this work where practicable. If the schedule allows, [redacted] The BOP and Shut-Down/Lay-up teams are already taking extraordinary measures [redacted] The team should evaluate whether it would really be taking on additional risk by directing the effort. From our team's experience, the risk posed to execution by BOP has to be managed or this typically non-critical path work can have a significant impact on both cost and schedule.

Based on what we have observed of this process, the DR Team is actively managing and attempting to mitigate the deficiencies in these estimates. The DR Team now has metrics in place that should provide early warning signs for management to take mitigating actions. The DR Team's Gate 3 process requires that these projects proceed to their respective gates and visibly report all deficiencies that erode the quality of these estimates.

Fuel Handling/Defueling

Overall Risk Perspective

The Fuel Handling/Defueling team, which is integrated between Refurbishment and the station, appears on pace to deliver its Class 3 estimates and has shown the results of good overall cooperation and vendor collaboration. These projects are not significant in terms of overall cost but represent OPG's most significant critical path risk to the Project.

In the ongoing collaboration with Bruce Power, the Project Team received more granular information regarding the success of Bruce Unit 1's defueling for its refurbishment. Bruce Unit 1 achieved defueling 63 total days compared to the

Project's assumption of 113 days. However, the additional details the team received allowed for more detailed analysis, and the team determined that Darlington's more complex and less efficient base design and related processes accounted for 30 of the 48 day difference, and those areas are not ripe for improvement. However, the analysis did net an opportunity to vet the 18 day difference between the stations in assumed Trolley Duty Cycle, which OPG executive management expects to be challenged.

With respect to Fuel Handling, the main challenge remains to improve the fueling machine reliability to increase the potential success for the fueling system's ability to simultaneously support Refurbishment and ongoing station operations. Over the last quarter, the team has made good progress in working through key issues, and OPG and vendor, GE-Hitachi, agreed to move forward by three months the schedule for commissioning the equipment to provide the Project with greater schedule float. While there have been challenges, it appears the schedule is achievable; that cooperation with the OPG team (including the station) and GEH has been good; GEH's engineering product has been of high quality; and the team has accepted and mitigated challenges along the way. While the risk of actual performance will remain until the reliability of the enhanced fuel handling equipment is proven, the actions taken by the team appear to have increased the overall probability of success.

Functional Groups

The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE Roadmap milestone for RQE Functional Estimates Complete by May 15 will not be met, though progress toward defining the functions' purpose and related estimates has matured over 4d. Unfortunately, this maturation has resulted in the functional cost estimates for virtually each group increasing over their 4d levels.

These increases require extensive vetting, which as of this writing, has only recently started. Key areas for this vetting process should include:

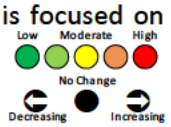
- Assuring that the functions are properly supporting the Projects, and not duplicating effort the performing contractors are expected to provide;
- Ability to meet all of the true oversight needs an owner's management group should provide, including validation of field execution, timely decision-making when issues arise and management of risks;
- Examining how the functions mesh together so that there is no duplication of effort, excess cost or confusion over roles and responsibilities;
- Identifying whether the functional groups have met 4d goals for right-sizing their teams.

In our view, these goals can be met through: (1) detailed vetting of the functional management plans in comparison to the functional cost estimates to assure that all assumptions for staffing are fully identified; (2) development of a division of responsibility ("DOR") matrix that shows both ownership of functional areas and potential rub points; and (3) detailed vetting of the cost estimates themselves. While considerable work remains before these estimates can be considered to be complete, the progress made thus far allows management to view the functions in a consolidated manner and make appropriate decisions on right-sizing the effort for RQE.

II. Campus Plan

1. P&M Management

P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on



training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

2. Vendor Performance Issues

ES Fox's bandwidth to support the both the ongoing P&M work and its current work load for Refurbishment has received considerable attention from OPG's management. [redacted]

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. In addition, the Sr. VP of Nuclear Projects has requested ES Fox to take immediate action to reconcile its cost and schedule positions on the Campus Plan Projects and utilize lessons learned from recent projects to help properly characterize the nature of their project estimates.

The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors. The team is taking measures to do so and must measure how ES Fox responds.

3. Major Campus Plan Projects

D2O Storage Facility

Overall Risk Perspective

The DR Team has awarded the mechanical and electrical package to SNC/Aecon via a LOI, with the full conformed contract to follow once SNC/Aecon presents its full, detailed execution budget and schedule. SNC/Aecon was given a short but reasonable time frame to complete its work. Based on the multiple iterations SNC/Aecon's RWPB team has produced for that building, we have advised OPG to request ongoing updates during this period to ensure SNC/Aecon prepares its budget and schedule. SNC/Aecon is currently working with OPG to prepare for its mobilization and work through procurement issues. On April 30th, RCMT completed its design work and provided SNC/Aecon with the engineering packages it will need to plan and execute the work. SNC/Aecon will provide field engineering through the completion of the work.

Ellis Don continues to work at OPG's direction on the foundation work, which is currently running on or near schedule. The OPG team reported the end date for foundation work had slipped 2-3 weeks, though the teams are working together to look at different shift patterns and work calendars to pull the dates back into early December 2015, if not earlier.

The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.

Based on the current D20 Storage schedule, the revised plan appears achievable to meet the needs of Refurbishment, though with all of the issues to date, completion of the building will require close attention by the DR Team. With the contract award to SNC/Aecon, the P&M team should re-evaluate the project risks based on the revised execution model and implement and report on the revised project controls strategy to the completion of the foundation work.

Auxiliary Heat

Overall Risk Perspective

The Auxiliary Heat System Building ("AHS") schedule and cost estimate continues to be a concern. ES Fox's current date for construction completion is September 1, 2015, and AFS is scheduled for October 27th. These dates have been challenged by OPG's team. The schedule pushes that are causing these dates to slip appear to be from issues that could be mitigated. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of $85.14M is being challenged by ES Fox, who has over $6M in change orders ($5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, [redacted]

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

Emergency Power Generator 3

Overall Risk Perspective

EPG 3's current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date has slipped to April 7, 2016. [redacted] and the Project's EAC is $___, an increase of $___ since 4d. Engineering completion has been delayed to May 2015 due to vendors' performance challenges, though ES Fox reported this date will be met. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox's additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M's management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox's performance. Given the short timeline to complete this SIO project, [redacted]

III. Other Focus Areas

A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG's corporate units to support the DR Project. Finance is embracing its role in the vetting and challenging of the various elements of RQE, and continues to provide its full support to the Project. The Project Team and the CIO are working together to implement needed changes that are tailored to the needs of the Project. This collaboration has resulted in the CIO supporting upgrades to software and necessary attention to the Project's hardware needs. In addition, we are encouraged by the increased focus People and Culture's senior

leadership is providing to develop flexible plans to address the personnel and succession issues that have been highlighted as major risks.

B. Risk Management

An effective risk management program is integral to the success of the Project. The Darlington Risk Management Program continues to evolve. Overall guidance, process and tools have matured and visibility of senior management support has improved. From a process standpoint, the DR Risk Management Program has matured into an excellent vehicle for identifying and facilitating the management of risks. The recent launch of the Risk Management and Oversights ("RMO") tool has greatly facilitated the review, analysis, tracking, and management of refurbishment risks across bundles, functions, and "Key Risk Areas".

The concept of "Key Risk Areas" ("KRAs") has been introduced to consolidate program and project risks by common themes or drivers (e. g. "Regulatory Approval", "Cost & Estimating Management"). A senior management sponsor is assigned to each of the Key Risk Areas for the purpose of ensuring that project managers and functional team leaders, along with the risk owners focus proper attention on identifying and managing the risks. We have observed a tendency for the project team to focus only on "urgent" issues. The KRA assignments are very critical because managing risks seems to fall into the "Important, but Not Urgent" category of priorities that managers face every day. In fact, the purpose of a risk management program is to identify the important issues before they become urgent—and so they can be effectively mitigated. Once an issue becomes urgent, the possible resolutions are inevitably limited and more costly. The KRA sponsor concept in theory is a good one—however, it will only be effective if it is given a priority and managed daily. That effectiveness has yet to be realized. We have made several recommendations for the improvement of the Risk Management Program and will continue to monitor its progress.

DRAFT

MODUS
STRATEGIC SOLUTIONS

BURNS McDONNELL

ONTARIO POWER GENERATION

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Darlington Refurbishment Committee of the OPG Board of Directors ("DRC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of August 7, 2015. Our main focus continues to be assessing the development of the Release Quality Estimate ("RQE") that the team intends to provide the Board of Directors at the October 1-2, 2015 retreat.

Specifically, this report focuses on the DR Team's current status with its RQE preparation, a summary of the processes used for deriving the estimate, remaining gaps in the RQE effort that the DR Team will need to close, and recommendations for the DR Team to take into account as it evaluates risk and contingency. As we have previously observed, the DR Team's RQE effort has followed an appropriate process for deriving the Project's estimate, though there have been some unexpected challenges that have impacted the planned pace of RQE's completion. Most notably, while some of RQE's work is significantly advanced, the date for OPG's acceptance of the estimate for the Retube and Feeder Replacement ("RFR") project with the SNC Lavalin/Aecon joint venture ("SNC/Aecon"), has slipped from June 15 to at least August 31. The additional time for vetting the RFR Class 2 Estimate has been extremely valuable, as the end result of the DR Team's efforts should be a very robust and defendable basis of cost estimate and schedule for the most significant scope of work in the DR Project. In addition, the team has encountered issues with assembling, verifying and validating the amount of cost data that is inherent with an effort of the magnitude of RQE. Thus, the DR Team's ability to assess the Project as a whole, including the full schedule, resource allocation, contingency and other such considerations, has been delayed and compressed. As a result, we believe the DR Team will be challenged to meet the current schedule for presenting a RQE that can serve as the Project's control budget by October 1-2.

Following the Recommended Practices provided by the Association for the Advancement of Cost Engineering International ("AACEi"), the DR Team has committed to provide a full, four unit Project "Class 3" estimate with an intended accuracy range of +10% to +30% (on the high end) to -10% to -20% (on the low end).[1] Per the AAECi recommended practices and OPG's own procedures, the RQE would be based on a sufficient level of maturity to form the Project's control budget, against which the overall Project's progress will be compared to completion. The DR Team intends to prepare unit-specific check estimates immediately prior to the start of execution for each unit that will leverage additional maturation of the planning effort and account for any lessons learned from prior units' performance. The check estimate for Unit 2, the first unit to reach the execution phase, is scheduled for August 2016 and the goal is to further mature the Unit 2 estimate and schedule for optimal management of the Execution Phase.

The total RQE amount will include the $2.547 billion OPG plans to spend during the current Definition Phase through October 2016. OPG engaged in this extensive planning and preparatory effort in order to mitigate issues that have severely impacted prior CANDU refurbishments and other nuclear megaprojects. This includes a commitment to complete engineering by August 15, 2015, more than one year before opening the breaker of the first refurbished unit, Unit 2. The Definition Phase has also included hard construction costs for:

- Completion of $1.2B of pre-requisite Campus Plan Projects needed for Refurbishment and ongoing operations;
- Purchase of all specialized tools required for the units' refurbishment;
- Procurement of Unit 2 pressure tubes, feeders, end fittings needed for refurbishing the units' reactors;
- Fees to vendors for development of detailed engineering, project estimates, execution schedules and construction work packages ("CWPs") needed for execution.

[1] For purposes of characterizing RQE and its component parts, OPG has utilized AACEi Recommended Practice No. 18R-97 COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES

In addition, OPG has already negotiated the terms and conditions of the most significant execution contracts with EPC contractors, many of which include provisions for establishing target pricing and incentives based on acceptance of detailed vendor estimates.

BMcD/Modus recognizes OPG's commitment to plan the work in advance and the DR Team's many accomplishments to date in the Definition Phase. However, the DR Team's RQE effort has been substantially compressed. The original schedule for RQE was to complete the estimate integration and analysis by October 15th and then present to the Board in November 2015. RQE preparation for that November delivery included a planned 3 ½ months of detailed integration and vetting of the amassed data; that work under the current schedule has been compressed to 1 ½ months, with much of the work being done in parallel. Significant work remains for the DR Team to meet its commitments with respect to the submission of RQE, as discussed below.

As noted, the DR Team intends to use the period from RQE to Unit 2 breaker open in October 2016 to further mature its planning, estimates and schedules, and present a Class 2 check estimate and detailed execution-ready schedule in 2Q 2016. The team has developed a "Readiness to Execute" regime through which it plans to test multiple processes and improvement initiatives with smaller BOP and Shut-Down/Lay-up packages that need to be performed prior to Unit 2's breaker open.

II. DR Project RQE Overview—Status

On January 20, 2015, the DR Team presented its RQE Roadmap to the NOC. That initial Roadmap anticipated the DR Team would produce RQE for Board approval at the November 12, 2015 meeting. This schedule was premised on a number of key milestones being met, most notably:

- Completion of Functional Estimates – May 15, 2015
- Acceptance of SNC/Aecon's RFR estimate – June 15, 2015
- All Execution Phase project Gate 3's complete (except for BOP and Shut-Down/Lay-up) and Project Data Frozen – June 30, 2015
- Presentation of RFR target price to NOC – August 20, 2015
- A six week review and validation period of the estimate and schedule date (July 1 to August 20)
- From August 21 to October 15, the senior team planned vetting and rationalization of changes;
- Finance had 3 weeks to provide a final review and approval before the October 15, 2015 planned completion;
- One month (October 15 to November 12) to prepare and route the materials before the November BOD meeting.

The DR Team's time to finalize RQE has been significantly compressed, and the once planned 3 ½ month period (July 1st to October 15th) for vetting of the integrated cost and schedule has been reduced in its current plan to 1 ½ months (July 31st to September 15th). The current schedule is premised on the DR Team completing the RQE base cost and contingency and associated unit by unit cash flows and consolidated business case by September 15th for presentation to the DRC 10 days later. To meet these challenging dates over the next month, the DR Team must complete:

- A thorough vetting of the Project's cost components through a series of "Program Integrated Scope and Reasonability Reviews" with the Project Managers leveraging the work completed to date;
- The receipt and review of an acceptable estimate and schedule submission from SNC/Aecon, which is currently expected on August 31, 2015, though which will still require verification, vetting and reconciliation with the rest of the RQE files;
- Concluding the negotiations with SNC/Aecon on the RFR target price;

- Finalizing the documentation for the basis of estimates for each of the Project's "bundles" or sub-projects;
- Final vetting of the DR Team's Functional groups, functional management plans, and associated cost estimates
- Senior management vetting and challenge of the program and its constituent parts to validate the overall schedule, resourcing, roles and responsibilities and confidence level in performing the work;
- Finalizing development of the DR Project's contingency, including reviewing all of the discrete risks for each bundle and the program as a whole, and capturing and properly modeling risk of performance for all four units;
- Integrating the cost and schedule data for each of the Program's component parts so that an integrated review can be performed to ensure proper alignment for future cost and schedule control; and
- Addressing potential quality control and quality assurance concerns in order to provide the confidence in the reliability and accuracy range RQE as the control budget for the Project.

This represents a tremendous amount of work in a short period of time and assumes that work feeding RQE outside of OPG's direct control will finish on time and with requisite quality. Moreover, for this effort to be successful, the data produced for developing RQE must be free of error and understandable, as there is no margin for rework. As discussed below, the team is currently integrating the data for these reviews to begin, and this effort has also proven to be more time consuming than initially thought, and currently lacks the final and most important part, the RFR estimate. BMcD/Modus is concerned that the remaining time to October will not be sufficient for the DR Team to finalize RQE commensurate with the necessary quality to establish the Project's control budget.

A. Status of the Components of RQE

As with our prior reports, Figure 1 shows the 4d cost estimate values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency. Once RQE is finalized, we will update this figure to reflect the current values and percentages of the Project's cost.

Figure 1 also provides context for the size and percentage of each component of RQE. The three largest parts of RQE are: RFR (26%); OPG Functions (22%); and Contingency and Management Reserve (25%). BOP and Shut-Down/Lay-up (5%), the Turbine Generator project (6%) and Campus Plan Projects (7%) are next largest slices of the budget. Below, we provide a brief update regarding the status of each of the major inputs to RQE, and in Section IV below, we provide additional details regarding key areas – RFR, Functions, and Contingency.

B. Major Inputs to RQE

Detailed Engineering:

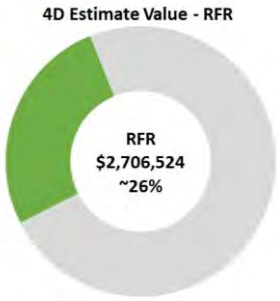
One of the lessons learned from other refurbishment and other nuclear megaprojects is that the control budget should be based upon completed engineering in order to mitigate the risk of unreliable and uncertain initial cost estimates. As a result, OPG has made a commitment to complete as much engineering as reasonably possible for the basis of the RQE control budget, and to ensure that engineering is sufficiently complete for each unit to prepare a Class 2 cost estimate prior to field execution. As of June 30, the Project's Detailed Design was 92% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE.

As the BOP and Shut-Down/Lay-up projects proceed with their development of detailed Class 3 estimates for their upcoming Gate 3s and prior to the check estimate, the DR Team should account for a risk that has manifested itself in

the Campus Plan Projects, that the definition of "design complete" needs to include in the engineering package all of the vendor/supplier procurement information. P&M projects have also had cost impact and scope creep due to the later incorporation of these details by the EPC contractor's revised "Issued for Construction" drawings, and this additional effort was not estimated at the outset of the work. The DR Team's Engineering VP has highlighted this risk which now must be monetized and carried in RQE.

Retube and Feeder Replacement:

SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Some notable highlights since our 2Q Report:

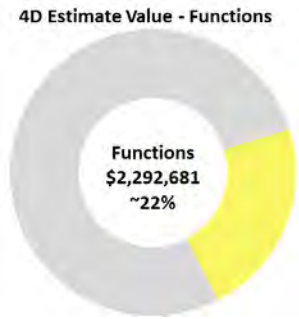


[redacted] On a parallel path, the project teams have engaged in "bottom-up" vetting of the estimate and schedule.

- These initial efforts resulted in OPG and SNC/Aecon agreeing to target a schedule duration of 1110 days and an associated cost of $2.6B (at P50 contingency level).

The teams are currently working to these goals with a target of mid-August for completing the analysis and August 31st for SNC/Aecon's "Rev. 1" submission, approximately 2 ½ months later than the DR Team anticipated. Because of RFR's importance to the Project, this delay threatened to impact the DR Team's ability to complete key elements of RQE. There has been increased cooperation between the teams to optimize the work flow to the extent possible. However, due to the enormity of the effort at both the project and executive levels, concluding this estimate is taking significantly longer than OPG anticipated. The DR Team has engaged in some work-arounds to keep the rest of the RQE process moving in parallel. [redacted]

Functional Groups:

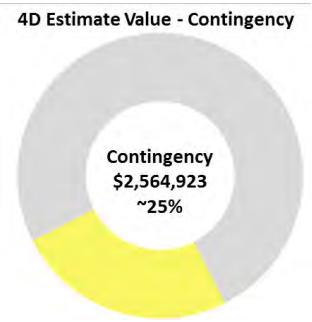


The DR Team's intention for RQE with the Functions is to develop a bounding estimate that incorporates all necessary roles and responsibilities, and then examine the organization in the Readiness-to-Execute roll-out after RQE.

Early in the RQE process, the initial functional estimates had shown 9% growth over what was presented in the 4d Estimate. The SVP commissioned a team drawn from multiple areas within the Project and the centre-led functions to examine the DR Team's functional estimates and provide recommendations for reducing redundancy and overall staffing size. The recommendations from this review have been accepted and are now being integrated into the various staffing plans. Once complete, the DR Team will need to vet the results to confirm that the current estimates are bounding in nature.

Management will still need to devote significant attention to right-sizing the team, defining clear roles and responsibilities and locking down appropriate assumptions prior to the Unit 2 check estimate. Past attempts to make top-down adjustments to the functional estimates have not been effective at holding down cost estimates, and this remains a risk. More importantly, the DR Team needs to be arrayed in a manner that is capable of effectively managing the execution phase. The DR Team's leadership is committed to doing so.

Risk and Contingency:

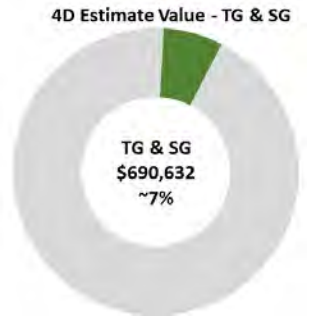


Contingency is the third largest category of costs in RQE behind RFR and the Functional Groups. The DR Team has developed and matured risk registers over the life of the project to date. The Risk team held workshops with each of the project and functional teams to review the current state of the risk registers to establish estimating uncertainty, clearly identify risks and fine-tune risk scoring so that contingency can be calculated and analyzed using Monte Carlo analysis methods. Once the data establishing the Project's base cost is fully available, the project teams will need to vet the results, and the DR Team's leadership intends to follow with full project reviews which are intended to challenge and affirm the variability in the estimates and approximate the level of estimate uncertainty.

We find the process for developing contingency to be robust, and the team has received help and advice from OPG's Enterprise Risk Management and OPG's vendor. However, the overall quality of the contingency development will be dependent on the quality of the data inputs. Due to the compressed RQE schedule, we remain concerned that the time for developing the base costs, understanding the estimate classifications and analysis of the residual impacts of discrete risks will compress the proper formation of contingency.

C. Status of Remaining RQE Inputs:

Turbine Generator and Steam Generator:

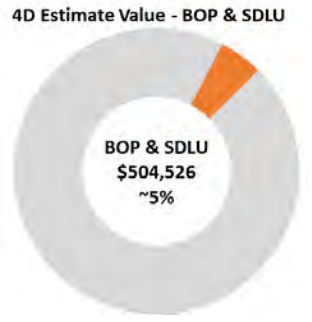


OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. OPG's approval of those detail estimates is pending final review, though is expected shortly.

As with RFR, the OPG and the SNC/Aecon project teams are integrated and working well together. The remaining risks at this time appear to center on completing the CWPs for execution and finalizing the Unit 3, 1 and 4 detailed schedule. In addition, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. This will be a first time evolution for OPG and will require significantly more planning than the limited scope for Unit 2.

The OPG Steam Generator Team has done a good job in managing its activities in order to meet its milestone dates and this project is currently on-track. No issues are apparent at this time; these estimates are expected to support RQE.

Balance of Plant/Shut Down-Lay-up:



At this time, the focus for BOP and Shut-Down/Lay-up has been Phase I/II engineering and planning work. The DR Team projects that detailed engineering for these projects will be substantially completed by the August 15, 2015 milestone. The DR Team has provided guidance to ES Fox to improve the development and quality of its related project estimates, and is in the process of characterizing the estimates it has received at this time. Approximately 35% of the BOP and Shut-Down/Lay-up work estimates will be in the Class 4/5 range, which increases the risk of estimating uncertainty and accuracy bandwidth for these projects. The OPG Estimating Team has taken a reasonable approach in characterizing the estimates on the basis of differences in their maturity level. Prior to RQE, the DR Team needs to devote significant time in finalizing the risk registers for these projects so that contingency can be properly attributed.

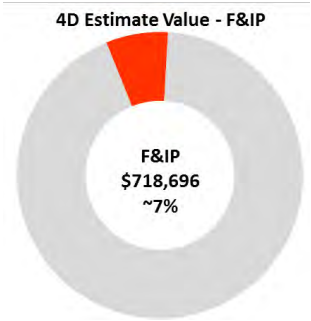
In addition, ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and

development of CWPs. The DR Team has placed a goal of having BOP projects proceed to their Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. To meet these goals, the BOP team has set interim milestone dates with ES Fox for these deliverables which will be regularly pulsed by the team.

Fuel Handling/Defueling:

The DR Team has received and accepted vendor Class 3 level estimates for RQE based on completed engineering from GE/Hitachi. Cold commissioning is ongoing for Fuel Handling system modifications, and while performance indicators had been lagging, recent progress has dramatically improved overall schedule performance. The recovery plan has also allowed the team to advance plans for testing and training. These recent improvements should allow for a better understanding of the critical path project durations and performance risks

Campus Plan Projects:



The overall performance of the most significant Campus Plan Projects – D20 Storage, Auxiliary Heat System ("AHS") Building, and Emergency Power Generator 3 ("EPG3") - has continued to be impacted by ongoing issues with poor initial estimates and scope definition, site conditions, [redacted] and OPG oversight.

- ***D20 Storage*** **–** OPG issued a purchase order to SNC/Aecon on July 31, 2015 that covers the mechanical, electrical and civil/structural work from grade. [redacted]

Ellis Don continues to perform the underground civil work, including foundations, dyke walls and closure slab at grade. Currently, the schedule (dated August 4) shows Ellis Don is 57 work days (82 calendar days) behind in meeting the key milestone for setting of the D20 tanks. On August 6, the D20 Storage team identified a partial recovery of approximately 15 days (to January 13th) of this milestone through resequencing of the work. However, at Ellis Don's current pace (SPI is 0.58), it is likely that these dates will continue to slip. If this work cannot be recovered, it will significantly compress SNC/Aecon's work and could impact Unit 2's need to use the D20 Storage tanks for moderator and primary heat transport drain after breaker open. OPG needs an execution schedule for D20 Storage that can be executed by the performing contractors based on the current understanding of the work, realistic projections based on field productivity to date, and which accounts for the limiting factors in the construction of the building.

We have recommended that P&M assess these risks using SNC/Aecon's estimate and schedule and revisit the business case to confirm whether the path chosen for execution is the most prudent course, and whether the team should revisit options for temporary storage of Unit 2's heavy water. It is notable that SNC/Aecon

currently classifies its estimate at Class 3, as the business case was premised on a Class 2 estimate, meaning that additional contingency may be needed to cover the risks. P&M is also pursuing options with SNC/Aecon to further improve the schedule and sequence of the work. In any event, this analysis must proceed so that the risks of performance are adequately captured and monetized in RQE.

- ***AHS –*** The AHS project, which has been subject to schedule delays and cost increases, is nearing completion. The current schedule shows the work is 92% complete and construction testing of the systems has begun. The target for completion is October 2015 based on a full understanding of the commissioning effort. OPG and ES Fox have executed a fixed price amendment to cover the outstanding costs that had been pending for several months. The current projected final cost is $99.5M, which has required a contingency draw of $15M over the approved $84.52M budget in 4d. AHS has provided multiple lessons learned that Refurbishment is taking into account in planning of BOP and Shut-Down/Lay-up work with ES Fox.

- ***EPG 3 –*** This project must be completed prior to Unit 2's breaker open. Construction has been impacted by issues with plant tie-ins and unforeseen underground conditions. Engineering of modifications to the EPG unit are complete, and ES Fox has provided OPG with an estimate at completion of $115M (increased from $88M in 4d). The Refurbishment Estimating team needs to fully vet the details of the estimate to determine whether it is of sufficient quality and represents a sound plan. In addition, the schedule for construction requires additional vetting to confirm the constructability and sequence of ES Fox's plan. These details need to be addressed before the project advances to its upcoming Gate 3.

In prior reports, we have commented extensively on the P&M team's structure and capabilities for managing the work. P&M had previously committed to making improvements in areas of project management, project controls and risk management through additional training and adopting Refurbishment processes, where necessary. These improvements need to be accelerated to properly manage the remaining Campus Plan Projects to completion within the RQE control budget. [redacted] The step-up in collaboration between the Refurbishment team and the ESMSA contractors has resulted in higher quality engineering packages and project estimates. The vetting effort described above with SNC/Aecon's D20 Storage proposal provides an example of the benefits that P&M has achieved. These same efforts need to be applied to all remaining Campus Plan Projects, as necessary, to reduce risk of remaining performance and attempt to properly characterize the risks of these Projects to the Refurbishment program.

III. Areas of Focus - RQE Quality

Estimate Characterization

The process of validating and vetting EPC cost estimates for the Project's bundles has followed the approved DR Project RQE Cost Estimate Plan. The vendors presented the cost estimate packages to the OPG Project team in a multi-stage progressive review process for comments and disposition. Among the issues covered at each review stage were scope, COMS, schedule, identification of key cost drivers, estimate basis, benchmark ratios, exclusions and assumptions, as well as cost challenges on a number of issues, such as vendor PMT, indirect costs and productivity factors. Once the EPC vendor completed the comments and disposition phases, and a final revised estimate was received, OPG's estimating team then loaded the estimates into the US Cost estimating platform for analysis.

Once loaded into OPG's US Cost database, OPG's estimating team then vetted and validated the estimate data to determine if the estimate was accurate, reasonable and competitive to the desired classification; as well as, identified any gaps in the documentation or methodology that may negatively impact the quality of the final estimate. The team then performed a technical review of the estimate from a scope point of view and proposed an AACE classification for further review. The process is documented with review checklists. Another member of the estimating team performed

a peer review of the estimate checklists. The estimating manager then conducted a final challenge of the proposed classification of the estimate. Upon completion of the review process, the estimating team issued an estimate declaration of appropriate AACE estimate class.

The estimating team is in the process of performing a reasonability review to obtain buy-in of the vetting process. The focus was to ensure the estimate and its classification is transparent and justifiable. A final estimate review report is then issued memorializing and summarizing the AACE classification, scope review, estimate review, and reasonability review for approval by the Project Manager. This report is targeted for the end of August 2015.

Over the coming weeks, BMcD/Modus will be reviewing and sampling the process to test whether the OPG estimating team has consistently applied its standards and accurately assessed the estimates.

RFR Project-Class 2 Estimate

RFR represents approximately 26% of the total estimated DR Project cost (per the 4d estimate, including contingency), and thus, remains the single largest risk to RQE and the DR Project as a whole. To provide context for the RFR estimate's current status, the following is a summary of the events over the past year.

After receiving SNC/Aecon's Class 3 estimate in June 2014, OPG worked collaboratively with SNC/Aecon to ensure that its Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale mock-up at the Darlington Energy Centre ("DEC"). The collaborative review process spanned much of the year between the delivery of the Class 3 estimate in June 2014 to mid-April 2015, [redacted] In April, OPG paused its review to allow SNC/Aecon to complete the estimate documentation on its own. [redacted]

[redacted]

[redacted]

[redacted]

[2] The SNC/Aecon contract specifies that the Class 2 Estimate would be delivered by May 15th, 2015. By mutual agreement, SNC/Aecon's Class 2 estimate was accelerated for delivery by April 10th, 2015, though SNC/Aecon was unable to meet this deadline. OPG ultimately provided SNC/Aecon with an extension to May 8th, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality.

[redacted].

Simultaneous to OPG's review, the parties jointly engaged an expert panel (including individuals selected by OPG and SNC/Aecon) who have played significant roles in virtually every CANDU refurbishment to date. The expert panel reviewed SNC/Aecon's submission [redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

[redacted] Starting in June, OPG and SNC/Aecon proceeded down parallel paths [redacted]:

- Project executive-level working sessions, intent on establishing a set of baseline cost and schedule objectives and addressing potential risks and barriers to performance [redacted];
- Continued bottoms-up vetting of the detailed estimate and schedule, with subject matter experts ("SMEs") from OPG and SNC/Aecon working shoulder-to-shoulder [redacted].

Based on the agreement reached at the project executive-level, the combined OPG and SNC/Aecon teams have been given targets for what OPG deems an acceptable schedule and cost (a P50 schedule of 1,100 days and a target cost of ~$2.6B including contingency). These targets were provided for context only, as the direction given by both management teams was to focus on coming to agreement on what is realistic and achievable, supported by workable plans, concrete data, and OPEX, rather than meeting top-down targets. This process has netted excellent progress towards [redacted] developing a principled basis for SNC/Aecon's estimate.

The current target date for delivery of the revised estimate is August 31th. Meeting this target will require completing the following:

- Finalize review of schedule critical path and sub-critical path durations from "bottoms-up"
- Rationalize risk register and reach agreement on nature, severity and ownership of risk
- Complete monetizing Unit 2 estimate based on outcome of SME examination
- Review all accepted changes to schedule and monetize differences in overhead/Project Management Team ("PMT") costs

- Provide analysis of discrete risks for Units 3/1/4 and monetization of same
- Complete all steps in pre-negotiated term sheet including finalizing incentive/disincentive approach
- Dispositioning all items in expert panel and BMcD/Modus list
- RWPB estimate which needs to be fully vetted.

From the outset, we have recommended that OPG take a reasonable amount of time to vet the Class 2 estimate given its importance. Completing all of this work by August 31st will be a significant challenge, [redacted]. However, the work done to date in vetting the estimate has had tangible results and greatly improved the price, schedule and risk profile for the overall Project.

Functional Groups

The Project's functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance, Project Controls and the Execution Team) constitute approximately 22% of the DR Project's total cost. The RQE Roadmap milestone for completing functional estimates by May 15th was not met, and the initial functional cost estimates for virtually every group increased over their 4d levels.

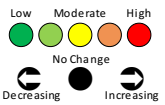
The SVP of Nuclear Projects challenged the functional team managers to both reduce their overall cost and right-size their staffing plans, and investigate ways to leverage other parts of OPG's business to reduce staffing burdens. To assist in this regard, the SVP requested formation of a senior review panel that included a broad spectrum of knowledge within the company. This panel provided the following observations from this review:

- Many of the panel's recommendations related to removing overlapping responsibilities between different functions;
- Future staffing reductions, based on Lessons Learned from the first unit, should be possible for the subsequent units included in RQE;
- Approximately 50% of the reductions contained in the report have been agreed to by the Functions. A 'top down' instruction will be required to achieve the balance of the reductions recommended. In addition, a single leader must be assigned to ensure the reductions are implemented and that a Divisional Self-Assessment or audit be performed prior to the 'Check Estimate' to ensure the reductions have remained in the estimate; and,
- Going forward, the project philosophy must be that if something is to be added to the estimate an equivalent reduction must be taken.

The panel made a number of recommendations regarding clarifying roles and responsibilities and resource allocation. From a cost estimate perspective, the panel essentially reversed much of the cost growth that the functions had estimated post 4d. These recommendations were presented to the SVP, who directed the functions to follow suit and revise their staffing plans.

In our view, the results of the senior panel still need to be vetted to ensure that the recommendations have been incorporated into both the teams' management plans and cost/staffing estimates. The SVP has directed top down adjustments in prior cost forecasts that have not been realized; thus, ensuring full buy-in of the panel's recommendations is necessary at this time. Moreover, once these changes are made, we would advocate vetting of the result to see whether the revised plans truly represent a bounding estimate. At a minimum, the functional management plans from the team must reflect that the panel's recommendations have been embraced and the staffing plan needs to reflect those assumptions.

Ultimately, the DR Team's leadership intends to "live test" the organization through the Readiness to Execute plan,



leading to potential refinements of the organization needed for the full Execution Phase. We have recommended that management also look at the division of responsibility (once available) to confirm the roles are well defined and duplication is eliminated, and examine the work itself and right-size the staff in accordance. The senior leadership is committed to doing so prior to the Unit 2 check estimate. There is considerable value in re-assessing the DR organization's structure considering the current transition to execution phase work and the ways in which the Project's planning has matured.

Risk and Contingency

Contingency for RQE will be comprised of seven (7) major "buckets", each of which require separate and unique inputs. These buckets include:

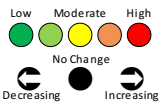
- Cost estimating uncertainty (determined based upon the class of estimate of the base costs and the opinion of OPG estimators and subject matter experts);
- Schedule estimating uncertainty;
- Discrete risks (both for the individual project bundles and the entire program);
- High impact/low probability risks
- Contingent work;
- Campus Plan/F&IP life cycle contingency estimates; and
- Insurance uncertainty

OPG has taken a scalable approach to calculating contingency for project bundles and functions. The rigor applied and method used (stochastic or deterministic) will depend on the state of the project bundle or function at the time the RQE package is assembled. Where the base plan cost and schedule estimate is mature enough to allow it, certain buckets will be run through a Monte Carlo simulation using the @RISK program. Other buckets (such as the high impact/low probability risks, Campus Plan life cycle contingency risks and insurance uncertainty) are derived deterministically using expert analysis and will be added to the outcome of the Monte Carlo simulations to comprise the total RQE contingency estimate.

OPG has retained the PALISADE Corporation to provide third-party expertise in supporting RQE and to ensure integrity of the modelling process. This third party expert will review the inputs generated by the risk management process, design the risk model, define the detailed modeling feed stock and execute and oversee the contingency modeling processes. PALISADE is the developer of the @RISK program and has performed this function for many capital projects.

During the week of July 20, 2015, the DR Risk Management team conducted contingency workshops with the project bundle and function teams. The purpose of these brief (1-2 hour) workshops was to guide the teams on the expectations regarding the data inputs needed for RQE contingency development. In these workshops, the discussions focused primarily on discrete risks and the scoring of those risks (probability of occurrence, cost and schedule impact if realized). These assumptions were then challenged by a panel that also reviewed the scoring, 3-point ranges and recurrence frequencies in the templates.

The Project and function teams were to take the comments from the workshop and update their contingency inputs for final submittal on July 27th. The Risk team has entered the input data and run a preliminary Monte Carlo analysis to arrive at preliminary contingency numbers for the DR Project. These amounts will need to be further analyzed to determine if the contingency is appropriate and reasonable. Once these inputs are adjusted, another Monte Carlo analysis will be run. The following are some of our key observations from these risk workshops:



- The workshop concept is good and leverages the work ongoing with risk identification since the start of the Project. However, the key to success is how the projects/functions develop appropriate contingency inputs. This is no small task considering the available time and the amount of effort involved. Individuals from the Risk Management Group will work with the project and functional groups to facilitate acceptable input for RQE. However, project and functional personnel must develop the justifiable content.

- [redacted] Over the last year, additional management focus has been placed on developing and rationalizing risks, and management's goals are well known to the project managers. [redacted] RQE will be the test of how deeply the DR Team understands the risk aspect of their work.

- [redacted] The calculations for the cost impacts of discrete risks should be estimated and vetted by the Estimating team with the same rigor as the base cost estimates.

- The Risk Management Team will also review all registers to identify and resolve duplicate and overlapping entries. Clarity and precision in the risk descriptions will influence how efficiently this review can be conducted. Eliminating such redundancy only increases confidence.

- [redacted] Nonetheless, absent detailed Construction Work Packages, fairly accurate OPEX for executing some of the BOP work, such as valve repair/replacement, can be employed. To develop the best input for RQE contingency, the BOP team has to rely on creative approaches such as existing DNGS OPEX, SME input and appropriate risk analysis. BOP (and, where necessary, other groups) are working closely with the Risk Team to timely develop acceptable contingency inputs.

The Project Controls team managing RQE is intent on issuing a number of key questions for the team to consider in looking at their contingency. In developing the global, program level contingency, the DR Team should fully consider the following risk areas as part of that exercise:

- ***Address vendors' concerns regarding OPG's role as overseer and integrator of the work***: Each of the vendors have voiced their concern that OPG's history is to provide multiple points of contact during a work cycle, who often provide conflicting information and direction and otherwise interfere with the field work. For the Project to be successful, the DR Team needs to dispel these fears with an optimized Execution Phase organization with clear accountabilities, and ensure that the Station and the Project are fully integrated. To address this, the DR Team has identified a plan to test its Readiness to Execute the work using actual work scheduled in 2015-16 prior to Breaker Open. This plan should be finalized and fully vetted for RQE and tracked with appropriate metrics and targets during the coming year. Nonetheless, for purposes of RQE, these risks need to be fully addressed.

- ***Fully analyze and account for the distinct risks inherent with the performance of Units 3, 1 and 4***: RQE is establishing a control budget for measuring OPG's performance on all four units. While this is sufficient for establishing the control budget's base cost, the full DR Project as it currently is planned actually consists of four separate and distinct execution models: Unit 2 is intended as a stand-alone project; Unit 3 will be completed while Unit 1 is started; Unit 1 will be started simultaneous to Unit 3's completion and completed at the same time Unit 4 is started; and Unit 4 will be "lapped" at its start by Unit 1. The DR Team has embedded certain risks regarding the subsequent units; these should be vetted for consistency and whether they cover the impact, needed resources, and other key factors that could make the execution of the subsequent units different, if not

more difficult. Thus, full consideration needs to be given to contingency and other cost factors associated with future unit performance.

- ***Developing appropriate succession plans for both OPG and vendors***: OPG is carrying as its most prominent enterprise risk the availability of qualified staff and craft resources over the 12-year lifecycle of the DR Project. Mitigating this risk will require increased flexibility in hiring of staff and potentially additional cost for incentivizing workers. The risk of losing key staff over time will manifest itself in multiple ways, including losing the learning curve and "tribal knowledge" provided by the performance of prior units. Thus, unless this risk is properly addressed (as well as the aforementioned risk of multiple unit performance), assumptions regarding unit-over-unit performance improvement could prove to be overstated.

- ***Scope definition for subsequent units***: Our understanding is the Darlington units are as close to alike as any multi-unit station in the world. This assumption has been tested through inspections and operational performance. However, the methods for replicating engineering and scoping effort for the remaining units presents an opportunity to reduce cost. These assumptions also could impact the direct work, as the cost for "design once, build four times" needs to be confirmed.

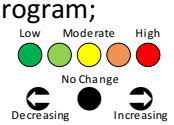
- ***Re-Assess utilization of the ESMSA agreement***: [redacted] Most of the ESMSA work in Refurbishment in the Balance of Plant and Shut Down/Lay-up bundles has not yet advanced to construction phase purchase orders. The DR Team has committed to finalizing the estimates for this work by next year's Unit 2 Check Estimate. The DR Team is aware of the track record established to date, and is committed to holding appropriate contingency for Refurbishment work. [redacted]

Documentation and Data Alignment

Assembly of the massive amount of data that underpins RQE would be a challenge by itself; adding the compressed time for integration and quality assurance makes the integration effort much more difficult. The Project Controls team leading the effort is currently tasked with integrating the multiple estimate submissions from the vendors, OPG functions and other costs into a Master Consolidated File ("MCF") for purposes of analyzing the individual estimates as well as the sum of the multiple parts. As of this writing, Project Controls reports being substantially complete with compiling the data, though that is the first step.

For full vetting of the DR Project as a whole to be effective, the DR Team will need to have the MCF fully populated and QC checked so that the team can analyze issues such as whether:

- The project management team (both OPG and contractors) is right-sized;
- Work windows are available for non-critical path work;
- Resource profiles for craft workers are properly levelized so that the work can be supported, and so that troughs in the work flow are smoothed out and the contractors know when and whom to hire and train;
- Productivity factors and assumptions used in the estimates are consistent and properly characterized;
- Unit-over-unit direct work costs have been properly considered;
- Resources identified in the vendors' cost estimates match the resources in their P6 schedules;
- Ratios of direct field labour to supervision are appropriate for the work and consistent across the program;



- Other such considerations.

Vetting the MCF once assembled will take considerable effort and likely will run longer than anticipated.

Report to

Darlington Refurbishment Committee

Board of Directors

November 12, 2015

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

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I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Report to the OPG Board of Directors ("BOD") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 30, 2015. This report provides the summary of our team's assessment of the DR Team's development of the Release Quality Estimate ("RQE"). This report also summarizes the DR Team's current status of "post-RQE" work that will be its focus going forward, assuming the Board of Directors' approval of RQE at the November 2015 meeting and subsequent shareholder approval, as well as the status of work that is currently being executed on the Prerequisite ("Campus Plan") work and the DR Project.

A. RQE

OPG and the DR Team have been working toward developing a realistic RQE for the DR Project since 2009. The major focus of the DR Team over this time period has been the development of detailed cost estimates of sufficient quality and basis in order to establish a four-unit, program level ***control budget*** for the DR Project. In order to develop the control budget, the DR Team needed to mature the planning to the point where the cost estimates were substantively based. While the DR Team will continue to refine the unitized estimates for each of the four units in order to make specific funding requests, the control budget, if accepted by the Board, will be the baseline against which both the stakeholder confidence and public trust will be measured.

Megaprojects ($1 billion or more in cost) are often adversely impacted by overly optimistic initial cost estimates that do not fully consider the risks and complexities inherent in such undertakings. The DR Team is aware of the industry track record and has taken reasonable steps to account for the particular risks of CANDU refurbishments and develop its cost estimates accordingly. In order to properly communicate the nature of the DR Project's estimate and approximate appropriate contingency, OPG has chosen to utilize the guidance of the Association for the Advancement of Cost Engineering International ("AACE International"). OPG's strategy in this regard is aligned with reasonable and acceptable industry practice for a multi-year, multi-phase megaproject.

In our last report (October 2015) we noted that the month leading up to the November Board Meeting would be challenging given the amount of work the DR Team had left to complete. The DR Team met each of its goals, including:

- Finalizing the target price negotiations with SNC/Aecon on the RFR contract;
- Completing outstanding actions regarding all of the sub-projects from the initial round of senior management-level reviews and revising cost projections accordingly, and vetting the results of those changes;
- Firming up and vetting direct cost estimates and associated critical path schedule basis; and
- Performing integrated reviews of contingency and developing recommendations for amounts of contingency "buckets" and which entity (i.e. project, executive management, BOD) should control those buckets.

With these activities accomplished, the DR Team has completed the work necessary for establishing its control budget, and as an additional benefit, the team has an improved understanding of the Project. Based on our nearly three years of oversight of the DR Project's planning, BMcD/Modus believes the process used for developing the control budget and critical path schedule that form the basis for RQE meets or exceeds industry thresholds. The control budget is based, most notably, on well-defined scope and detailed engineering, which has sufficiently matured to allow classification using the AACE International guidelines in the manner OPG intended for RQE. In addition, the level of detail in the RQE control budget is in line with our experience for projects of this nature and should form the basis for a robust project controls regime that will be used to track progress.

Given the complexity and length of the DR Project, it is impossible for OPG to predict all of the issues that the DR Team may confront during execution. In order to reasonably incorporate the risk of these unknown issues, it is important to build a deterministic-based contingency augmented by a strong risk-management process and stochastic Monte Carlo model. Over the course of the Definition Phase, the DR Team's risk management approach has matured and the team has

put into place a robust process for modeling and monetizing contingency that considered the issues experience on prior CANDU refurbishments as well as issues previously encountered by OPG. In the course of developing the RQE contingency, all project and function managers increased their focus on risk matters to ensure that risks were reasonably identified; response plans were established; and occurrence probabilities and impact quantification were developed. The DR Team performed a reasonable amount of challenge and review of the risks. While risk management and contingency development has many subjective aspects, the DR Team's process is well constructed and executed. It is in the upper percentile of comparable project practices. As with any complex megaproject, contingency values can never be perfect, though OPG has developed contingency at an appropriate level of maturity for establishing the Project's control budget.

While there is still considerable work ahead for the DR Team to further refine its estimates, schedule and execution planning for each of the Project's units, the DR Team has substantially met the goals it set in 2009 at the DR Project's inception for its Definition Phase. With RQE's completion, the DR Team is focusing on ensuring the documentation needed to substantiate its decisions is properly archived and available for future needs, including the unit-specific estimates and future regulatory proceedings. The team has set a goal of completing the RQE document archive by the end of 4Q 2015. We discuss the process used to derive RQE's control budget and recommendations for further refinement in the Unit 2 Estimate[1] that will be issued prior to the Execution Phase in 2016.

B. Status of Prerequisite Projects

We have noted the need for Projects & Modifications ("P&M") to provide greater confidence that the remaining key Campus Plan Projects, most notably D20 Storage and EPG 3, can be completed in time to support Refurbishment and meet current cost estimates. Providing such confidence depends as much on progress in the field as it does on P&M providing requisite metrics and progress reports so that this work can be accurately forecasted and managed. P&M has made good progress over the past month with D20 Storage. The Project Controls team is now tracking quantities of installed concrete by Ellis Don, the civil contractor, which will allow for better forecasting. Ellis Don has also added a second shift to increase its production. All of these efforts have improved the outlook for the foundation work, though P&M must continue to track Ellis Don's progress in order to confirm that it can meet its recovery schedule dates for turnover to SNC/Aecon of November 30, 2015 for the south side of the D2O West Annex Basement and December 22, 2015 for the seismic dyke.

As P&M's attention begins to shift to SNC/Aecon, P&M is closely monitoring the SNC/Aecon's recovery of initial delays in its preparatory activities, including procurement and prefabrication of process piping. P&M has assigned key staff [redacted] P&M's ability to manage this transition should be further enhanced by performance metrics SNC/Aecon is providing for its critical path activities. The other key prerequisite project being performed by SNC/Aecon is the Reactor Waste Processing Building ("RWPB"). Site work is ongoing while SNC/Aecon continues to develop its full execution cost estimate and schedule.

Another key project, the Emergency Power Generator 3 ("EPG 3"), is being performed by ES Fox. Based on ES Fox's assessment, the civil construction of this project is currently approximately 20% complete, though ES Fox and P&M must still agree to a cost estimate and full performance schedule to progress the work. SNC/Aecon's performance with D20 Storage and RWPB and ES Fox's performance with EPG 3 should be a leading indicator of OPG's ability to open breaker on time in October 2016 for Refurbishment and provide important lessons learned going forward.

C. Readiness for Execution

With the completion of RQE, the Definition Phase also completes, and assuming BOD approval, the Execution Phase of the Project will formally begin. As we have noted, the key work ahead before Unit 2's Breaker Open in October 2016 will be focused on its "Readiness to Execute" plan ("RTE") in which the DR Team intends to live-test its plans for unit execution using pre-requisite work. During this time, the DR Team intends to, among other things: complete all execution processes and procedures; finalize its execution schedule and confirm the schedule's critical path and sub-critical paths for Unit 2; develop and test all of its tracking metrics for execution work; finalize tracking methods for vendor performance and

[1] The Unit 2 Estimate has also been referred to as the "Unit 2 Check Estimate". However, because the term "check estimate" has a particular meaning within the industry, we prefer use of the term Unit 2 Estimate.

procurement, and; finalize the Division of Responsibility ("DOR") and staffing for the execution organization. The Readiness to Execute is an aggressive plan that has multiple deliverables and will involve effort from the entire DR Team, and will leverage the work the DR Team has already accomplished with the vendors to prepare for execution. We have recommended that the DR Team schedule as many of the activities as possible in a resource-loaded, logic-based schedule and track its progress in the same manner as any project. The DR Team has initiated its Readiness to Execute planning in earnest and should be prepared to provide the BOD and senior management with meaningful progress reporting.

II. DR Project RQE – Summary of BMcD/Modus Assessment

A. Overview

RQE represents the culmination of the DR Team's efforts in the Definition Phase. In order to formulate our opinions regarding RQE, BMcD/Modus have performed two in-depth assessments:

- Assessment of the DR Team's Process for Developing RQE ("RQE Assessment");
- Assessment of OPG's Critical Path Schedule, on which RQE is based ("Critical Path Assessment").

This report summarizes these detailed assessments which provide the DR Team with our view of RQE and identify certain issues and challenges the Team should consider in its continued preparation for Unit 2's Execution Phase and beyond. In summary, the RQE Assessment and Critical Path Assessment conclude that:

- The estimates developed for the multiple sub-projects have the requisite basis to establish a meaningful control budget;
- OPG met the broad goals for RQE it established at the outset of the Definition Phase and in doing so followed acceptable industry practice, including its use of the guidance of AACE International that OPG chose for specific guidance in its estimating, risk and schedule development;
- RQE is based upon sufficiently mature scope and engineering definition, as well as an understanding of necessary operational experience ("OPEX") and lessons learned from prior refurbishments and other similar megaprojects, and reasonable alignment with the vendors who are performing the work;
- The DR Team and OPG as a company have adequately assessed the DR Project's risks and have reasonably approximated contingency necessary to offset those risks over time;
- The critical path for the Project was developed using a deterministic approach that considered past similar evolutions, simulated work in the Mock-Up reactor and reasonable assessments of potential improvements in key work series;
- The critical path has been captured using acceptable scheduling practices and resource curves have been sufficiently analyzed and incorporated into the estimate for the current phase of planning;
- The DR Team has a comprehensive plan to prepare for the Execution Phase of the Project; and
- The areas of RQE that are less mature – namely that Balance of Plant ("BOP") and Shut-down/Lay-up ("SDLU")– have adequate contingency for the known risks and uncertainties.

1. OPG's Goals and Adherence to AACE International Guidance

In order to aid OPG in its development and characterization of the RQE estimate, OPG appropriately chose to utilize AACE International's Cost Estimate Classification System[2], which explains the importance of these guidelines and the intent of their general use:

[2] See AACE's Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) and Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011)

> *An intent of the guidelines is to improve communication among all of the stakeholders involved with preparing, evaluating, and using project cost estimates. The various parties that use project cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates,… improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays or disputes caused by misunderstandings of cost estimates and what they are expected to represent.*

AACE recommends that cost estimates be categorized into five different "Classes" based on the project's level of maturity and definition. Class 5 estimates are based upon a low-level of project scope definition and therefore these estimates have the highest amount of uncertainty and the lowest level of accuracy. In contrast, a Class 1 estimate should have little uncertainty and very high accuracy. As noted in our past assessments of the DR Team's cost estimates (4c and 4d), this approach was appropriate and allowed for better understanding of the nature of RQE.

Pursuant to the Nuclear Refurbishment Project RQE Cost Estimate Plan (NK38-PLAN-09701-10235):

> *The target classification of the RQE cost submission is AACE Class 3 with an expected 50% level of confidence on the point estimate and accuracy range, exclusive of applying escalation, interest and management reserve, within:*

Class 3	*Level of Project Definition: 10% to 40%*	*Budget authorization or control*	*Accuracy Range:* *L: -10% to -20%* *H: +10% to +30%*

> *An assessment of the class of estimate achieved by each project bundle will be performed by the NR Estimating Team based upon AACE Recommended Practices and the nature of the project scope of work.*

As stated above, AACE International's guidelines use maturity level of project definition deliverables as the primary characteristic for classifying estimates. In its procedure, OPG listed the specific deliverables that would need to be developed in order to sufficiently advance the Project to support an RQE within the target Class 3 classification.

Based on our RQE Assessment, we concur that the DR Team has sufficiently matured the work in these areas in order to support RQE as a Class 3 estimate and establish a control budget. We do note that some bundles lack Class 3-level maturity (i.e. BOP and SDLU) while others have been deemed Class 2 (RFR). These differences in maturity are not unusual for projects of this complexity, and the DR Team has a full understanding of those parts of the work that need greater definition.

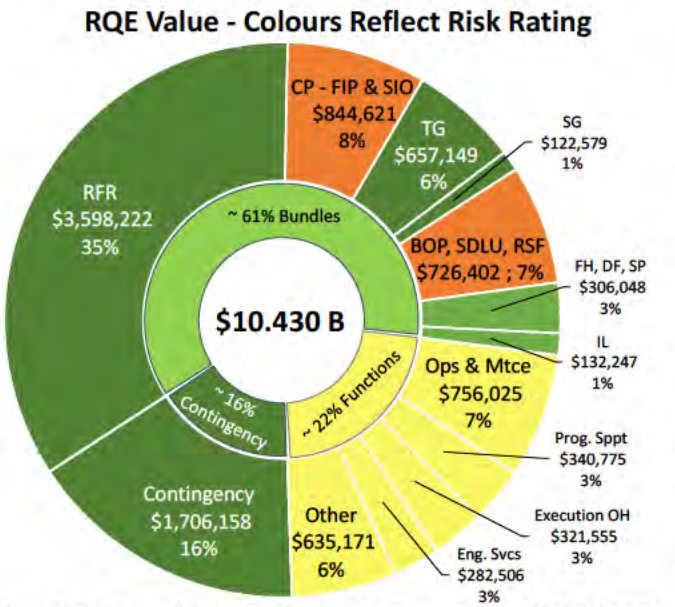
During the Definition Phase, the DR Project's scope was substantially developed and supported with detailed engineering packages. With some exceptions, the detailed engineering packages were prepared in sufficient time for that scope to be adequately assessed and estimated by the DR Project's EPC vendors. Additionally, as we noted in our 3Q 2015 report to the DRC, the process the DR Team used for validating and vetting the cost estimates for the Project's bundles has followed the approved DR Project RQE Cost Estimate Plan, and the result of this process was as intended – the vendors' estimates for project cost have been classified so that management understands the underlying quality, accuracy and reasonableness. This knowledge aided management in identifying potential risks in performance, gaps in the vendors' planned approaches, and areas to shore up for the future unit-specific cost estimates.

Moreover, with this effort complete for the control budget, the DR Team is better positioned for all of its remaining cost estimating work, which will be considerable during the Project's lifecycle. The Unit 2 Estimate the DR Team intends to deliver in the 3Q of 2016 to the Board of Directors will support that unit's execution. The team is committed to performing a similar estimate prior to each unit's execution. In addition, projects of this type must have ongoing cost estimate support for evaluating potential change orders, claims and cost overruns. The process the DR Team has used for RQE should be adaptable for each of these future needs.

In addition, with the development of the control budget, the DR Team has advanced its understanding of the Project's estimated costs such that it should no longer need to depend upon AACE International's cost estimate classification. The DR Team has now established its own measuring stick. With the exception of those projects (BOP and Shut-Down/Lay-up) that have not advanced to Class 2/3 designation and which still need to reach appropriate maturity, OPG should henceforth measure its progress against the control budget without further regard to AACE International classification.

2. Summary of RQE Elements

In the following sections, we discuss in summary fashion: the basis for each of the DR Project's major cost elements; how these estimates were developed and characterized; the risks identified for each bundle, and; recommendations for further maturation of the estimates.

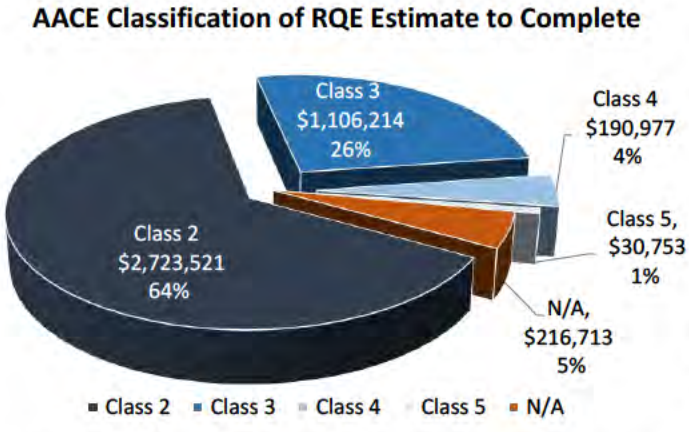


Note 1: Excludes Interest, Escalation, Inflation, and Management Reserve, $3.171B, for a total DR Project cost of $13.6B
Note 2: Contingency as a percent of estimate to complete is 29%
Data Source: RQE Total Cost Snapshot 4.vFinal - October 21, 2015

Figure 1

The adjacent **Figure 1** shows the updated RQE control budget values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency (in 2015$). Figure 1 shows the entire control budget including Definition Phase costs of $2.3B.

Figure 1 also provides context for the relative size and percentage of each component of RQE. The three largest parts of RQE are: RFR (35%); OPG Functions (22%); and Project and Program Contingency (16% of the total control budget and 29% of the estimated cost to complete). The Turbine Generator and Steam Generator projects (7%), Campus Plan Projects (8%), and BOP, Shut-Down/Lay-Up, and Retube Support Facilities (7%) are the next largest slices of the budget.



Note 1: Excludes Interest, Escalation, Inflation, Contingency, and Functional costs
Note 2: N/A - Not Applicable
Data Source: RQE Total Cost Snapshot 4.vFinal - October 21, 2015

Figure 2

Figure 2 provides a depiction of the estimate class applied to each sub-project (or "bundle") per AACE International guidance and OPG's governance for RQE.

Below, we provide a brief update regarding the status of each of the major inputs to RQE in which we summarize the basis of the estimates that are being included in the control budget; the method and depth of vetting the DR Team applied to those estimates; a summary of the basis of the control budget's contingency, and; a summary of the current issues each project should address during the Ready to Execute period leading to breaker open.

B. Schedule Basis for RQE

Establishing a control budget for a construction project requires an understanding of the project's planned schedule. In particular, setting the control budget requires the ability to identify the execution critical path and the resources necessary to support it, as the critical path influences a large portion of the project's costs and the risks on which contingency is based. As a result, we performed a Critical Path Schedule Assessment as a part of our RQE evaluation to determine whether the DR Project's schedule provides sufficient underpinning to the RQE control budget.

Our Schedule Assessment is based upon our review of four main phases of the schedule: Pre-requisite projects to breaker open; defuel and drain with system shutdown / layup; re-tube and feeder replacement; and system commissioning / return-to-service. Due to the current maturity of the integrated schedule, we have focused on the critical path work and schedule only, covering primarily the following questions:

- Does the process used to develop the schedule conform with the DR Project's contracts and approved scheduling plans and procedures;
- Is the basis for the critical path well defined and documented;
- Does the resulting schedule match the documented critical path basis utilized in monetizing the cost estimates; and
- What work remains to complete the schedule and increase quality (i.e. Does the schedule reflect an executable plan for the DR Unit 2 Outage?).

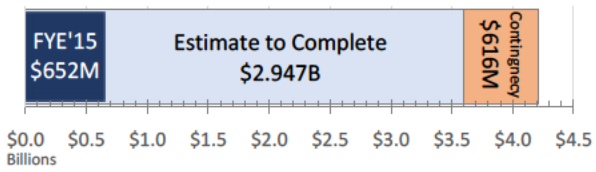
As part of RQE, the DR Team has developed the integrated schedule's critical path at a level consistent with the overall project status. Due to several issues, including delays in issuing purchase orders, the projects have varying stages of schedule maturity. As a result, many of them (particularly those for Balance of Plant) are not detailed enough to be execution-ready schedules. For a large number of DR Project's bundles, implementation planning and work order development are in the early stages and overall integration between OPG Operations and outside vendors is not yet complete. These details are the subject of the next phase of schedule maturity that will occur during the Readiness to Execute period. However, we have determined that the schedule is sufficient for purposes of supporting RQE and is adequate as a baseline for the critical path durations. The DR Team recognizes that much work needs to be done over the next several months in order to have a fully integrated executable schedule.

C. Project Summaries

RETUBE AND FEEDER REPLACEMENT (RFR)

Retube and Feeder Replacement Project Summary	
Control Budget:	$4,214,626,000
RQE Base Cost:	$3,598,222,000
Estimate to Complete:	$2,946,571,000
Contingency (as a Percent of ETC):	$282,820,000 (10%)
(Project + Program Allocated Cont.):	$616,404,000 (21%)
Estimate Class:	Class 2 (95%) Class 3 (5%)
Percent of RQE:	35%

Control Budget
$4.215B



Risk Perspective

1. RFR Basis of Estimate

RFR is the single largest element of the RQE and its budget reflects the overall importance of this work to the DR Project. The RFR cost estimate was developed over the past three years by SNC/Aecon, the project's EPC contractor, under the terms of contract executed between the parties on February 8, 2012. SNC/Aecon prepared four separate estimate submittals, each intended to be a further refinement of the prior estimate. SNC/Aecon's current estimate was updated and finalized on September 18, 2015 and forms the basis of the target price contract the parties intend to finalize prior to the Board of Directors meeting. OPG's estimating team confirmed that the underlying quality of this estimate is Class 2. The most significant supporting facts for this classification include:

- The final target price value of $2.750 B (2015$) has been fully negotiated and is based on mutually agreed upon project durations and schedule contingency, and encompasses 12.9M work hours, project management, supporting tasks, fee and all other costs;
- SNC/Aecon has designed and procured the specialized tools needed for the work. Some of the schedule task durations used in the estimate basis are derived from actually using the tools on the Mock-Up reactor and timing the results;
- All detailed engineering for Unit 2 is complete;
- Construction Work Packages ("CWP's") have been prepared and submitted as a part of the estimate;
- All 53,000 pages of the SNC/Aecon's submission were vetted by OPG's subject-matter experts;
- Both OPG and SNC/Aecon have teams with considerable experience on prior CANDU refurbishment projects and much of that experience has been incorporated into the estimate;
- Tool design has been significantly improved over those used in prior refurbishments, increasing reliability and making the tools easier to use;
- Training on the full-scale Mock-Up, which has never been done on prior refurbishments, should significantly increase the trades' performance in the field;
- Risk identification and contingency planning have been thoroughly performed and known risks are incorporated into the base schedule durations and work planning efforts.

2. Vetting and Characterization of Estimate

Over the course of the 3+ years of SNC/Aecon's estimate development, OPG worked collaboratively with SNC/Aecon to ensure that its final Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale Mock-Up at the Darlington Energy Centre ("DEC"). On May 8th, 2015, SNC/Aecon presented its first draft of the Class 2 estimate to OPG, [redacted]

From this point through September 2015, OPG engaged SNC/Aecon in a detailed vetting process aimed at reducing the overall cost estimate, providing substantive basis for SNC/Aecon's portion of the critical path, and challenging the nature of SNC/Aecon's stated risks and contingency. The OPG and SNC/Aecon teams established a review and vetting process that was driven by subject-matter experts from each team with specific experience in prior CANDU refurbishments. This process was extremely successful at achieving consensus between the subject-matter experts, who objectively agreed with the underlying schedule durations in most instances. In fact, there were only minor disagreements over a small handful of items with a value of approximately $12M of the nearly $750M of direct craft performance estimates. As we noted in our last report, the process utilized to reach these final estimates was extremely detailed and rigorous, which should provide confidence in the results of the vetting process.

3. Contingency

Contingency related to the RFR work is split between the following major buckets:

- The contract includes a contingency amount that can be utilized to resolve issues without impact on the target price. SNC/Aecon is holding, as part of the Target Cost, contractually required contingency in which the parties agreed to a set amount based on the results of the base cost development. The basis and monetization of this contingency was heavily vetted by the subject-matter experts and senior management. The resulting 13.5% contingency totaling $368M is largely based on a deterministic analysis of the potential duration for work task performance and other discrete risks that could impact the work, as monetized with the use of Monte Carlo simulation. The DR Team has assumed for purposes of the control budget that this contingency will be utilized.
- OPG is holding $282M of contingency at the project level which includes discrete risks not carried under the contract.
- OPG is also holding $334M for schedule uncertainty which, due to the RFR project's significant critical path duration, is based on the modeled difference in impact to the critical path between SNC/Aecon's "most likely" (or P50) schedule and OPG's "late finish" (or P90).

In total, OPG is carrying $616M in contingency for RFR or RFR-related risks over and above the contingency that is built into the contract. With a remaining cost for RFR of $2.33B, this equates to 26%. Given the track record of prior CANDU refurbishments, the work performed to identify performance risks and the overall importance of RFR to the work, this level of contingency appears, at this stage, to be appropriate.

4. Summary and Remaining Issues

BMcD/Modus have been closely monitoring the development of SNC/Aecon's cost estimate and OPG's vetting of same, and believes the process the parties used to develop the cost estimate was robust and produced an estimate with significant detail. Moreover, we have witnessed the relationship between the parties substantially improve at every level, which will be important as issues arise. Based on the initial commercial goals the parties set forth, the contract appears to have thus far driven appropriate behaviours and a beneficial result.

With the Class 2 Estimate and target price agreement in place, the RFR team's attention is now turning to execution. The major near-term focus will be on the following:

- Recovery of procurement dates for some components: SNC/Aecon's procurement is generally lagging behind, though some of this lag is driven by aggressive contract milestones, not actual needs for the material. This is currently being addressed by the joint SNC/Aecon and OPG RFR team who have established a "war room" similar to that exercised for the Class 2 estimate development.
- Retube Waste Processing Building ("RWPB") estimate, schedule and performance: the work on RWPB continues while the estimate and schedule preparation continues. The $167M estimate included in RQE was presented as an upper limit estimate, though SNC/Aecon's final estimate and execution plan needs to be fleshed out before that can be definitively stated.
- Logistics need further refinement: SNC/Aecon needs to devote further attention to its supporting activities for material and tooling logistics during the Execution Phase.
- SNC/Aecon's construction organization needs to be built.
- Execution Phase schedule needs additional work and must align with the Project's work breakdown structure so that metrics for reporting progress can achieve needed fidelity.
- SNC/Aecon needs to remobilize in the DEC and make full and beneficial use of the Mock-Up to practice tasks and

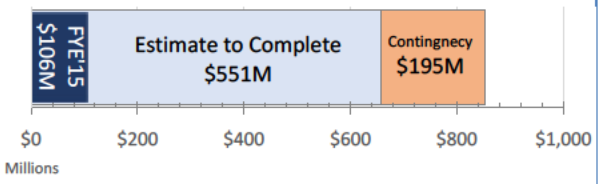
train workers (this work is commencing as of the end of October).

Each of these elements will provide necessary information regarding cost, schedule, risk and overall confidence as the DR Project advances that can be rolled into the Unit 2 Estimate.

TURBINE GENERATOR (TG)

Turbine Generator Project Summary	
Control Budget:	$852,004,000
RQE Base Cost:	$657,149,000
Estimate to Complete:	$551,203,000
Contingency (as % of Estimate to Complete):	$194,855,000 (35%)
Estimate Class:	Class 3 (85%) Class 2 (15%)
Percent of RQE:	6%

Control Budget
$852M



Risk Perspective

1. Turbine Generator Basis of Estimate

The Project's Turbine Generator work consists of two significant evolutions: (1) maintenance work; and (2) digital controls change-out for Unit 3, Unit 1 and Unit 4. In 2014, the DR Team decided to postpone the controls change-out for Unit 2 until the conclusion of the DR Project in order to reduce the risk of the Unit 2 work. Thus, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. The digital controls upgrade will be a first time evolution for OPG and will require significantly more planning than the limited maintenance scope for Unit 2. The risk profile of the subsequent units has been developed with this in mind. Based on the risk profile of similar controls replacements, the decision to delay Unit 2 appears to have been prudent.

Unit 3 will also be the first replacement of the generator mid-section and stator rewind. A new stator will be installed for Unit 3, and the existing Unit 3 stator will be rewound and installed in Unit 4. These evolutions have been planned sufficiently in advance that this work should not be a threat to the schedule of the later units.

OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. These estimates are expected to be fully accepted before the Board of Directors meeting.

2. Vetting and Characterizing the Estimate

Vetting of the Turbine Generator Project estimates came in two phases. Alstom, the original equipment manufacturer ("OEM"), is supplying parts and engineering per a fixed price. That contract was assigned to SNC/Aecon for management after its team was awarded the labour portion of the work. SNC/Aecon's estimate followed much of the same structure as its RFR effort, including successive iterations of the estimate from Class 5 to Class 2. The final Class 2 estimate that forms the basis of the target price with SNC/Aecon was the test case for OPG's estimating process which was robust and laid the groundwork for the RFR estimating vetting that followed thereafter.

3. Contingency

The total contingency of $194.8M equates to 35% of the project's remaining cost. The TG bundle includes three contingency buckets: (1) $27.9M for cost uncertainty; (2) $49.8M for discrete risks identified by the Project Team; and (3) $117M for potential component replacement based on the results of concealed condition assessments on each unit's turbine generator. This contingency bucket was vetted and classified using the OPG estimating process. The team has fully examined the potential schedule impact of discovery work and believes it has reserved sufficient non-critical path

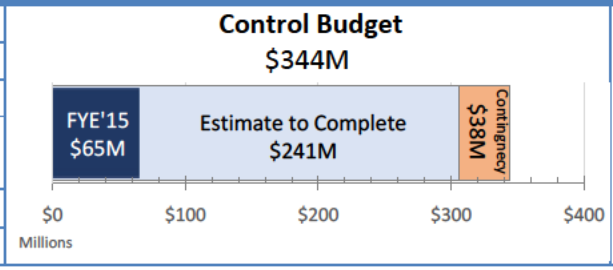
time for major component procurement and replacement in the event such work is required.

4. Summary and Remaining Issues

BMcD/Modus monitored the process used for vetting the TG estimates, and we believe this effort was robust and resulted in further maturation of the estimate. SNC/Aecon's plan for execution was fully explored and significant cost reductions were realized for RQE. As stated above, the Unit 2 work is essentially routine maintenance, though the performance of that work will allow for improved understanding and efficiency for the future units. The controls change-out for Unit 3 needs to be further examined so that the team is assured the labour hours are properly estimated and risks from schedule impacts are mitigated. These will be issues for future unit estimates.

FUEL HANDLING, DEFUELING AND SPECIALIZED PROJECTS (FH, DF, SP)

Fuel Handling, Defueling and Specialized Projects Summary	
Control Budget:	$343,890,000
RQE Base Cost:	$306,048,000
Estimate to Complete:	$240,888,000
Contingency (as % of Estimate to Complete):	$37,842,000 (16%)
Estimate Class:	Class 3
Percent of RQE:	3%



1. Fuel Handling, Defueling and Specialized Projects Basis of Estimate

In summary, the scope of these project bundles includes: (1) Defueling each of the reactors to begin refurbishment, which is the first major evolution on the critical path and fully in OPG's control; (2) Fuel Handling equipment replacement to increase the likelihood of the power track maintaining operation through the Refurbishment outages; and (3) Specialized Projects to replace out of-date components to the Darlington Shutdown System computers, and replacement of the vault coolers that have reached the end of their useful lives. The work for these sub-bundles is directed by OPG, with the DR Team and the Darlington Station working cooperatively, with vendors supplying engineering, parts and labour for portions of the work. OPG decided to minimize the number of engineering changes to these critical components by calling for "like-for-like" replacements and thus limited the potential risk of execution.

While the total cost estimate for Fuel Handling/Defueling/Specialized Projects constitutes only about 3% of the total cost of the DR Project, each of these projects could strongly influence the critical path. Defueling each of the Project's reactors is the first critical path activity in the Unit 2 outage, and this is a first time evolution for Darlington. Ensuring the Fuel Handling components work throughout the DR Project is OPG's responsibility, as OPG will seek to maintain the operation of the running units during each defueling period of each unit's refurbishment. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. The DR Team has been focused on evaluating the past defueling evolutions at other CANDU plants and scrubbing the planned durations to the extent possible.

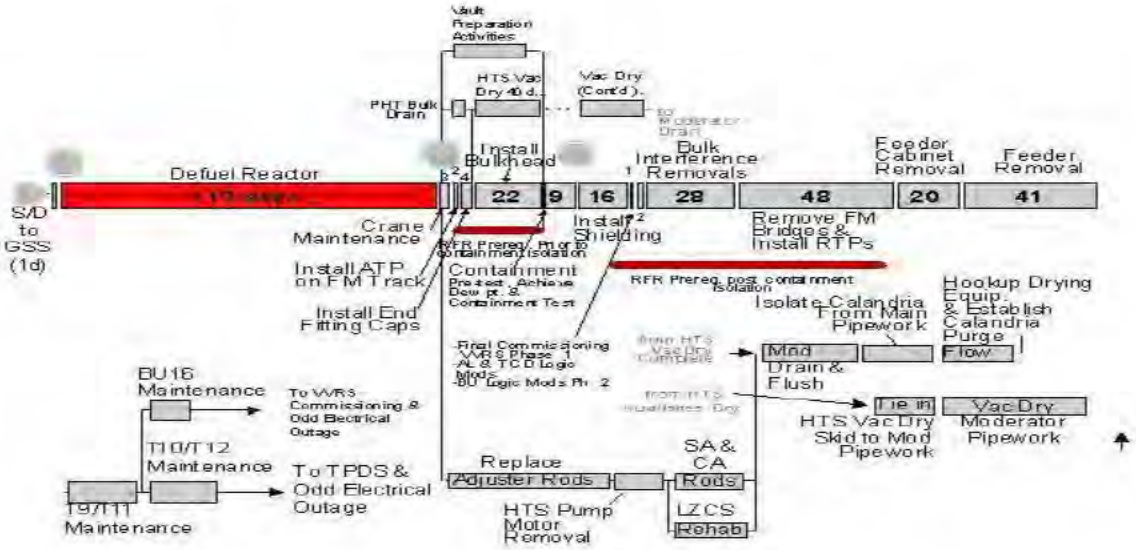
2. Vetting and Characterizing the Estimate

The process for vetting the estimates for these sub-projects was robust, included a team drawn from the station and the project and involved an assessment of reasonable performance in light of past CANDU refurbishment execution, station and vendor performance, and the first-of-a-kind nature of some of this work. It was the latter that drove the estimated Class 3 designation, as the Defueling/Fuel Handling team needed at least one unit's performance before committing to tighter cost estimates.

The current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely (i.e. P50) is 113 days, and the 90% confidence level duration is 134 days. **Figure 3** below depicts the criticality of the defueling duration

at the beginning of the Project.

Figure 3



The Defueling Project Team believes these same durations should be utilized for all four units, as the learning curve for performing defuel will have limited value in improving performance over time. The team believes the 90 day best case is strictly a function of core hydraulics and cannot be improved, while the worst case is based largely on the potential for equipment failure. In the course of deriving these point durations, the Defueling team has dispositioned OPEX from Bruce Power and Pickering and has consulted with its vendor, GE/Hitachi. The due diligence performed by the Defueling team has greatly improved the DR Team's understanding of this critical duration.

3. Contingency

Each of the sub-bundles within this Project is carrying contingency that was assigned on the basis of the work's approximated risk. The following depicts the level of contingency assigned to each:

Bundle	Base Cost Estimate	Est. to Complete	Contingency	% Contingency on ETC
Defueling	$39.6	$10.6	$5.4	51%
Fuel Handling	$158.6	$144.7	$19.6	14%
Specialized Projects	$107.9	$85.5	$12.8	15%
Total	$306.1	$240.8	$37.8	16%

The Fuel Handling and Specialized Projects contingency appears to be appropriate based on the "like-for-like" nature of the work, while the Defueling bundle is carrying a significantly higher percentage due to the risk of delaying the critical path. The discrete risks identified for this work tend to be schedule-focused, which seems appropriate.

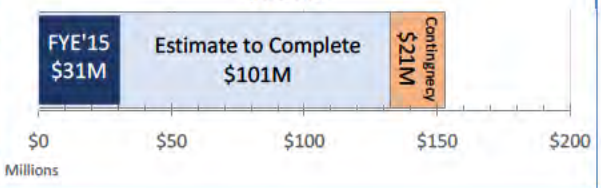
4. Summary and Remaining Issues

The Defueling/Fuel Handling teams have done a very good job of rooting out the risks and finding mitigation approaches. The commissioning of the test fuel handling equipment is complete and the team accelerated the schedule to maximize the amount of practice the teams can perform in advance of breaker open. OPG's performance of these projects will be under tremendous scrutiny going forward, so practice and proving-out processes for documenting progress will be important during the Readiness to Execute phase.

ISLANDING (IL)

Islanding Project Summary	
Control Budget:	$153,104,000
RQE Base Cost:	$132,247,000
Estimate to Complete:	$101,418,000
Contingency (as % of Estimate to Complete):	$20,857,000 (21%)
Estimate Class:	Class 3
Percent of RQE:	1%

Control Budget
$153M



Risk Perspective

1. Islanding Basis of Estimate

The various islanding projects are relatively small in cost but are very significant to the DR Project's success. The design of the Darlington plant makes isolating a single unit for refurbishment a challenge. These projects include: (1) Installing a bulkhead that isolates the Refurbishment unit reactor vault from station containment once the irradiated fuel has been removed from the core, which will allow both airlock doors to be opened to facilitate worker and material transfer into/out of the vault, thus significantly improving RFR worker efficiency. Bulkhead installation is the single largest element of the Islanding Project and its performance will be by SNC/Aecon; (2) Establishing barriers and access control around the Refurbishment Island to keep the Refurb station staff from entering operating unit areas and to keep Station workers from entering Refurbishment work areas; and (3) Establishing terminal points on station systems to allow them to be isolated from the operating units to the maximum extent possible.

2. Vetting and Classification

The majority of the cost for the Islanding work is being carried under SNC/Aecon's contract and was estimated by SNC/Aecon using essentially the same process as it did for RFR.

3. Contingency

The total contingency of $20.86M equals 21% of the remaining costs. The largest and most significant driver of contingency is the potential impact on the DR Project's schedule from potential delays installing the bulkhead. The risk register for Islanding appears to be appropriate for its current state of maturity.

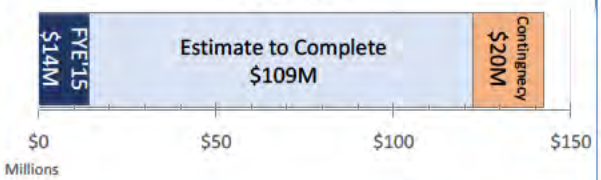
4. Summary and Remaining Issues

The DR Team has performed extensive reviews of plant conditions and OPEX, particularly from Bruce Power, and its efforts appear to have isolated and mitigated the risks to the extent possible. There will be some Islanding work during the Readiness to Execute phase that will allow the team to test its processes and metrics for the larger, more important scopes after breaker open.

STEAM GENERATOR (SG)

Steam Generator Project Summary	
Control Budget:	$142,171,000
RQE Base Cost:	$122,579,000
Estimate to Complete:	$108,589,000
Contingency (as % of Estimate to Complete):	$19,592,000 (18%)
Estimate Class:	Class 2 (72%) Class 3 (28%)
Percent of RQE:	1%

Control Budget
$142M



Risk Perspective

1. Steam Generator Basis of Estimate

The scope of the Steam Generator Bundle is largely composed of maintenance work, including the following: (1) Primary side cleaning; (2) Secondary side cleaning (Tubesheet Water Lancing); (3) Access Port installations (modification); (4) Inspection and Repair (Primary and Secondary Side); (5) Divider Plate Inspections, Boiler Open/Close & Inspection Support; (6) Lay-up work, and; (7) Bleed Cooler Inspection. All of the work has been executed in other plants. The contract for the work was let to a joint venture of B&W and CANDU Energy, a subsidiary of SNC Lavalin.

2. Vetting and Classification of the Estimate

The SG work is classified as Class 2 due to the nature of the work and the fixed-price contract.

3. Contingency

The project is carrying $19.6M in contingency (18% of remaining cost) which is largely driven by the potential for discovery work, and coordination issues with RFR and OPG's Inspection Maintenance Services.

4. Summary and Remaining Issues

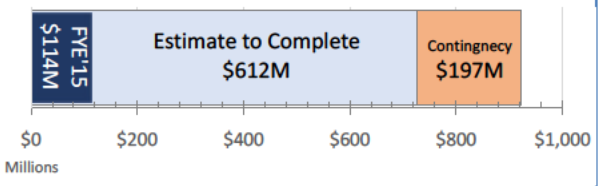
The development of the SG project has proceeded well and the work planning is well underway. The risks discussed above with coordination and the Project's schedule appear to be the most important factors for the team to consider. The performance of the Primary Side Cleaning is currently planned to be the only work other than RFR to extend past the 60% window designated for non-critical path work.

BALANCE OF PLANT, SHUT DOWN LAY-UP AND REFURB. SUPPORT FACILITIES (BOP, SDLU, RSF)

BOP, SDLU, and RSF Project Summary

Control Budget:	$922,940,000
RQE Base Cost:	$726,402,000
Estimate to Complete:	$612,043,000
Contingency (as % of Estimate to Complete):	$196,538,000 (32%)
Estimate Class:	Class 2 (1%) Class 3 (53%) Class 4 (39%) Class 5 (6%)
Percent of RQE:	7%

Control Budget
$923M



Risk Perspective

1. BOP, SDLU and RSF Basis of Estimate

This work scope includes a number of smaller to medium-sized packages. Approximately two-thirds of the work is based on design modifications, while the rest of the work is like-for-like replacement of aging components. The DR Team completed detailed engineering for the modification projects in time for the August 15, 2015 milestone, with some minor exceptions. The BOP work includes seventeen unique sub-projects that range in value from approximately $700,000 to $66M, and the scope includes replacement of components, electrical cable, and inspect and repair/replacement of valves. SDLU consists of twenty-eight different sub-projects and includes a number of prerequisites for construction, including breathing air for workers in the vault and barriers, as well as lay-up of plant systems for the unit being refurbished. RSF consists of building, improving and maintaining shops and other facilities for use during construction. The majority of this work has been released to ES Fox under the terms of the ESMSA contract.

The majority of the BOP work will be performed during the first 50-60% of the refurbishment schedule, with the goal of keeping BOP work off the critical path. Much of the SDLU and RSF work will proceed breaker open, but maintenance of the lay-up of systems will stretch throughout the length of the Project.

2. Vetting and Characterizing the Estimates

These project bundles are the least mature in the Refurbishment scope, which is reflected by their respective estimate classifications; 1% is Class 2, 53% is Class 3, 39% is Class 4, and 6% is Class 5. Based on our observations, these characterizations by the estimating team appear to be appropriate. The DR Team has set aggressive goals to receive all of ES Fox's remaining BOP/Shut-Down/Lay-up/RSF estimates to a Class 3 level by no later than January 2016. The OPG estimating team is collaborating with ES Fox's estimators on these remaining estimates to keep the process on schedule and test the quality of the estimates.

3. Contingency

These bundles' contingency is broken down as follows:

Bundle	Base Cost Estimate	Est. to Complete	Contingency	% Contingency on ETC
Balance of Plant	$430.0	$353.6	$125.3	35%
Shut-Down/Lay-up	$218.0	$196.8	$53.1	27%
Refurbishment Support Facilities	$78.4	$61.6	$18.1	29%
Total	$726.4	$612.0	$196.5	32%

The drivers for contingency include: (1) cost uncertainty due to the maturity level of the packages and the recent completion of supporting detailed engineering; (2) potential upfront delays to Refurbishment causing early schedule issues; (3) past performance of ES Fox on the Campus Plan Projects; and (4) potential for discovery work.

ES Fox's performance on the Campus Plan Projects provides vital OPEX that the team has considered in identifying risk for these projects. The DR Team is aware of the issues [redacted] and are attempting to mitigate those issues. [redacted] The OPG scheduling team has recognized these shortcomings and worked with ES Fox to improve the deliverables. 45% of the BOP and Shut-Down/Lay-Up work estimates are in the Class 4 or 5 range, which increases the risk of estimating uncertainty for these projects. Moreover, the risk profile of these projects should reflect the risks from ESMSA vendor performance. The BOP and Shut-Down/Lay-Up project teams have identified discrete risks related to vendor performance. Additionally, OPG has included some program-level contingency due to the past track record of these vendors in the event performance issues resurface during Refurbishment.

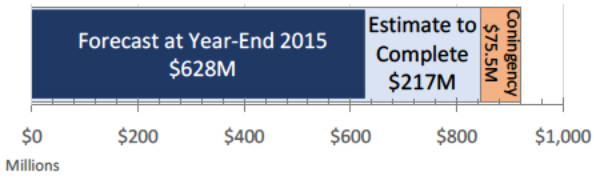
4. Summary and Remaining Issues

BOP and Shut-Down/Lay-Up will be under significant scrutiny once the DR Team's focus shifts to the Readiness to Execute plan. ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and development of Construction Work Packages. The DR Team has placed a challenging goal of having all of the BOP projects proceed to their respective Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. The BOP team has set interim milestone dates with ES Fox for these deliverables which may be too aggressive for the DR Team to receive quality work product.

CAMPUS PLAN PROJECTS (CP – F&IP AND SIO)

CP – F&IP and SIO Project Summary	
Control Budget:	$920,079,000
RQE Base Cost:	$844,621,000
Estimate to Complete:	$216,713,000
Project Contingency (as a Percent of ETC):	$41,525,000 (19%)
(Project + Program Allocated Cont.):	$75,458,000 (35%)
Estimate Class:	Not Applicable
Percent of RQE:	8%

Control Budget
$920M



Risk Perspective

1. Budget Status

There are six active Campus Plan Projects in execution at this time with the Refurbishment Project Office ("RPO"), the RFR Island Support Annex ("RFRISA") and Replacement of Buried ESW Piping approaching completion. There are two other pre-requisite projects, the Auxiliary Heat System ("AHS") which for budgetary purposes was reclassified as a Station project though P&M is still managing the work. The costs for AHS are no longer carried in RQE. The other pre-requisite project, the Refurbishment Waste Processing Facility ("RWPB") is being performed by SNC/Aecon under the RFR Definition Phase contract and is not part of P&M's reporting.

We have noted in past reports that while the remaining dollars involved in the Campus Plan Projects do not necessarily have a significant monetary impact to RQE, certain of the projects, most notably D20 Storage and EPG 3, remain a risk to breaker open of Unit 2. These projects' completion dates have shifted over time and further delays could result in drawing attention away from the Readiness to Execute plan. Overall, the entire portfolio of Campus Plan Projects experienced $76.3M in base cost growth from 4d to RQE, an increase of 9%, which resulted in contingency drawdowns from the allocated budget amount set in 4d. P&M is currently forecasting an Estimate to Complete ("ETC") for all remaining Campus Plan and SIO work of $216,713,000.

2. Contingency

Based on the history of these projects, the velocity of change and the volume of remaining work, the $75.5 million in remaining contingency needs to be closely tracked to ensure it is enough to cover any remaining cost issues with completing these projects. In particular, D20 and EPG3 pose the greatest risk to the remaining Campus Plan Contingency, and EPG 3's final cost estimate has not been fully vetted and approved. P&M's change control process needs to be monitored so that the use of contingency is readily identified and so there are sufficient funds going forward. In Section III below we discuss the status of these projects and describe some of the risks that could cause the base costs for these projects to increase.

FUNCTIONS

With the exception of Operations & Maintenance, the remaining functional groups that compose the DR Team jumped in size from 4d to RQE. The non-Operations & Maintenance groups' cost estimates increased in aggregate from $1.28B (2015$) to $1.53B, an increase of 20%. The largest gains were for the Execution Organization (48%), Contract Management (38%) and Managed Systems Oversight (42%). Operations & Maintenance's budget decreased by from $1.1B (2015$) at 4d to $0.81B for RQE, a reduction of 27%. This reduction was due primarily to identification and removal from the DR Project of non-Refurbishment Operations & Maintenance costs.

The DR Team has high confidence in the extent of the estimates it has prepared for RQE and are all-inclusive of what could reasonably be identified for staffing at this time. However, the pace of the proposed ramp-up of the DR Team's staff is aggressive and will be very difficult to meet. In order to meet the plan, the DR Team would have to increase from 770 to

just over 900 (17%) staff in less than 3 months. The team has been chronically under-spent during the Definition Phase, and missing these major ramp-up dates will further impact the accuracy of the team's staffing forecasts.

The commitment from the NPET to further rationalize and organize the functions on the basis of a division of responsibility matrix ("DOR") has been held over to the Readiness to Execute phase. The DR Team committed to putting a DOR in place that defines each function's accountability and responsibility by early 1Q 2016, which in turn should result in optimizing the organization. While the DR Team's goal for RQE was to identify the outer cost limit for the functions, BMcD/Modus is more concerned that the DR Team operate efficiently, have highly qualified and skilled resources, and actively manage the field work during the Execution Phase. The team has considerable work ahead to meet these goals.

D. Summary of RQE Risk and Contingency

As part of our assessment of RQE, BMcD/Modus has focused a lot of time and attention on the DR Team's development of contingency for the Project's control budget. Our review focused on the development of input factors, the Monte Carlo stochastic modeling, results analysis, and finalization of RQE contingency provisions. Specifically, we focused on the following aspects of the DR Team's contingency development:

- Whether the processes used for capturing risks were sufficiently robust;
- The extent to which contingency is properly modeled; and
- Whether the risks and associated contingency amounts were properly monetized.

The DR Team's development of the contingency for RQE compares favorably with what our team has observed in the industry. While risk management and contingency development has many subjective aspects, the DR Project's process is well constructed and executed. It is probably in the upper percentile of comparable project practices. Nonetheless, because of uncertainties and unknowns, contingency values are not perfect, but the DR contingency process likely contributes to a reliable and defensible RQE.

1. Contingency Process

OPG prepared and approved the RQE Contingency Development Plan NK38-NR-PLAN-09701-10006 in Q1 2015, establishing the approach for developing the RQE contingency and describing the associated contingency development principles and processes. The Plan established a contingency process utilizing a number of AACE recommended practices for contingency development. It appropriately states that the practices will be supplemented with the expert opinion and judgment of the NPET (Nuclear Projects Executive Team) to ensure there is confidence that the contingency estimate is robust and sufficient to deal with the risks and uncertainties characterized at the time of RQE.

Six basic buckets were addressed in developing the RQE contingency:

1. **Cost Estimating Uncertainty** - The project managers and function leads provided three point estimate uncertainty ranges.
2. **Schedule Uncertainty** – Uncertainty range estimates for critical path durations were provided to the risk team by the project managers. Schedule cost impact was determined by applying a daily "burn rate" to any schedule impacts. Allocation of schedule contingency between the affected project and the overall program critical path was carefully addressed.
3. **Discrete Risks** - Discrete risks from the project, program and function Risk Registers were reviewed and post-mitigation probability of occurrence values were finalized. Quantitative cost & schedule impact values were developed with associated three point ranges as model input. In addition, provision for risk event recurrence over the four units was established for model input.
4. **High Impact Low Probability Risks** – The Board of Directors Controlled Contingency was established deterministically to address these issues and to provide for some coverage of unanticipated items beyond control of the DR team.

5. **Campus Plan/ F&IP –** The nature of Campus Plan risk registers, estimates and schedules required that contingency be established a through a combination of stochastic, deterministic and expert judgment means. Probabilities and impact ranges for the discrete risks were updated. Cost elements were assigned uncertainty ranges. The results of the risk probabilities and impact quantification with three point ranging, along with estimate uncertainty ranges were then submitted for Monte Carlo analysis. The Monte Carlo contingency values were assessed by P&M's management and deterministic adjustments were made for RQE. The stochastic and deterministic numbers were then compared and justifiable adjustments were made. In addition, program contingency was added to reflect the historic performance issues associated with Campus Plan projects.
6. **Insurance Uncertainty** – A premium cost point estimate and pessimistic/optimistic uncertainty range was provided by Finance and factored into the contingency calculation.

In developing the contingency at the project level, the DR Team took care to ensure there was no double-counting or duplication. From our review, the team was successful in not over-generating the contingency.

2. Vetting of Risks and Contingency

The RQE contingency was subjected to many stages of review and vetting. The RFR project received focused attention from SNC/Aecon and the DR Team, given its overall importance to the Program. The process used for vetting the base contract amounts also resulted in thorough understanding and development of the risk model.

For the various projects the Risk Team conducted contingency workshops, where subject-matter experts challenged, critiqued and provided constructive feedback. After the workshops, members of the risk team met with the respective managers to update data that was entered into the @RISK Monte Carlo model and preliminary results were obtained. Those results were analyzed and changes were made to the model and input data was refined. To monetize schedule impact, Finance reviewed cash flow projections and developed a point estimate for daily burn rate and an associated uncertainty range. That approach is considered reasonable.

The DR management team recommended establishing a contingency to be controlled at the Board of Directors level. This was done by considering deterministic estimates primarily based on experience-based judgement. Other considerations included OPG's risk tolerance, the budget ceiling, and the overall established contingency. Provisions for "Black Swan" (high impact low probability) risks were considered in establishing this layer of contingency. Factors included acts of God, the labor and political environment, vendor defaults, nuclear safety or security events, unforeseeable scope increases, and financial matters. No strict rules or best practices exist for estimating low probability/high impact events and the subjective approach employed by DR is not uncommon.

3. The Monte Carlo Model

The DR Team used modeling experts from the Palisade Corporation[3] to develop a Monte Carlo simulation method for the Project. In Palisade's final report, which focused on the RQE contingency process, Palisade stated that the model used by the DR Team contains all the elements of risk management's best practices and contains well-defined methodology as its foundation. Palisade also cited the collaboration of risk experts interfacing with project/functional managers and SMEs.

The RQE Monte Carlo model is extremely robust and comprehensive. All four units are addressed in one integrated fashion. Over 2600 three point estimates were used to model outcome (maximizing use of three-point range estimating contributes to the veracity of the input by allowing the source to avoid conservative single value "plug-in" numbers). Over 470 discrete risks were analyzed. Approximately 273 risks were included in the contingency calculation, which 55 were program/function related and 218 were from projects. Close to 800 estimate uncertainties were analyzed and 128 schedule activities assessed across the four Units.

[3] Palisade Corporation provides widely accepted @RISK software system to a global base of customers and consults on the process for developing stochastic tools for understanding and quantifying risks and uncertainties.

A schedule correlation factor of 70% is included the contingency model, reflecting interdependence of schedule activities. In addition, because DR is a multiple unit project, provisions to address risk recurrence are incorporated based on project and functional manager input.

4. Contingency Results

The resultant contingency amounts are reflected in **Table 1**. Monte Carlo based values are at the P90 level for Projects/Bundles/Functions and for allocated Program Contingency. "P90" means that, based on the inputs and model structure, there is a 90% confidence that the contingency value is appropriate to cover the risks and uncertainties analyzed by the model.

Table 1

RQE Contingency Summary

Contingency Element	P90 Amount ($x1,000)[4]	Basis	Simplified Contingency Draw Approval Requirements[5]
Projects/Bundles/Functions	$851,648	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty[6]	If less than $100K – Project Manager approves for trending with no contingency draw until accumulated. Then…[7] …If greater than $100K and less than $5M – Project Manager and Project Director approves contingency draw. [8] …If greater than $5M, CCB approves[9]
Program	$854,475	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty	Program Change Control Board ("PCCB")[10]
Board of Directors Controlled Contingency	$800,000	Subjective analysis of unanticipated/uncontrollable items (Vendor default, Labor/political matters, etc.	PCCB + CEO or DR Board Committee[11]
Total Contingency	$2,506,123		

The third column in **Table 1** reflects the DR Project's recommendation for the management of contingency. It should be noted that the Board has not yet provided approval of this process. In determining level of control for contingency, it may also be beneficial for the Board to review contingency at both the P50 and P70 levels. We will provide a comprehensive review of how OPG intends to monitor and use contingency in our Change Management Assessment Report that will be issued later this year.

[4] *See* RQE Total Cost Snapshot 4 October 21, 2015.
[5] Other provisions are in place based on percentage of baseline and for schedule changes impacts.
[6] *See* Campus Plan Exception described earlier in this report.
[7] Change costs are trended and do not result in contingency draw unless the project/bundle/function can't absorb the cost. At that point, approval is based on the amount of accumulated cost impact for the affected project, bundle, or function.
[8] N-MAN-00120-10001 PC-12 "Nuclear Refurbishment Program Change Management Section 6.1.
[9] *Ibid.* Section 6.1. The Change Control Board ("CCB") is comprised of: VP Refurbishment Execution, Director Refurbishment Engineering, Director Refurbishment Operations & Maintenance, Director Refurbishment Planning & Controls, Director Refurbishment Unit Outage, and Director Nuclear Controllership.
[10] *Ibid.* Section 5.13. The Program Change Control Board ("PCCB") is comprised of NR Dir. Planning & Controls, SVP NR, VP Nuclear Finance, VP Assurance, VP NR Engineering, VP Refurbishment Execution and VP Operations & Maintenance.
[11] *Ibid.* Section 6.4.4.

5. Observations and Recommendations

As stated, BMcD/Modus have found the process OPG has utilized for developing contingency to be sufficiently robust to support RQE. However, risk management is not a once-a-year exercise; it should be considered a pillar of project management. Thus, we have made certain recommendations for further enhancing the management of risk and governing the appropriate use of contingency established in the control budget:

- With some exceptions, the DR Team chose to monetize contingency utilizing the experience of the project managers as opposed to developing detailed estimates that were vetted by the OPG estimating team. We recommend that for the Unit 2 Estimate, OPG utilize the same estimating process for the contingency as it does for the base costs.
- OPG should ensure that significant contributors to contingency are justified and well documented. Justification of components such as: a) the broad application of schedule correlation; b) schedule burn rates; and c) levels of management control over contingency should be well documented.
- The infrastructure for identifying and managing risks has been in place for several years, though to a large extent, the program has been relegated to the "important, but not urgent" category as projects and functions focused on day-to-day challenges. While the RQE contingency process required the projects and functions to devote considerable attention to risk and contingency development effort, we observed some of that focus wane as the RQE effort was completed. Momentum and a sense of urgency for risk management needs to be maintained through the Execution Phase. The DR Team should consider making the discussion of risks and risk management a greater priority in its internal communications.
- Consideration should be given to developing information and training sessions that discuss the value of the risk program not only for development of RQE contingency but also the importance of sustained (or increased) efforts in executing and managing the DR Program. (This is also important for documenting and managing internal OPEX).
- OPG needs to increase senior management visibility and risk program advocacy throughout the organization.

Finally, it is important to understand that stochastic processes for developing contingency values do not create conclusive "answers". They serve as statistical tools to inform management regarding a basis for establishing and justifying contingency. These tools do not manage or mitigate risks; only management can do so. Therefore, management focus on risks needs to be strong and ongoing.

E. Remaining Work – Program Level

1. Quality Assurance

The DR Team is in the process of tying-up the remaining loose ends in the RQE submission and is performing quality assurance checks to ensure there are no major data fidelity issues in the control budget. The following are the priorities the team is using to ensure the quality of the RQE submission:

- All costs need to be supported by the documentation necessary to tie all numbers to their source;
- Risk registers need to incorporate any changes that came from NPET reviews; and
- The RFR team must close-out review SNC/Aecon's full Class 2 submission that OPG received on September 18, 2015 to ensure that there are no significant gaps or unresolved issues prior to locking down the target price.

The process for close-out of 4d was not given priority status, which elongated its close-out. The team is putting appropriate focus on close-out of RQE at this time.

2. Schedule

A major component of the Readiness to Execute plan will be developing and finalizing the Unit 2 execution schedule with all work at the appropriate level of detail. The DR Team's original goal of having the full execution schedule completed

for RQE was not met, though as noted, the control budget is supported by a well-defined critical path and windows for non-critical path work have been vetted and considered. We believe that the DR Team has done sufficient schedule work to support RQE, though considerable work remains before the schedule is execution-ready. BMcD/Modus will be providing our comments and recommendations regarding the schedule development as the work progresses.

3. Documentation

The DR Team developed considerable documentation in support of RQE that must be properly archived through a document control process which is directly traceable to the RQE. The team intends to implement a robust Integrated Data Base where the documentation will ultimately reside. The organization of this documentation should consider the future needs of subsequent cost estimates, configuration management, commercial uses and requirements for substantiating the basis of Project costs for regulatory purposes. Once the IDB is set-up, we recommend testing the sufficiency of the organization of the documents to ensure the documents are accessible and comprehensive. The team has put a goal of completing the document archive by the end of 2015.

III. Status of Campus Plan Projects

The outlook for completion of the largest and most significant remaining Campus Plan Projects – D20 Storage and Emergency Power Generator 3 ("EPG3") – had generally improved, though there are significant remaining issues and risks that have impacted both these projects' schedules and cost estimates.

A. D20 Storage

Ellis Don continues working on the foundation for D20 Storage, and SNC/Aecon is preparing to complete the building and perform the mechanical, electrical, HVAC and steel/structural erection. Ellis Don's work must be substantially completed before SNC/Aecon can start its work in the basement of the D2O building. P&M has bifurcated its team to simultaneously focus on Ellis Don's progress and SNC/Aecon's preparation.

Ellis Don's recent progress has ramped up since our last report. As of October 30, 2015, P&M reported Ellis Don to be 83% complete with its foundation work, and had only two walls and one staircase left to pour. Ellis Don's progress has been positively impacted by adding a second shift to increase the volume of work. In addition, the P&M team has benefitted from assigning an experienced project manager to oversee the civil construction and from the Project Controls effort to field verify and report Ellis Don's progress.

The DR Team's Program Status Report dated October 23, 2015 stated that Ellis Don's "concrete placement in the basement is expected to be completed by December 22nd for the north section and 1-2 weeks later for the south section." The current schedule (as of October 30 in OPG's network) shows Ellis Don completing its work on December 26, 2015 however with the increase in production and with good weather, their completion date could move forward. Ellis Don's recent improvement makes completing the foundations in mid-to-late-December much more likely. Turnover of the entire site from Ellis Don to SNC/Aecon will likely miss the contractual date of November 30, 2015. However, Ellis Don is currently working on a recovery schedule so that it will turn over the West Annex Basement on November 30, 2015 and the seismic dyke by December 22, 2015. SNC/Aecon has fallen behind in its pre-fabrication of piping that is on its critical path, and has further indicated that it may accept partial acceptance of the site on November 30th. However, since its piping work and tank setting is on critical path, the value of SNC/Aecon's partial site acceptance may be minimal until it can recover its critical work streams. Due to the fact that both contractors will be working in a confined space, it will be important for OPG to carefully manage this transition. The contractors' schedule progress needs to be accurately recorded and based on recent objective progress so that OPG can document this transition for commercial purposes.

SNC/Aecon has prepared and revised its cost estimate and schedule (which still requires final vetting and disposition of its basis of estimate), and is now producing metrics that are reporting its progress based on quantities of work. These early metrics are showing SNC/Aecon is behind by approximately 2-3 weeks in its procurement and prefabrication of piping. The baseline schedule shows SNC/Aecon's plan to meet all of the project's key milestones; however, as noted these dates are likely to be impacted. Schedule updates from SNC/Aecon need to be properly captured so that an accurate forecast

of any impact can be properly documented and managed. [redacted] SNC/Aecon intends to do so once it has secured agreements with its major structural, civil and HVAC subcontractors. SNC/Aecon has committed to reporting key subcontractor status via earned and actual work hours against its plan, which should provide P&M with enough information to track this key work.

The current SNC/Aecon schedule is based on the D2O project meeting an interim deadline of June 28, 2016 to accept water from Unit 2 so that there is confidence that Refurbishment of Unit 2 can proceed. This deadline was initially set about 1 year ago when the DR Team reviewed the need for a contingency plan for D20 Storage in the event the building could not be completed. We have recommended that P&M and Refurbishment re-examine this milestone if it is able to implement one of the alternatives it is currently reviewing for draining primary heat transport and moderator water from Unit 2. If an effective mitigation strategy can be implemented, it could allow deceleration of some of the work which could potentially reduce the overall risk of construction. However, such a deceleration should only occur if it is supported by objective progress data from field progress that substantially improves the confidence of all concerned that D2O Storage Facility will be available for Refurbishment of Unit 2.

B. EPG 3

OPG has committed to placing EPG 3 in service prior to Unit 2's breaker open. The civil construction is currently approximately 20% complete, and ES Fox intends to set the EPG unit by the end of November. Construction has previously been impacted by issues with plant tie-ins and unforeseen underground conditions. In its Project Status Report issued October 29, 2015, P&M reports that "Corporate milestone "Generator In Place" – Nov 30, 2015 currently at risk." While there is a recovery schedule in place, the Project Status Report currently shows that the Turnover/Available For Service milestone is not forecasted to occur until August 5, 2016 (323 days late), only two months in advance of breaker open. Furthermore, it should be noted that neither the additional forecasted costs ($21.3M over the approved amount of $88.2M) nor the recovery schedule have gone through a gate for final approval. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a schedule that is doable and predictable as soon as possible.

In its Project Status Report, P&M reports that "Engineering holds remain on a number of packages to incorporate design input from LLM Vendors. Holds to be resolved by Dec 2015." These engineering issues should not impact the civil work, though some involve changes to allow the stock generator to meet OPG operational requirements which could impact the installation or in-service date of the EPG unit if they are not resolved in time. The VP of Engineering and Sargent & Lundy have established a process for working through these issues and bringing more timely visibility to engineering issues as they arise on ESMSA (Campus Plan, BOP and Shut-Down/Lay-up) projects.

P&M also identified EPG 3's commissioning as a risk. "This is a first time evolution for these modifications and there is limited commissioning experience with this type of equipment. The risk is that the commissioning of this new system may take longer and be more challenging than anticipated/estimated resulting in numerous work interruptions/clarifications and extension to the schedule or missing AFS (OPEX from Pickering Temporary Emergency Power System)." To mitigate this risk, the DR Team has assigned a dedicated manager to lead the commissioning effort, though the schedule should accommodate the time needed for commissioning with these risks in mind.

P&M's Program Status Report dated October 23, 2015 showed the forecast as $115M, and noted that, "the forecast is expected to increase by an additional $5-10M. The increase is a result of additional costs to recover schedule delays that occurred during excavation and fuel line relocation, design changes based on newly available equipment information, and additional resources and time allotted for commissioning. This cost increase can be accommodated within the available contingency." P&M further noted in the October 27th Project Status Report that, "Significant costs increases are being addressed with contractor. SCRs in place," and "A new gate package will be prepared to identify the new EAC and schedule completion," which P&M anticipates having in 4Q 2015. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a cost estimate and schedule that is doable and predictable as soon as possible.

IV. Readiness to Execute Planning

With the completion of RQE, the DR Team intends to shift its entire focus to the Readiness to Execute plan. The team has developed detailed milestones and has established forums for progressing deliverables. In our review, we believe the Readiness to Execute plan is comprehensive and should provide a solid basis for testing the DR Team's execution planning. There are certain parts of the plan that are intended to deal head-on with key project risks; in future reports, BMcD/Modus intends to focus on certain key aspects of the readiness work, including the following:

- **Procurement:** The DR Team is piloting processes for tracking and overseeing vendor procurement, and is enhancing the warehouse capacity for the storage of materials and equipment. The risks for procurement are well known and documented in the industry, and OPG and its vendors are already experiencing some issues that will need to be managed carefully. Transparent reporting of status and identification of problem areas are the most effective means for mitigating those problems.
- **Project Team Development**: With the DOR in place, the team intends to sort out accountabilities and test its responses to real-time work situations. As part of this exercise, the team needs to review protocols for frequency and timing of key meetings and expectations for key communications.
- **Completion of Construction Work Packages**: Completing CWPs for the remaining work will require substantial effort, and is a necessary prerequisite for developing the schedule. In particular, BOP work packages must be completed by April 2016 to support the schedule and Unit 2 Estimate development.
- **Schedule Development**: The DR Team intends to iterate the baseline schedule two times prior to breaker open. In its Rev. B schedule, the team will flesh out all of the work known for RQE, which will expose certain areas in the schedule that are potentially problematic. During the first half of 2016, the schedule will be further refined, with Rev. C supporting the Unit 2 Execution Phase. In the process of developing the schedule, the DR Team should review lessons learned from the schedules prepared by SNC/Aecon and ES Fox for the Campus Plan Projects. These schedules are a leading indicator of how these vendors will schedule work (if allowed) for the Refurbishment. There are a number of issues with the vendors' current approach [redacted] that if not corrected will inhibit the schedule's ability to properly calculate and forecast the work. Not correcting these deficiencies will cause OPG to be reactive throughout the Execution Phase. Moreover, the Campus Plan Projects have also learned the importance of planning commissioning tasks well in advance, so that execution of the work (including physical testing, preparation of a multitude of documents and turnover activities) is performed in a manner that allows for the work to be accepted. These details need attention in the final Rev. C schedule.
- **Reporting and Metrics**: The DR Team has considerable work planned to improve metrics and reporting as part of the Readiness planning. It intends to put in place a new cost tracking system and developing metrics that will provide useful tools for project management. The team is committed to basing these systems on installed quantities which is standard in the industry. Much of the DR Project's current controls suite is based on financial reporting, which has its place but is not appropriate for field execution. In addition, the team needs to define a single source of data so that there is fidelity across all reports. BMcD/Modus will be closely reviewing the team's efforts in developing its reporting regime.
- **Unit 2 Cost Estimate**: The culmination of the Readiness to Execute activities will be the development of the Unit 2 Estimate for the BOD's approval. The work performed for RQE should position the team for this exercise, though it should consider lessons learned from the RQE effort and develop a Unit 2 Estimating Plan. As part of that plan, the DR Team should consider using the same RQE processes and protocols for all of the Unit 2 Estimate. During RQE, a decision was made to vary from the approved estimating process for some of the components of the estimate, including PMT costs, functional costs and the discrete risks. With the goal of the Unit 2 Cost Estimate being to tighten the estimates, the established process used for vetting EPC costs will allow for more formative vetting of these costs, increasing their reliability.

F1 Soil Management Plan
for
PROJECT
Heavy Water Management Building (HWMB)
D2O Storage Facility
Purchase Order No: 00217807

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Confidentiality

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List of Acronyms

B&M	-	Black and McDonald
BBA	-	Barry Bryan Associates (1991) Limited
bgs	-	below ground surface
BH	-	borehole
COG	-	CANDU Owners Group Inc.
CLOCA	-	Central Lake Ontario Conservation Authority
CTP	-	conditional transfer permit
DNGS	-	Darlington Nuclear Generating Station
GG	-	Gross Gamma
GS	-	Gamma Spectroscopy
H3	-	Tritium
HWMB	-	Heavy Water Management Building
IWST	-	Injection Water Storage Tanks
LPSW	-	Low Pressure Service Water Line
MOE	-	Ontario Ministry of Environment
MW##	-	monitoring well
NORM	-	normally occurring radioactive material
OPG	-	Ontario Power Generation
PA	-	protected area
PCBs	-	polychlorinated biphenyls
PGL	-	Pottinger Gaherty Environmental Consultants Ltd.
PHC	-	petroleum hydrocarbons
sVOC	-	semi-volatile organic compounds
TCLP	-	Toxicity Characteristic Leaching Procedure
VOC	-	volatile organic compounds

1.0 GENERAL

The scope of this plan is to provide a means for Black and McDonald (B&M) to inform all interested parties of B&M's intended methods and means for handling the excavated soil for the new Heavy Water Management Building (HWMB) and associated shallow excavations for relocation of utility services, transportation of excavated soil from the Protected Area to Campus Plan F1 (F1) laydown area, and soil management. This plan does not address the decision for the final soil destination (i.e., F3 location or offsite). The decision for the final soil destination will need to be endorsed by the Director Refurbishment Operations and Maintenance, SVP Darlington, VP Nuclear Services and VP Environment.

As part of the Darlington Refurbishment and Continued Operations Project, large volumes of soil (including bedrock) will be excavated at the Darlington Nuclear Generating Station (DNGS) site to accommodate new infrastructure within the Protected Area (PA), including the HWMB, Low Pressure Service Water line (LPSW) relocation as well as other shallow excavations for relocation of services.

Large volumes of soil from within the PA will be removed as a result of these excavations and there is insufficient laydown area within the PA to stage these materials. Therefore, the excavated soil will be transported and staged on a geotextile pad to be constructed at F1. This pad is required to be in-service application for up to 10 years. The design of the pad is described in Section 6.

1.1 Purpose

The purpose/objective of the Soil Management Plan is to:

a. Ensure compliance with environmental legislation, regulations and conditions of approval;
b. Ensure proper records are maintained to meet regulatory environmental requirements; and
c. Ensure that all personnel involved with the F1 area are aware of the scope of work and the requirements for soil transportation and soil management.

1.2 Scope

This plan deals with the following excavated materials from the HWMB and various shallow excavations within the PA:

a. Daylighting soil using a vacuum truck (top three (3) metres);
b. Spoils from caisson drilling; from surface to 16m below ground surface (bgs), installing caissons along the outer perimeter of the HWMB foot print;
c. Excavation of soils within the HWMB foot print, inside the enclosed caisson area from surface to 3m bgs;
d. Bulk excavation; soil from 3m to a depth of 13m bgs within the HWMB foot print, inside the enclosed caisson area; and
e. Bulk excavation; bedrock from 13m to a depth of 16m bgs within the HWMB foot print, inside the enclosed caisson area.

This plan is to be used in conjunction with "Contractor Environmental Management Plan" (Ref. 16.4).

2.0 BACKGROUND

B&M contracted Kinectrics Inc./Pottinger Gaherty Environmental Consultants Ltd (PGL) to evaluate environmental soil quality within the HWMB footprint in spring 2013.

The Borehole Drilling Investigation (NK38-REF-38000-0483285) consisted of the installation of six new boreholes to determine options for soil generated by HWMB excavation. PGL logged and sampled the soils. Groundwater samples were collected from six existing monitoring wells and one sump. As a part of the work, PGL also reviewed historical reports pertaining to the Injection Water Storage Tanks (IWST) spill in 2009.

The IWST water was primarily demineralized water containing 44,807,000Bq/L of tritium and 58.8mg/kg of hydrazine. Historically, 29 boreholes and 28 wells were used to investigate spill effects. The investigation identified tritium impacts near the HWMB. Two samples both from MW148 had tritium levels over 0.02µCi/kg (0.041µCi/kg and 0.074µCi/kg at 3.6m and 9.7m, respectively). The investigation also identified petroleum hydrocarbons (PHC) and limited volatile organic compounds (VOC) impacts. The soil and groundwater quality were evaluated against Ontario Regulation 153/04 Table 3 industrial/commercial/community standards for coarse-textured soil in a non-potable groundwater condition (Ministry of Environment [MOE] Table 3). Soil and bedrock samples from two locations were submitted for Toxicity Characteristic Leaching Procedure (TCLP) waste characterization to assist with soil management. The TCLP results were compared to Schedule 4 of the General Waste Management Regulation (Ontario Regulation 347). None of the soil and bedrock samples were leachate toxic (i.e., soil and bedrock are non-hazardous).

The results of the work completed by PGL were consistent with IWST findings. The general soil quality within the proposed excavation is good. Tritium in soil was below the 0.02µCi/Kg limit in all samples tested. Testing for conventional parameters indicated that additional testing will not be required for landfilling.

However, there are MOE Table 1 and MOE Table 3 soil exceedences. If the soil is to be reused at DNGS or offsite, then additional testing of the material should be conducted according to Ontario Regulation 153/04.

Two soil samples from the IWST work (conducted in 2009) had elevated tritium levels. Therefore, PGL recommended that their investigation report and results be provided to OPG Health Physics to assess if additional radiological sampling was required for the release of the material. Additional asphalt samples and soil samples were collected as a part of the project to facilitate offsite shipment of soil. This report (NK38-REF-38000-0483285) was previously provided and is available on request.

3.0 REGULATORY REQUIREMENTS

The following regulatory requirements need to be met to use the area at F1:

a. Soil sampling and management procedure will follow Ontario Regulation 153/04 soil sampling requirements;
b. OPG's standard for F1 is the MOE Table 3 Industrial Commercial Community standards for a coarse-textured soil in a non-potable groundwater condition;
c. The F1 area is within a wetland area regulated by Central Lake Ontario Conservation Authority (CLOCA); therefore, a Large Fill permit was prepared and submitted to CLOCA for approval. The Permit expires on September 23, 2015, and will be reapplied for, as required by the Project;
d. Soil transportation and soil movement at the F1 laydown area has been designed such that it will not interrupt bird migratory season and will not interfere with endangered species habitat;
e. All federal, provincial and municipal regulations will be followed, including conditions stipulated by the CLOCA Large Fill permit; and
f. Completion of OWRA – Minor Modification Notice (N-FORM-10559) within 30 days of discharging F1 sump water to OPG yard drainage/forebay.

4.0 ROLES AND RESPONSIBILITIES

B&M (with their subcontractors, PGL and EllisDon) will work in coordination with OPG to ensure compliance of this Plan. The list below identifies personnel involved in the Plan and their roles and responsibilities.

a. Project Manager (PM) – responsible for the overall F1 Soil Management Plan, ensuring that it is prepared, approved and followed. (Bruce Smith 416-791-1898).
b. Construction Manager (CM) – responsible for the implementation of the F1 Soil Management Plan on the project. (Kurt McDonald 416-677-7273).
c. Environmental sampling, analysis, and monitoring (ES) – Responsible for all environmental sampling, analysis, and monitoring activities at F1. (Salima Jaffer/Brandon Partridge 905-668-4908)
d. All onsite personnel – all personnel are responsible for identifying and reporting any adverse conditions or issues that could affect soil management.

5.0 MANAGING EXCAVATED MATERIALS

This section describes how excavated materials are removed from the PA and additional requirements, if any, prior to being transported to F1. Details pertaining to Campus Plan C13 are not duplicated herein. Information on the specifics of C13 are detailed in the Soil Management Plan for C13 Area (Ref. 16.9).

5.1 Daylighted Soils

Soil will be removed by vacuum truck from various small excavations within the PA and taken to area C13 pad. The soil will be dewatered and tested for radiological parameters. PGL will provide the analytical results to Radiation Protection for evaluation. When Radiation Protection provides a decision regarding the pathway, the tested soil may be shipped offsite to a landfill site or to soil staging areas F1/F3 (as available) at Darlington Nuclear outside the PA.

5.2 Excavated Soils

Excavation work will be conducted using various types of heavy equipment.

Trucks will be used to transport excavated soil material from the PA to Area F1 outside the PA. The trucks will be loaded with soil from the HWMB excavation while the truck is stationed on the asphalt of the roadway. Once truck has been loaded, a laborer will walk around the truck and inspect the immediate area for debris. The laborer will sweep the dry debris away from the truck and the truck tires will be swept using a stiff bristle broom/brush.

The truck tires will be inspected by PGL prior to the truck leaving the PA and confirmation will be communicated to the driver that the truck is clean and can proceed to F1. A specific route will be followed and inspected on a daily basis. Refer to the Traffic and Logistics Plan (TLP Ref. 16.8).

Two types of trucks may be used to transport soil from the PA to Area F1: Tri-axel (dump trucks) and/or Rock trucks with a low "belly" to contain soil/water.

a. For the installation of the caissons, a drill rig will auger down to bedrock while inserting a steel liner. The soil pulled up by the auger is the caisson spoils.
    i. The caisson spoils will be removed from augers within the HWMB foot print.
    ii. The spoils will be allowed to dewater for a period of time but will not remain within the HWMB footprint. Any water generated from saturated spoils will be contained on the HWMB foot print and will be directed/stopped using soil berms or straw bales from migrating from the HWMB footprint.
    iii. If soil is saturated and needs to be removed from the footprint, then rock trucks will be used exclusively.
    iv. The caisson spoils will be loaded using an excavator or loader onto trucks and transferred to F1.
    v. The caisson spoils will be off loaded onto the F1 geotextile pad in a cell designated for caisson spoils.
b. The bulk excavation will be completed as described in the following steps. The top one (1) metre of material that the spoils were allowed to drain on will be excavated and placed in the same cell as the caisson spoils. The next two (2) metres will be loaded and transferred to F1 and unloaded on the geotextile pad in a cell designated for this material.
c. Below the three (3) metre markdown to bedrock the soil will be excavated into trucks at grade. This material will likely be damp and will be placed in the same cell as the caisson spoils.

d. Using a jack hammer attachment to the excavator the bedrock will be broken up, loaded into trucks and transferred to F1 and unloaded on the geotextile pad in a cell designated for this material.

The F1 pad will be constructed with two separate cells to hold at least 25,000m^3 of soil/bedrock. The estimated volume of material type being generated during excavation work is listed below in Table A with the storage cell number identified.

Table A: Estimated Volumes of Material Generated During Excavation Works

Cell	Origin of soil	Estimated Volume
Cell 1	Grade to 3m below grade (shallow excavations within PA) 1 to 3m below grade (HWMB) estimated amount	7,000m^3
Cell 1	Bedrock (HWMB excavation)	2,300m^3
Cell 2	Caisson Spoils (full depth of HWMB excavation)	2,254m^3
Cell 2	3m below grade to Bedrock (HWMB excavation)	12,650m^3
	Total	**24,204m^3**

***Due to construction delays at F1, soil generated during the caisson work of the HWMB construction project will be staged in Cell 1. The caisson spoils will be positioned towards the north end of Cell 1 to segregate it from shallow soil from C13. When Cell 2 is complete, soil from the caisson work will be moved to Cell 2.*

6.0 LAYDOWN AREA F1

6.1 Description of F1

Area F1 is shown on the Campus Plan Appendix A. The site is covered with vegetation and mixed gravel fill. An existing concrete pad, approximately 72m x 23m, is on the northwest side of F1. On the east side is an existing building that is not being used. East of the F1 pad is an area designated F1a which is approximately 90m x 30m. Once the excavated material has been dewatered, sampled, tested and declared suitable for transfer under a UTP; it will be shipped offsite for landfilling or spread out on area F1a or area F3 (another soil staging area at OPG DN) as available.

6.2 Background of F1

In preparation for the design of the F1 soil staging pad, B&M requested PGL to prepare a design scope document as well as assess existing soil quality (environmental and geotechnical) conditions at the proposed F1 area.

A design document "F1 Soil Staging Pad Scope Document" was prepared and accepted by OPG on August 9, 2013. The functional design requirements included allowing end-users to use the geotextile pad facility for soil storage over a 10-year period. PGL contracted Barry Bryan Associates (1991) Limited (BBA) to design the F1 Pad. The following general design elements were required:

a. The designed pad shall abutt the existing concrete pad to the north;
b. Four chambers to hold soil/bedrock;
c. Berms to separate the chambers to delineate the area;
d. Sump and holding tank need to be included for each of the chambers; and
e. The pad shall follow the natural grade of the Site to the south be graded.

PGL reviewed historical environmental documents provided by OPG and then conducted a limited test-pit investigation program at the proposed F1 area to characterize background soil quality (environmental and geotechnical). PGL completed the environmental evaluation and contracted Soil Engineers Ltd. to complete a geotechnical evaluation of the proposed F1 pad area.

Nine test pits were conducted within the footprint of the F1 pad south of the existing concrete pad. Soil samples were tested for conventional (environmental and geotechnical) and radiological parameters. PGL prepared and submitted a report for the environmental findings; all tritium limits of samples collected were below the method detection limit of 15bq/kg (Ref. 16.10). This document was previously provided and is not included herein.

Soil Engineers Ltd. provided a report of their findings; their report indicated that 0.6m of material would need to be removed and engineered material supplied to support the volume of soil/bedrock on the pad (Ref. 16.11).

6.3 Preparation of F1 (F1 Early Works Plan)

To support the initial construction activities for F1, B&M requested PGL to prepare an F1 Early Works Plan. This plan included the evaluation of the items listed below.

- **Sediment Control:** a silt fence will be erected around the full Disturbance Limit (as shown Appendix A – Erosion, Sediment, & Drainage Control Plan). The silt fence will be inspected on a weekly basis and within 12 hours of a rainfall event. Additionally, there will be berms erected around the soil staging area to prevent sediment from leaving the staging area. There are no water courses in close proximity to the F1 Area so further measures are not warranted.
- **Drainage Control:** the site will be graded per the Engineer's requirements (BBA) and the facility will be constructed on the west half of F1. The Pad will be approximately 100m x 80m. Additional drainage swales with straw-bale check dams will be installed to route water around the pad (see Appendix A – Figures).
- **Soil Removal:** soil with low engineering value will be removed (about 10,000m^3) and placed east of the onsite building (F1a). This soil was tested *in situ* during the F1 Preparation works. PGL confirmed that the soil meets MOE Table 3 coarse-grain standards for the tested parameters of concern. This soil will be placed on a geotextile fabric, staked in place to mark the existing ground elevation (to assist during site restoration works). A copy of this report has been provided and is not included in this document.
- **Dust Control:** all trucks will have a bed cover that will be closed once the truck is filled. It is anticipated that once the soil is placed at F1a it will remain there until such time the area is required to be developed for additional plant operations. The soil will be placed using heavy equipment (i.e., rock trucks, dozers) in flattened mounds and hydro-seeded. Side slopes will be maintained at 3H:1V.

- **Public Access:** all driveway entrances to F1 will be fitted with a chain and signage to prevent public access to the area. As part of the site fence perimeter, a locked gate already exists at the Maple Grove Road extension, north east of the F1 area. The construction silt fence will also demark the construction area.

6.4 F1 Design

The four-cell pad design described in Section 6.2 was revised by the Project Team (BBA, PGL, EllisDon and B&M) based on discussions, evaluations, and existing site conditions. All design changes have been presented and approved by OPG prior to implementation.

To maintain separation between the excavated soil/bedrock and the native soil an impermeable geo-membrane pad will be built on Area F1 with two distinct cells with berms (or similar) separating the cells to avoid cross contamination of materials. See Appendix A – Figures (Site Plan).

F1 pad will include two cells, as described in Section 1, to hold caisson spoils, soil from the top 3m (10ft) of the excavation and shallow daylighting activities, soil from 3m below grade to the top of bedrock and bedrock material.

A general overview of the F1 Early work activities are provided below:

1) Clean up surficial material (Black Beauty) at F1 identified;
2) Install a silt fence around F1 area;
3) Install bollards with chains to limit site access at all three driveway entrances to F1 area;
4) Excavate the top 0.6m of soil within the F1 pad footprint. This material will be stockpiled east of the existing building;
5) Stockpile excavated soil from Item 4 on a geotextile fabric. The soil will be mounded with side slopes of 3:1 (H:V) and hydro-seeded; and
6) Remove vegetation from existing drainage swale on the south side of F1 area if required.

BBA and B&M are evaluating/approving materials (geotextile liner, sump, concrete additive, piping, valves, etc.) to be used to construct the pad to support the 10-year application.

Once the early works are completed the F1 area will be graded (see Appendix A – Liner Cross-Section). This will be covered with a 16oz, non-woven geotextile; a double layer of Enviro Liner 4040 will be installed, followed by another layer of 16oz, non-woven geotextile topped with six inches of sand and a final layer of woven geotextile.

To protect the liner, a 4-inch Geoweb (Geo Cell) will be in placed on top of the liner, filled with Granular B and compacted. This Geoweb is rated for 40,000lbs and will protect the liner from possible damage from equipment. In order to secure the Enviro Liner, the liner has to be anchored to the block walls/berms.

Sediment runoff will be prevented by using a geotextile filter to prevent any sediment from flowing out of F1. Three underground sumps will be installed, one for Cell 1 and two for Cell 2. Any remaining moisture in the soil will infiltrate to the liner and be directed to the sumps. Sumps will be inspected and emptied as identified in Section 11.

The cells will be covered by a manual tarping system. The tarps are multi-layered material and will be provided in roughly 100ft by 30ft sections. The sections will be positioned using an excavator (similar) and manually joined together in the field using woven straps. Tarps will be placed on the soil pile as the cell is filled, typically starting from the concrete-block wall out. The tarps will limit the amount of rainwater that F1 cells accumulate and minimize the volume of rain water that enters the F1 sump system.

7.0 MOBILIZATION PLAN

a. Caisson spoils and bulk excavation soil will be loaded into trucks as identified in Section 5.2. The trucks will leave the PA following a pre-planned route as shown in the TLP (Ref. 16.8). The specific route will be followed and inspected by B&M (or their subcontractor) on a daily basis.

b. As required, street sweeper vehicles (or similar) will be deployed to clean the pre-planned route between the PA and F1. The sweeper deployed should sweep and vacuum up the debris. Debris collected will be discharged at the F1 pad.

c. Trucks leaving the PA will have the tires cleaned to remove debris off the truck and tires. A laborer will walk around the truck and inspect the immediate area for debris. The laborer will sweep the dry debris away from the truck and the truck tires will be cleaned using a stiff bristle broom/brush. The truck tires will be inspected by PGL prior to the truck leaving the PA and confirmation will be communicated to the driver that the truck is clean and can proceed to F1.

d. B&M (or their subcontractor) will provide the personnel to inspect and clean the trucks at the HWMB excavation site. The trucks will be inspected for (hydraulic/seal) leaks prior to leaving the PA by the truck operator. If a leak is discovered the truck will unload excavated soil back on to the HWMB excavation area. The truck will be cleaned/washed and sent for repair.

e. The trucks will be monitored by the Exploranium when exiting the PA.

f. The trucks will deposit the soil from the HWMB footprint onto the F1 laydown area in the entrance of the appropriate cell. To minimize tracking of soil via the truck tires; trucks should remain on the concrete apron at F1.

g. Trucks leaving F1 will cross a rip-rap section of road which will shake debris off the truck and tires. Drivers will stop the truck near the F1 gate and will inspect the truck/tires and remove any additional debris using a stiff-bristle broom prior to exiting the site. The trucks will travel back to the PA on the assigned route (Ref. 16.8).

h. Trucks will stop before leaving F1 area to allow PGL personnel time to inspect truck tires before leaving F1. PGL personnel will provide go/no-go to the driver after visual inspection. If it is a no-go, the driver will have to clean the tires again.

i. To leave the Site at the end of the day (i.e., travel on public roads); Tires and truck box will be inspected by PGL personnel and driver will brush truck tires before allowing the trucks to leave OPG property.

j. For traffic management and vehicle-noise management, see TLP (Ref 16.8).

8.0 CONTROL OF ACCESS TO F1

Access to F1 area will be controlled. Only soil generated from construction projects within the Darlington PA with potential radiological impacts (e.g., the D20 Storage Project) will be accepted.

a. All three access points at F1 will be secured with gates/chains and locks. A silt fence will enclose rest of the area.

b. A placard will be installed on the gate identifying F1 site contact names.

c. EllisDon will issue placard/magnetic stickers to authorized truck operators for offloading soil during the D20 project works.

d. PGL will record truck number and license plate (Truck tracking form – see Appendix D) and provide direction for offloading soil to the correct cell based on excavated materials.

9.0 SOIL SEGREGATION PLAN AND VOLUME TRACKING

Excavated soil from in the OPG's D20 Project will be placed in Cell 1 or Cell 2 at Area F1 based on *in situ* soil analytical data (i.e., where and from what depth below grade the soil originated from LPSW and HWMB excavations). Excavated material is described in Section 1, Table A.

Soil will be transported to F1 in a dump truck or similar. The soil will be unloaded at the entrance to the cell and moved into the cell with a second piece of earth moving equipment. This method will minimize trucks tracking mud across the site.

Soil will be placed in either Cell 1 or 2. To facilitate manual tarping of the cells, soil will be placed adjacent to the cell walls to provide support to the tarp to be deployed. Moving the soil from the entrance area to where it is to remain while the cell is being filled will provide aeration.

While the cells are being filled, tarps will only be deployed to cover specific areas. During this time, weighted-sand bags or similar may need to be used to secure the tarps.

a) Once the soil has been received at F1, active soil management will be evaluated on an ongoing basis. All segregated soil piles located at the F1 area will be sampled and submitted an external lab for analysis. The analytical results will determine active soil management (i.e., aeration of the soil using mechanical equipment). Initial soil turnover will be performed two times a week to a maximum depth of 1m. Sampling and analysis will be conducted weekly per gridded area within the cell until a baseline can be established. Once the baseline is established (after one month) the sampling and aeration frequency will increase or decrease based on the soil-turnover aeration and tritium-removal efficiency. PGL will document sampling work conducted and track sample results versus depth and area within the cell. Other factors that will affect soil-turnover aeration are weather and temperature. Once a soil pile is deemed inert (i.e., meets the requirements of a UTP) the material will be removed at the earliest convenience to the final destination that is either offsite landfilling or at F3 as available.

b) The volume of soil for each area will be tracked by monitoring the number of trucks for each area being excavated and/or calculation of area excavated. A truck-tracking form will be used to document this information. (Appendix D – Inspection Forms).

c) Two construction entrances will be provided at F1 equipped with 20m-long mud mats/clear stone for removing mud/debris from truck tires. (Appendix A – Erosion, Sediment, & Drainage Control Plan). This option has been selected as there is no electrical power or water available at F1. Once construction of the pad is complete, truck access to offload material at F1 will only be through the west entrance.

10.0 SOIL SAMPLING PROTOCOL

a) The sampling methodology for moving soil from the Protected Area to F1 meets the sampling requirements in Ontario Regulation 153/04. Mainly, the sampling protocol consists of *in situ* soil characterization, augmented with 2% audit sampling of the trucks as they leave the protected area.

i. Ontario Regulation 153/04 characterizes imported fill at a site for purposes of filing a Record of Site Condition. It is also used as an industry standard for providing an acceptable level of characterizing soil.

ii. The regulation specifies sampling requirements if soil is to be re-used as clean fill onsite or offsite. If offsite, one sample is required for every 160m^3 for the first 5,000m^3 and one sample per 300m^3 after that. The regulation also identifies the number of samples required to reuse soil onsite. This consists of field screening 50 soil samples and analyzing 10 samples for every 1,000m^3. Based on the nature of the work and the potential contaminants, we recommend that 10 soil samples be analyzed for every 1,000m^3.

iii. The estimated quantity of soil that will be moved to temporary laydown pad F1 area is 24,204m^3. Field screening of soil will not be conducted at this time as the material will only be moved from within the PA to outside the PA. Based on the estimated 2,800 truckloads, PGL will collect soil samples from 2% of the trucks (i.e., at a frequency of 1 sample per 50 trucks). Soil samples collected will be sent to an external lab for testing of conventional parameters, tritium and gross gamma for documentation purposes only. Representative soil sampling to facilitate removal of the material from the PA was conducted and reported by PGL in spring 2013 (NK38-REF-38000-0483285).

iv. Based on the *in situ* soil characterization completed as well as the 2% audit sampling to be conducted (on soil from trucks leaving the PA). Radiation Protection has provided a blanket Conditional Transfer Permit (CTP).

b) The sampling methodology for moving soil from F1 to F3 or F1 to offsite will meet the requirements in Ontario Regulation 153/04 and be consistent with the CANDU Owners Group Inc. (COG) sampling methodology recommendations described in the report, "COG-08-3105I, "Protocols for sampling of representative scenarios of recurrent non-homogenous solid waste".

i. The sampling protocol to evaluate material prior to removing from the F1 pad will be conducted at a frequency of one sample for 100m^3, for a minimum total of 207 samples that will be sent to an external lab for analysis. These samples will be shipped under the blanket CTP provided by Radiation Protection. Additional sampling may be required based on evaluation of radiological and conventional results for material to be re used at Darlington.

ii. Radiological and TCLP parameters will be tested and results evaluated prior to determining offsite shipment from F1 to F3 if available or to a MOE-approved landfill facility if necessary. The soil must meet: (i) the applicable release limits for radiological testing and be in compliance with the Nuclear Substances and Radiation Device

regulation, and (ii) MOE Table 3 coarse-grain standards for the tested parameters of concern.

iii. Sample parameters associated with each type of analyses are listed in the Table B below.

c) Soil placed in the F1 laydown area cells will be tracked weekly as soil is moved from inside the PA to the F1 pad. Cells will be mapped in a grid system and soil will be traced to segregate any abnormal tritium, gamma or conventional parameter results.

Table B: Soil Sample Parameter Summary

Parameter Type	Analytical Testing
Radiological Parameters	H3 = Tritium GG = Gross Gamma GS = Gamma Spectroscopy
Conventional Parameters	PHC = Petroleum Hydrocarbons F1 to F4 M&I= Metals and inorganics VOC =volatile organic compounds (including benzene, toluene, ethylbenzene and xylenes
TCLP	TCLP = metals and inorganics, VOC, sVOC, bulk and leachate PCBs, soil pH and ignitibility.

11.0 SUMP SAMPLING

a) Each of the F1 soil-storage cells will have three underground sumps to collect water from the soil and rainwater. There will be an insulated valve controlling the flow of water between the two sumps. The sumps will be inspected daily and an inspection checklist will be completed (see Appendix D). The checklist will include the following items: date/time, personnel name, observed leaks/accumulated debris, approximate volume in sump.

b) One sump will be sampled when it is 50% full and the valve will be closed so that additional water cannot come into it. The sampling parameters are provided in Table C below. The samples will be submitted to OPG Chem Lab or an external lab for analysis.

c) If the samples are submitted to an external lab for analysis, the sample shipment will require a CTP issued by the Radiation Protection Department with the approval the Responsible Health Physicist.

d) If the limits in Table C are met, the water can be either discharged to surface or transferred to the nearest yard drainage point to F1 (see Section 12 and Appendix B).

e) If there is an oil sheen on the water and the rest of the parameters are acceptable, Detox will be called in to skim off the sheen for disposal as per item (f) or (g) below as applicable.

f) If there are total organic carbon or pH issues and the dewatering system is not available, the water will be disposed via Detox for disposal as per item (g) or (h) below as applicable.

g) If all parameters except Tritium from Table C are met, the following process can be followed to dispose of the water inside the protected area at the forebay:

i. Ensure dedicated vac truck is used for all transfers. If a new vac truck is required, or truck was utilized for a different task, then a sample must be submitted for Table C parameters;

ii. If the sump has additional water added to it during this time, it will have to be re-tested for Table B parameters;

iii. The vac truck cannot be used for other work until the sump transfer is complete; and

iv. Discharge water from vac truck to the forebay at the same location as the Box Drain Pump out in a controlled manner (approximately 1hr discharge). Ensure vac-truck tracking form is complete (Appendix D).

h) If tritium limits *and* other parameters in Table C are exceeded, the following options should be considered for practical effectiveness in achieving the parameter criteria:

i. Dilute with station non-chlorinated waste water, (if the intent is to meet (f), or

ii. Transfer to the dewatering system (if still in operation)

iii. Dispose water via Detox to Clean Harbours.

Table C: F1 Sump Sample Parameter Summary

Parameter	OPG Limits
Tritium	<100Bq/L can be discharged to surface Between 100Bq/L to 4000Bq/L will be transferred to yard drainage for release at catch basin 654 or 468 (Appendix C) >4000Bq/L can be diluted (with non-chlorinated waste water or domestic water) and re tested. If only tritium concentration persists, then either (i) dispose offsite via Detox or (ii) return water to the protected area for discharge at the forebay, provided that all other parameters have been satisfied. >8000Bq/L cannot be diluted, either (i) dispose offsite via Detox or (ii) return water to the protected area for discharge at the forebay, provided that all other parameters have been satisfied.
Gross gamma	GG < MDA/NORM (verify with Radiation Protection)
Total Suspended Solids*	≤70mg/L
Visible Oil*	No visible sheen/allowed
Total Organic Carbon*	≤15mg/L
pH	6.0-9.5

Notes:
1.(*) The effluent shall be essentially free of floating and settleable solids and cannot contain oil or any other substance in amounts sufficient to create a visible film, sheen foam or discolouration on the receiving waters.
2. Offsite disposal of sump water by Detox will be covered by the blanket CTP with an upper limit of 2µCi/L (74,000Bq/L).

In the event of extreme rainfall or predicted rainfall, PGL staff will close the gate valves to isolate the sumps from F1 pad cells 1 and 2. If standing water accumulates in the cells, the water will be vacuumed (vac truck) out of the cells before the valves are opened. Testing of the water will follow that detailed in the F1 SMP.

Table D: Additional Considerations for F1

Concern	Mitigation
Weather – rain/snow/wind events	Review weather forecast to plan for staffing, sampling of sump water, installation of tarp to cover soil pile, inspection of silt fence.
Timing for receipt of analytical results	Ensure that samples are collected timely so that sump water can be discharged/disposed of appropriately

12.0 YARD DRAINAGE POINTS

The nearest yard drainage points to F1 are provided in Appendix B. Yard Drainage Catch Basins 654 and 468 (that have a maximum discharge limit of 4,000Bq/L) are potential options for re-routing water if the 100Bq/L groundwater limit is exceeded in the sump water tested at F1. .

As a prerequisite to the use of the yard drainage system, these locations would need to be confirmed in the field (i.e., walkdown); accessibility and condition of the catch basin to receive the discharge water evaluated. This action will be completed by Ellis Don prior to soil being shipped to F1 and reported as being completed in an email communication to OPG Environment and B&M.

13.0 GROUNDWATER MONITORING AT F1

Parameters and groundwater sampling frequency requirements for the F1 soil staging area are outlined in the F1 Groundwater Monitoring technical memo (NK38-REF-38000-0483349) provided in Appendix E. There are eight wells that will be sampled on a quarterly basis to evaluate groundwater tritium concentrations in specific wells at F1 and wells in close proximity to F1 (upgradient and downgradient).

In addition to these eight wells, two new sentinel wells will be installed at F1; one east and one west the F1 lay down area. The wells will be positioned along the southern edge of the soil staging pad down gradient of the pad and sump tanks. The sentinel wells will be sampled according to the F1 Groundwater monitoring technical memo and are designed to monitor the possible introduction of tritium to groundwater from the subsurface piping system of the F1 pad and the sump tanks.

Background groundwater sampling will be conducted as a prerequisite at those well locations where historical tritium results were not available. Once soil is placed at F1, groundwater sampling will be conducted at these wells quarterly until the F1 pad is removed. The quarterly results will be tabulated and provided to OPG in an email and an annual technical memo will be generated documenting the

findings. Groundwater wells will continue to be sampled quarterly for one year after F1 has been decommissioned. A final report documenting all the work will be completed three months after the removal and restoration of F1 and a short technical memo will be completed documenting the groundwater monitoring work completed in the year after decommissioning works.

If groundwater well sampling results are higher than the prescribed limit, then: (i) increased sampling frequency will be followed per NK38-REF-38000-0483349 and (ii) remediation actions to restore F1 and surrounding affected area will discussed and scheduled for implemented by the Project.

14.0 RESTORATION OF F1

When F1 is no longer required for staging soil for the OPG Projects and/or, no longer needed by other Nuclear Refurbishment projects and/or as directed by OPG, the material installed for the soil staging (silt fence, geotextile, berms, etc.) will be removed, recycled as appropriate and or appropriately disposed of.

The area will be restored in consultation with OPG (i.e., if the area is to be developed for additional plant operations or remain unoccupied). If the area if to remain vacant, the original soil removed from the proposed pad location will be relocated, graded to allow precipitation to drain naturally to the existing swale and hydro-seeded. Imported sand fill may remain at F1 if deemed clean.

Environmental testing of (soil/granular fill) materials to remain at F1 will be required as well as testing of the native material under the pad location to confirm that the soil quality has not been altered from its original condition as documented in the test pit work conducted by PGL at F1. Material will be tested for conventional and radiological parameters as identified in Section 10.0.

Soil/granular fill will be screened and sampled according frequencies set out in Ontario Regulation 153/04: for every 100m^3; five samples will be field screened and one submitted for analytical testing.

A report documenting the post F1 removal findings will be generated based on the soil quality results. If soil impacts are identified, recommendations for remedial works will be provided after consultation with OPG's Project team and Environment Group.

15.0 BACKOUT PROVISIONS

In the event that backout condition occurs, excavation equipment should be left in a safe state.

a) Backout in the case of fire or personal injury. Notify station emergency response team (ERT) first. In addition to backout procedures, workers will immediately notify the CMO who will immediately notify the shift manager.

b) Backout in the case of an electrical storm or unsafe weather conditions such as high winds, rain or snow.

c) Backout In the event of a station alarm: stop work, listen and follow instructions given on the public address system. Ensure that the work area does not pose a safety hazard, cover any open areas. All workers shall proceed to the designated assembly area identified in the daily pre-job briefing.

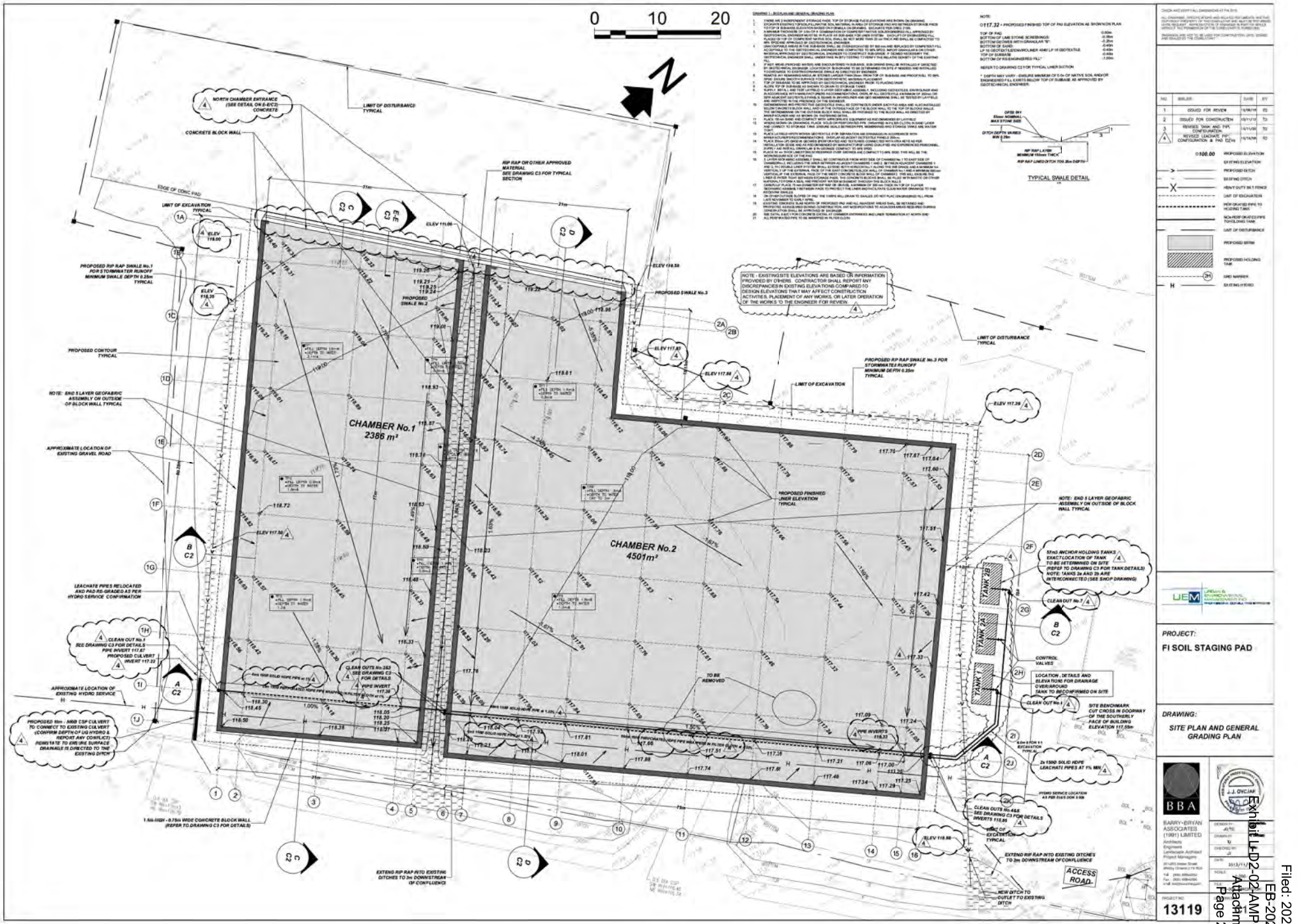
d) Backout in the case of a spill event. Follow Spill plan actions outlined in Ref 16.5.

e) Backout if tangible evidence of hydrocarbon impacted soil is encountered. Notify OPG, B&M and PGL project managers. Contact PGL personnel to investigate so that soil is segregated/sampled as determined to be required for landfilling, per options outlined in this Plan.

16.0 REFERENCES

16.1. N-GUID-09701-10013: Environmental Requirements Guideline
16.2. D-INS-79000-10002: Waste Disposal Guidelines for Solid Waste and Recycling at Darlington
16.3. D-INS-07290-10000: Darlington Spill Prevention and Contingency Plan
16.4. NK38-PLAN-38000-10003: Contractor Environmental Management Plan (B&M 48070014-CEMP)
16.5. NK38-PLAN-38000-10005: Spill Prevention and Contingency Plan (B&M 48070014-SPCP)
16.6. NK38-PLAN-38000-10020: Groundwater and Dewatering Plan (B&M 48070014-GDP)
16.7. NK38-PLAN-38000-10006: Waste Management Plan (B&M 48070014-WMP)
16.8. NK38-PLAN-38000-10018: Transportation Logistics Plan (B&M 48070014-TLP)
16.9. NK38-PLAN-38000-10004: Soil Management Plan for C13 area (B&M 48070014-SMP)
16.10. NK38-REF-38000-0483816: F1 Test Pit report
16.11. NK38-PLAN-38000-0475693: F1 Early Works Plan
16.12. NK38-REF-38000-0483285: Borehole Drilling Investigation
16.13. NK38-FEX-15200-0506: Catch Basin 468 Location
16.14. NK38-FEX-15200-0507: Catch Basin 654 Location

APPENDIX A



NO.	ISSUE	DATE	BY
1	ISSUED FOR REVIEW	14/06/16	EG
2	ISSUED FOR CONSTRUCTION	03/11/12	TO
3	REVISED TANK AND PIPE CONFIGURATION	14/11/08	TO
4	REVISED LEACHATE PIPE CONFIGURATION & PAD ELEVs	15/12/08	TO

PROJECT:
FI SOIL STAGING PAD

DRAWING:
SITE PLAN AND GENERAL GRADING PLAN

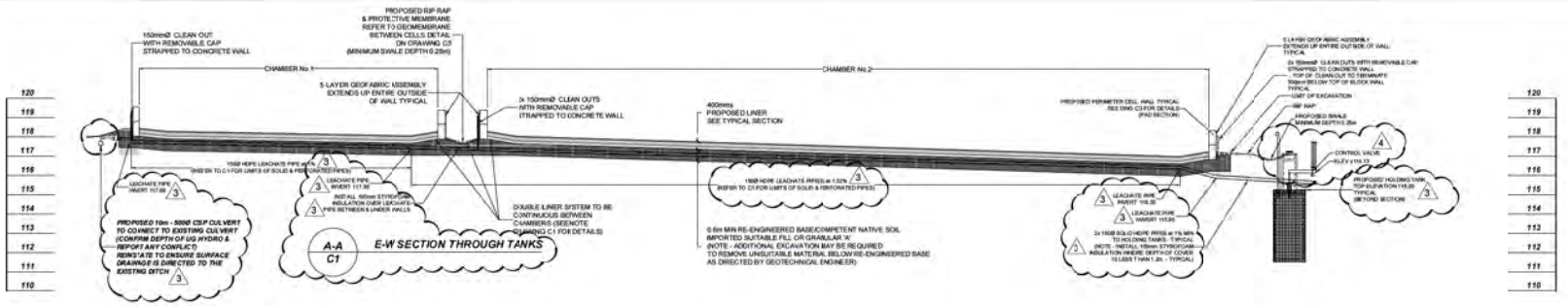
BARRY-BRYAN ASSOCIATES (1991) LIMITED
Architects
Engineers
Landscape Architect
Project Managers

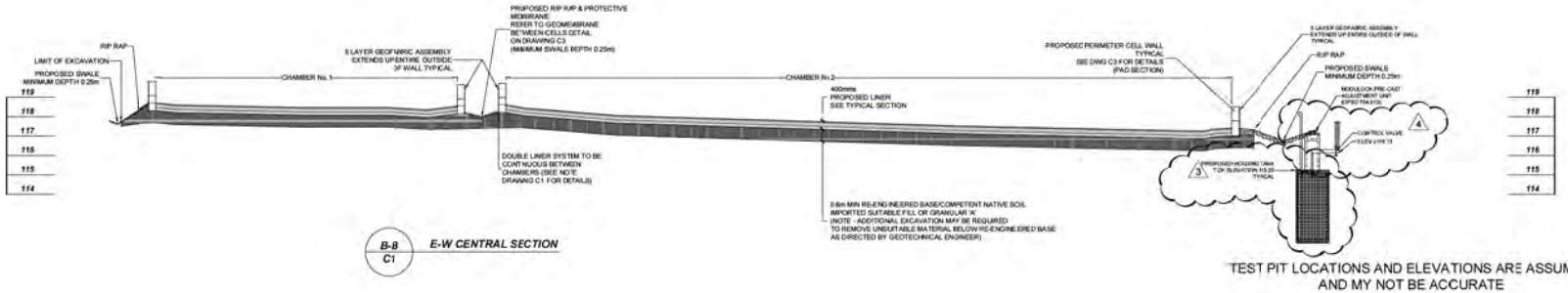
DESIGN BY: AS/TS
DRAWN BY: TO
CHECKED BY: JJ
DATE: 2013/11/12
SCALE: 1:500

PROJECT NO. 13119

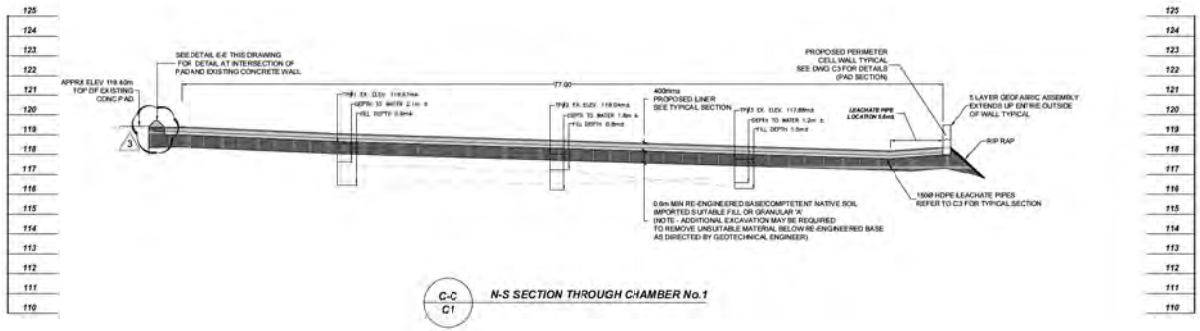
J. J. OVCJAR
100135744
PROVINCE OF ONTARIO
2013-11-12

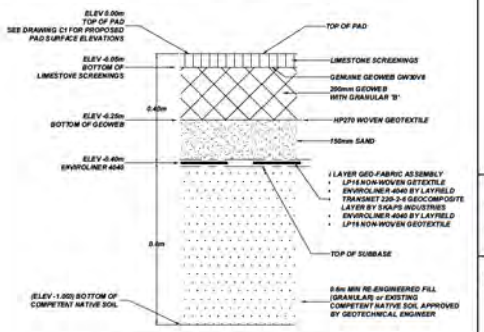
Exhibit I.LD2-02.AMPCO-137
Attachment 139
Page 23 of 54
Filed: 2021-04-19
EB-2020-0290



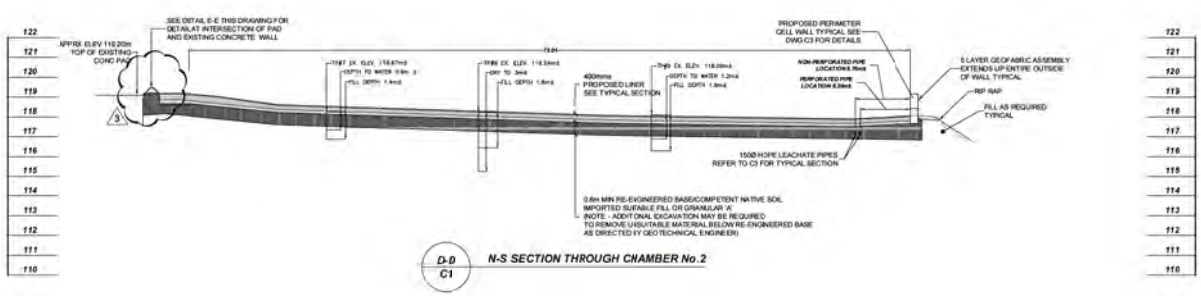


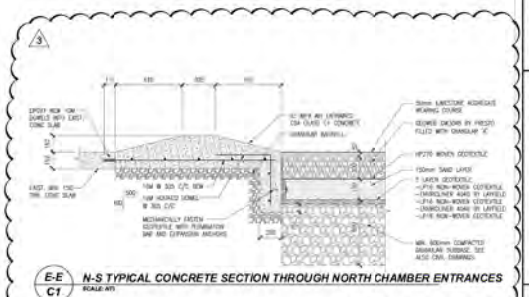
TEST PIT LOCATIONS AND ELEVATIONS ARE ASSUMED AND MY NOT BE ACCURATE





TYPICAL PROPOSED LINER DETAIL





NO.	ISSUES/REVISIONS	DATE	BY
1	ISSUED FOR REVIEW	13/06/13	TD
2	ISSUED FOR CONSTRUCTION	13/11/13	TD
3	REVISED LEACHATE PIT CONTOURATION & PAD EL'n	13/12/06	TD
4	ADDITION OF VALVES & LEACHATE PIPE ELEVATIONS	14/01/16	TD

NOTE:
- INSTALL SUB-DRAINS IN NATIVE SOIL IF REQUIRED BY GEOTECHNICAL ENGINEER TO ADDRESS HIGH WATER TABLE
- IF NECESSARY INSTALL SUBDRAINS WHERE DIRECTED BY GEOTECHNICAL ENGINEER. SUBDRAINS SHALL DISCHARGE TO EXISTING OR NEW SWALES AS APPROPRIATE
- DOUBLE LINER SYSTEM TO EXTEND BEYOND NORTH LIMIT OF PAD TO CENTERLINE OF PROPOSED 600Ø
- DOUBLE LINER SYSTEM TO EXTEND VERTICALLY UP OUTSIDE FACE OF ALL CONCRETE BLOCK WALLS AND BE CONTINUOUS BETWEEN ADJOINT PADS (SEE NOTE DRAWING C1)

UEM Urban & Environmental Management Inc.

PROJECT:
FI SOIL STAGING PAD

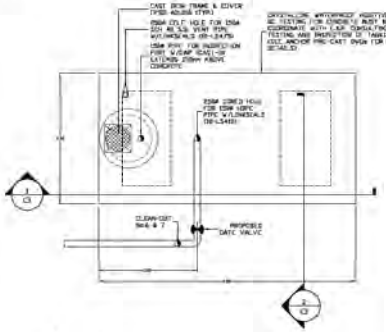
DRAWING:
GRADING PLAN SECTIONS

BBA
BARRY-BRYAN ASSOCIATES (1991) LIMITED
Architects
Engineers
Landscape Architect
Project Managers

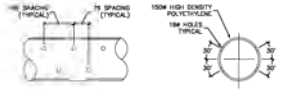
J.J. OVCJAK
100139855
PROVINCE OF ONTARIO

DESIGN BY: AD/TD
DRAWN BY: TD
CHECKED BY: JJ
DATE: 2013/11/13
SCALE: 1:200 H, 1:400 V
FILE: 13-009 DWR.DWG

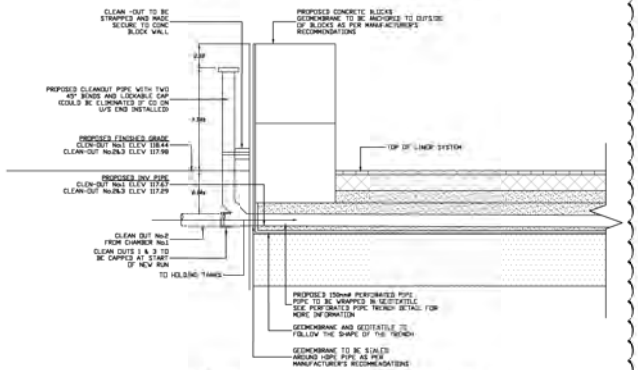
PROJECT NO. 13119
DRAWING NO. C2



3 57m³ TYPICAL HOLDING TANK DETAILS



PERFORATED LEACHATE COLLECTION PIPE WRAPPED IN FILTER CLOTH
3 TYPICAL HOLE SPACING DETAIL
NTS



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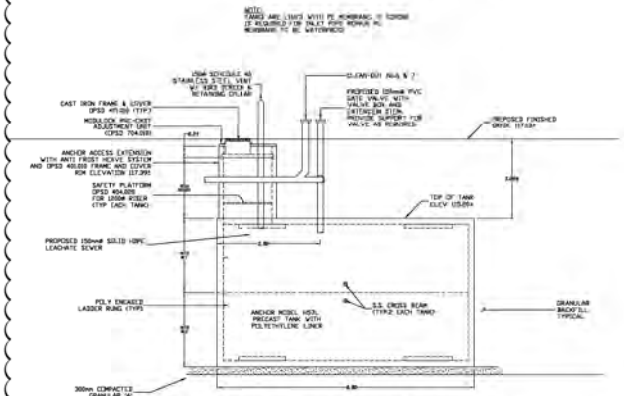

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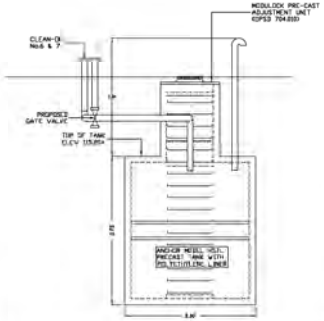

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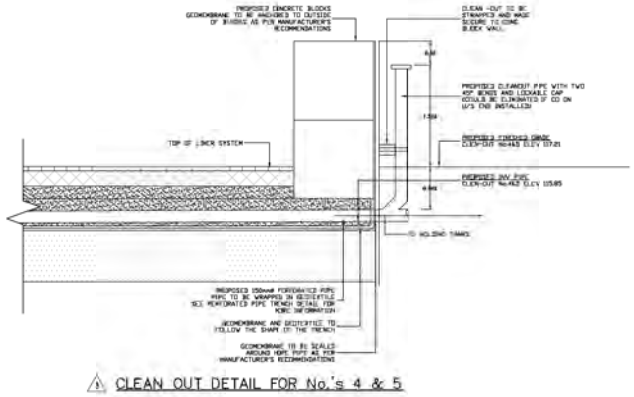

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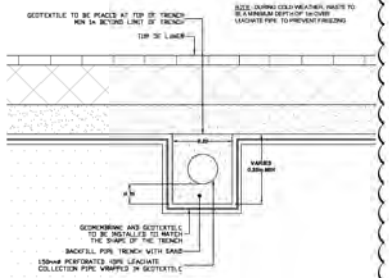

CHAMBER No.1 PIPE TRENCH DETAIL
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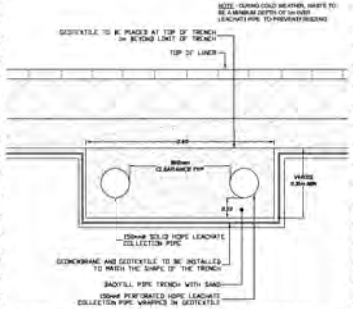

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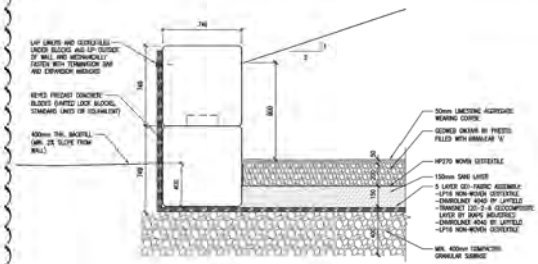
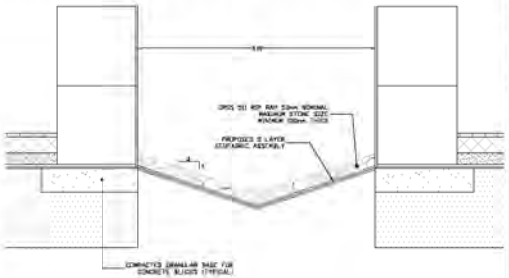


PAD SECTION



GEOMEMBRANE DETAIL BETWEEN CELLS
NTS

NO.	ISSUES	DATE	BY
1	FOR CLOCA REVIEW	11/09/11	TD
2	ISSUED FOR CONSTRUCTION	12/11/14	TD
3	REVISED TANK CONFIGURATION	13/10/09	TD

PROJECT:
FI SOIL STAGING PAD

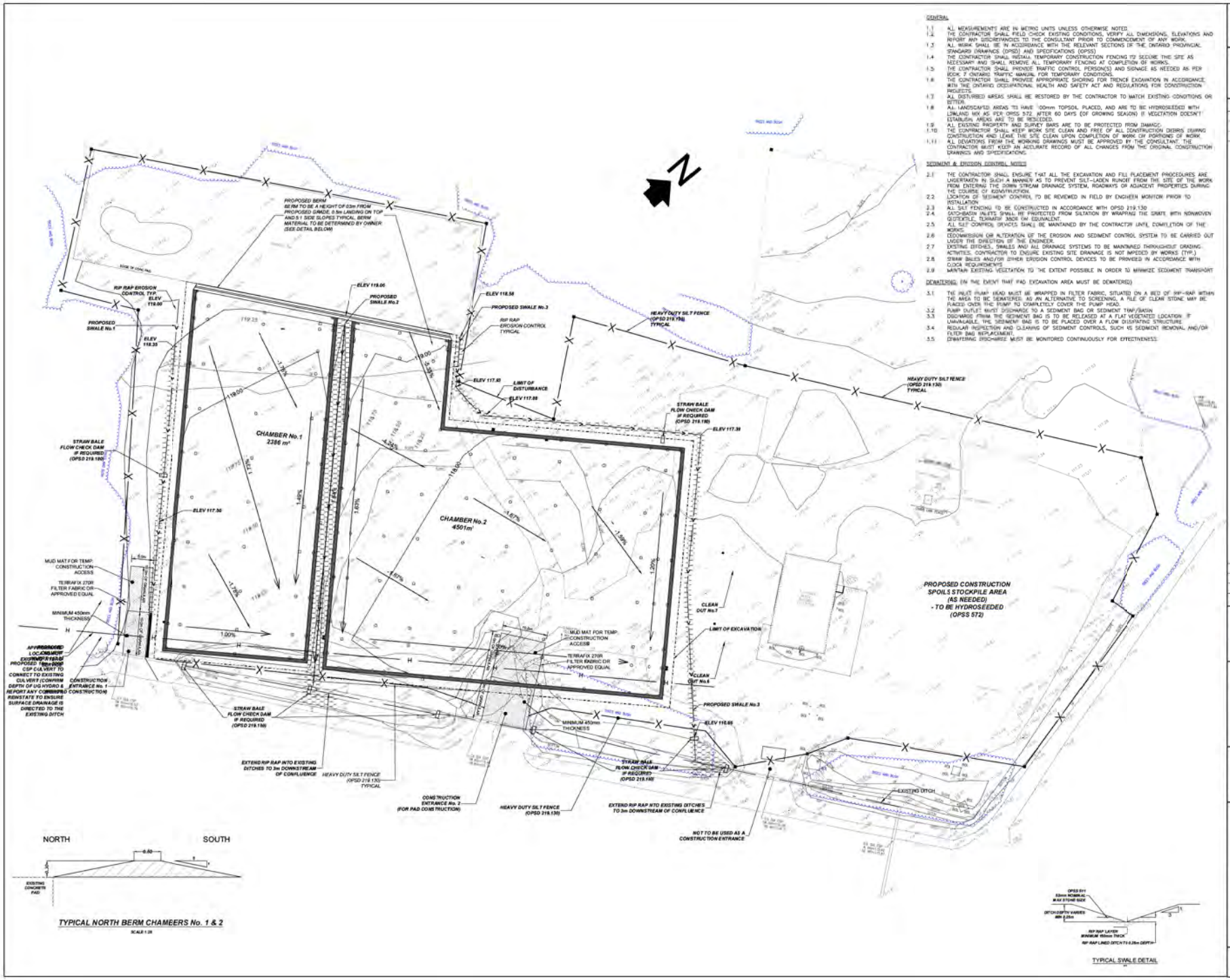
DRAWING:
DETAILS

BBA
BARRY-BRYAN ASSOCIATES (1991) LIMITED

J.J. OVCJAK
100128677

DESIGN BY: JO/TD
DRAWN BY: TD
CHECKED BY: JJ
DATE: 2013/11/12
SCALE: VARIES
FILE: 13-009 EMPLACTON

PROJECT NO.: 13119
DRAWING NO.: C3



GENERAL

1.1 ALL MEASUREMENTS ARE IN METRIC UNITS UNLESS OTHERWISE NOTED.
1.2 THE CONTRACTOR SHALL FIELD CHECK EXISTING CONDITIONS, VERIFY ALL DIMENSIONS, ELEVATIONS AND REPORT ANY DISCREPANCIES TO THE CONSULTANT PRIOR TO COMMENCEMENT OF ANY WORK.
1.3 ALL WORK SHALL BE IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD) AND SPECIFICATIONS (OPSS)
1.4 THE CONTRACTOR SHALL INSTALL TEMPORARY CONSTRUCTION FENCING TO SECURE THE SITE AS NECESSARY AND SHALL REMOVE ALL TEMPORARY FENCING AT COMPLETION OF WORKS.
1.5 THE CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL PERSON(S) AND SIGNAGE AS NEEDED AS PER BOOK 7 ONTARIO TRAFFIC MANUAL FOR TEMPORARY CONDITIONS.
1.6 THE CONTRACTOR SHALL PROVIDE APPROPRIATE SHORING FOR TRENCH EXCAVATION IN ACCORDANCE WITH THE ONTARIO OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS.
1.7 ALL DISTURBED AREAS SHALL BE RESTORED BY THE CONTRACTOR TO MATCH EXISTING CONDITIONS OR BETTER.
1.8 ALL LANDSCAPED AREAS TO HAVE 100mm TOPSOIL PLACED, AND ARE TO BE HYDROSEEDED WITH LOWLAND MIX AS PER OPSS 572. AFTER 60 DAYS (OF GROWING SEASON) IF VEGETATION DOESN'T ESTABLISH, AREAS ARE TO BE RESODDED.
1.9 ALL EXISTING PROPERTY AND SURVEY BARS ARE TO BE PROTECTED FROM DAMAGE.
1.10 THE CONTRACTOR SHALL KEEP WORK SITE CLEAN AND FREE OF ALL CONSTRUCTION DEBRIS DURING CONSTRUCTION AND LEAVE THE SITE CLEAN UPON COMPLETION OF WORK OR PORTIONS OF WORK.
1.11 ALL DEVIATIONS FROM THE WORKING DRAWINGS MUST BE APPROVED BY THE CONSULTANT. THE CONTRACTOR MUST KEEP AN ACCURATE RECORD OF ALL CHANGES FROM THE ORIGINAL CONSTRUCTION DRAWINGS AND SPECIFICATIONS.

SEDIMENT & EROSION CONTROL NOTES

2.1 THE CONTRACTOR SHALL ENSURE THAT ALL THE EXCAVATION AND FILL PLACEMENT PROCEDURES ARE UNDERTAKEN IN SUCH A MANNER AS TO PREVENT SILT-LADEN RUNOFF FROM THE SITE OF THE WORK FROM ENTERING THE DOWN STREAM DRAINAGE SYSTEM, ROADWAYS OR ADJACENT PROPERTIES DURING THE COURSE OF CONSTRUCTION.
2.2 LOCATION OF SEDIMENT CONTROL TO BE REVIEWED IN FIELD BY ENGINEER MONITOR PRIOR TO INSTALLATION
2.3 ALL SILT FENCING TO BE CONSTRUCTED IN ACCORDANCE WITH OPSD 219.130
2.4 CATCH-BASIN INLETS SHALL BE PROTECTED FROM SILTATION BY WRAPPING THE GRATE WITH NONWOVEN GEOTEXTILE, TERRAFIX 270R OR EQUIVALENT.
2.5 ALL SILT CONTROL DEVICES SHALL BE MAINTAINED BY THE CONTRACTOR UNTIL COMPLETION OF THE WORKS.
2.6 DECOMMISSION OR ALTERATION OF THE EROSION AND SEDIMENT CONTROL SYSTEM TO BE CARRIED OUT UNDER THE DIRECTION OF THE ENGINEER.
2.7 EXISTING DITCHES, SWALES AND ALL DRAINAGE SYSTEMS TO BE MAINTAINED THROUGHOUT GRADING ACTIVITIES. CONTRACTOR TO ENSURE EXISTING SITE DRAINAGE IS NOT IMPEDED BY WORKS (TYP.)
2.8 STRAW BALES AND/OR OTHER EROSION CONTROL DEVICES TO BE PROVIDED IN ACCORDANCE WITH CVCA REQUIREMENTS
2.9 MAINTAIN EXISTING VEGETATION TO THE EXTENT POSSIBLE IN ORDER TO MINIMIZE SEDIMENT TRANSPORT

DEWATERING (IN THE EVENT THAT PAD EXCAVATION AREA MUST BE DEWATERED)

3.1 THE INLET PUMP HEAD MUST BE WRAPPED IN FILTER FABRIC, SITUATED ON A BED OF RIP-RAP WITHIN THE AREA TO BE DEWATERED. AS AN ALTERNATIVE TO SCREENING, A PILE OF CLEAR STONE MAY BE PLACED OVER THE PUMP TO COMPLETELY COVER THE PUMP HEAD.
3.2 PUMP OUTLET MUST DISCHARGE TO A SEDIMENT BAG OR SEDIMENT TRAP/BASIN
3.3 DISCHARGE FROM THE SEDIMENT BAG IS TO BE RELEASED AT A FLAT VEGETATED LOCATION. IF UNAVAILABLE, THE SEDIMENT BAG IS TO BE PLACED OVER A FLOW DISPATING STRUCTURE
3.4 REGULAR INSPECTION AND CLEANING OF SEDIMENT CONTROLS, SUCH AS SEDIMENT REMOVAL AND/OR FILTER BAG REPLACEMENT.
3.5 DEWATERING DISCHARGE MUST BE MONITORED CONTINUOUSLY FOR EFFECTIVENESS

NO.	ISSUES	DATE	BY
1	ISSUED FOR REVIEW	13/09/11	TO
2	ISSUED FOR CONSTRUCTION	13/11/12	TO

NO.	REVISIONS	DATE	BY

PROJECT:
FI SOIL STAGING PAD

DRAWING:
EROSION, SEDIMENT & DRAINAGE CONTROL PLAN (DURING PAD CONSTRUCTION)

BARRY • BRYAN ASSOCIATES (1991) LIMITED
Architects
Engineers
Landscape Architect
Project Managers

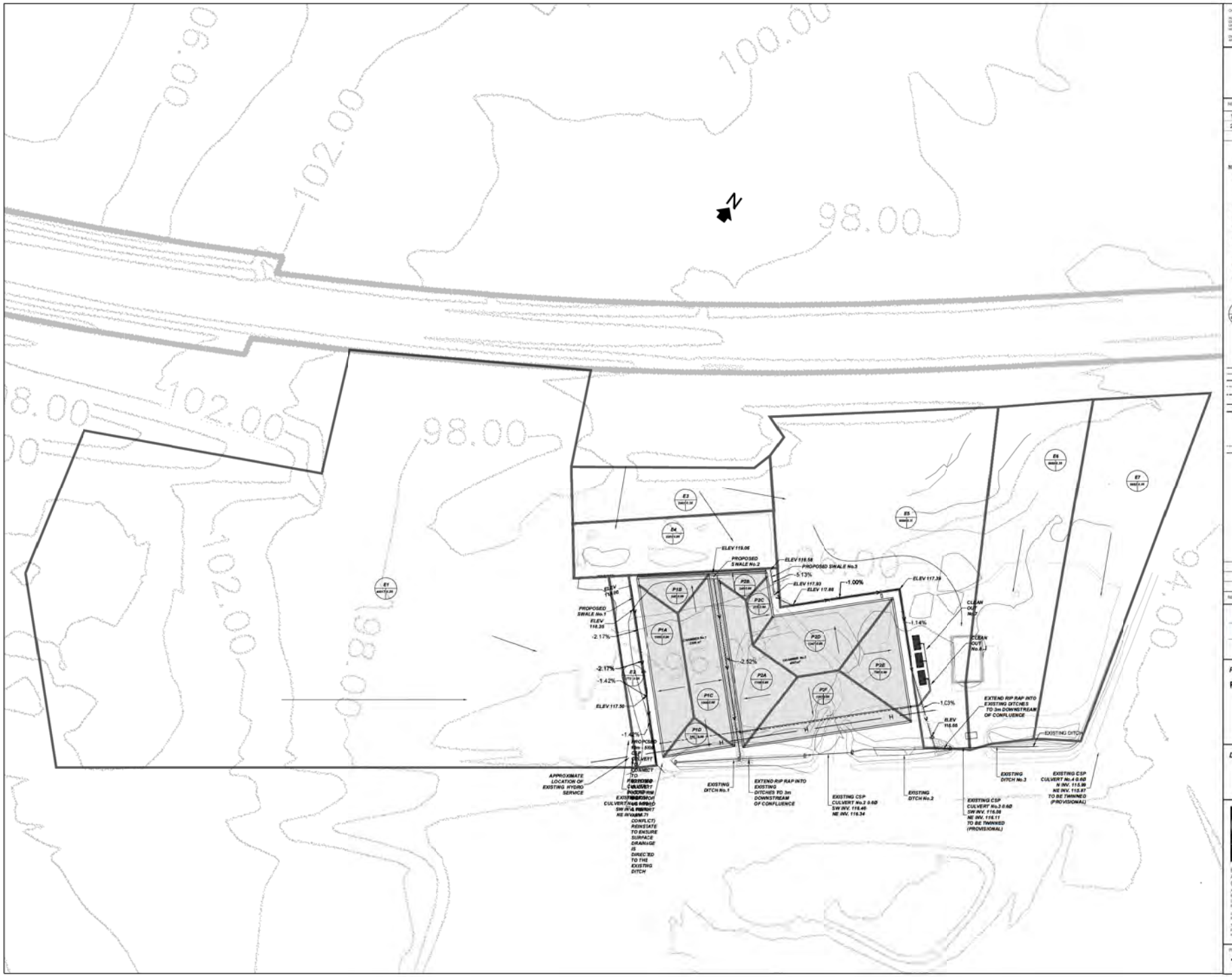
DESIGN BY: AOTE
DRAWN BY: TO
CHECKED BY: JT
DATE: 2013/11/12
SCALE: AS NOTED

PROJECT NO.: 13119

J.J. OVCJAK 100128683

Exhibit I.ED.2-02.AMPCO-137 Attachment 139 Page 26 of 54

EB-2020-0290 Filed: 2021-04-19



NO. | ISSUES | DATE | BY
1 | ISSUED FOR REVIEW | 13/06/14 | TG
2 | ISSUED FOR CONSTRUCTION | 13/11/19 | TG

NOTES:

1. CATCHMENT E1, LOCATED WEST OF THE PROPOSED PAD, DRAINS INTO THE EXISTING ROADSIDE DITCHES SOUTH OF THE PROPOSED PAD. THE E1 BOUNDARY SHOWN IS BASED ON THE AVAILABLE TOPOGRAPHIC MAPPING AND SHOULD BE CONFIRMED BY FIELD EXAMINATION OF AERIAL PHOTOGRAPHS. BOUNDARIES SHOULD BE CONFIRMED, INCLUDING DRAINAGE BOUNDARY EFFECTS OF ROADSIDE DITCHES AND CULVERTS NOT VISIBLE ON EXISTING MAPPING.
2. ALL OTHER PERVIOUS CATCHMENTS (E1, E2, E6, E6, AND E7 ASSUMED TO HAVE A 15% RUNOFF COEFFICIENT FOR REALFLOW CALCULATIONS.
3. EXISTING IMPERVIOUS CATCHMENT E2, WAS ASSUMED TO HAVE A 90% RUNOFF COEFFICIENT FOR FINAL FLOW CALCULATIONS.
4. PROPOSED TARP COVERED CATCHMENTS P1 AND P2 ARE ASSUMED TO HAVE A 100% RUNOFF COEFFICIENT AND 100 YR 4 HR CHICAGO STORM FOR PEAK FLOW CALCULATIONS.
5. EXISTING CULVERTS 1 AND 4 WILL EXPERIENCE A PIPE STRETCH OF 1 - 15% INCREASE IN FLOW DUE TO PAD CONSTRUCTION.
6. TWINNING OF CULVERTS 3 AND 4 (PROVISIONAL) WILL ENSURE 100 YR 4 HR CHICAGO STORM DIAMETER CULVERTS WILL PROVIDE SUFFICIENT CAPACITY FOR 0.3 M FREEBOARD AT THE ENTRANCE TO THE PROPOSED PAD.
7. EXISTING DITCH GEOMETRY NEEDS TO BE CHECKED TO DETERMINE IF DITCH MODIFICATIONS ARE NECESSARY.
8. ACCESS ROAD (E3 AND E4) EXISTING PAD (E5 AND E6) TO BE KEPT FREE OF DEBRIS AND SWEPT PERIODICALLY DURING CONSTRUCTION AND DECOMMISSIONING OPERATIONS.
9. ALL PROPOSED SWALES TO BE 0.3m DEEP MINIMUM

CATCHMENT ID
RUNOFF COEFFICIENT
AREA (Ha)

100.00 PROPOSED ELEVATION
EXISTING EQUIPMENT
PROPOSED SPCC
EXISTING DITCH
HEAVY DUTY SILT FENCE
LIMIT OF EXCAVATION
PERIMETER PIPE (1) INCLUDING TARP
EXCAVATION EXTENT INCLUDING TARP
LIMIT OF DISTURBANCE
PROPOSED BERM
PROPOSED ROLLING TYPE
GRID MARKER
EXISTING WORK

NO. | REVISIONS | DATE | BY

UEM

PROJECT:

FI SOIL STAGING PAD

DRAWING:

DRAINAGE PLAN

BBA
BARRY • BRYAN ASSOCIATES (1991) LIMITED
Architects
Engineers
Landscape Architect
Project Managers
(C1-470) Wales Street
Winnipeg Manitoba CTN 0S8
Tel: (204) 489-0250
Fax: (204) 489-0256
e-mail: bba@bba-engineers.com

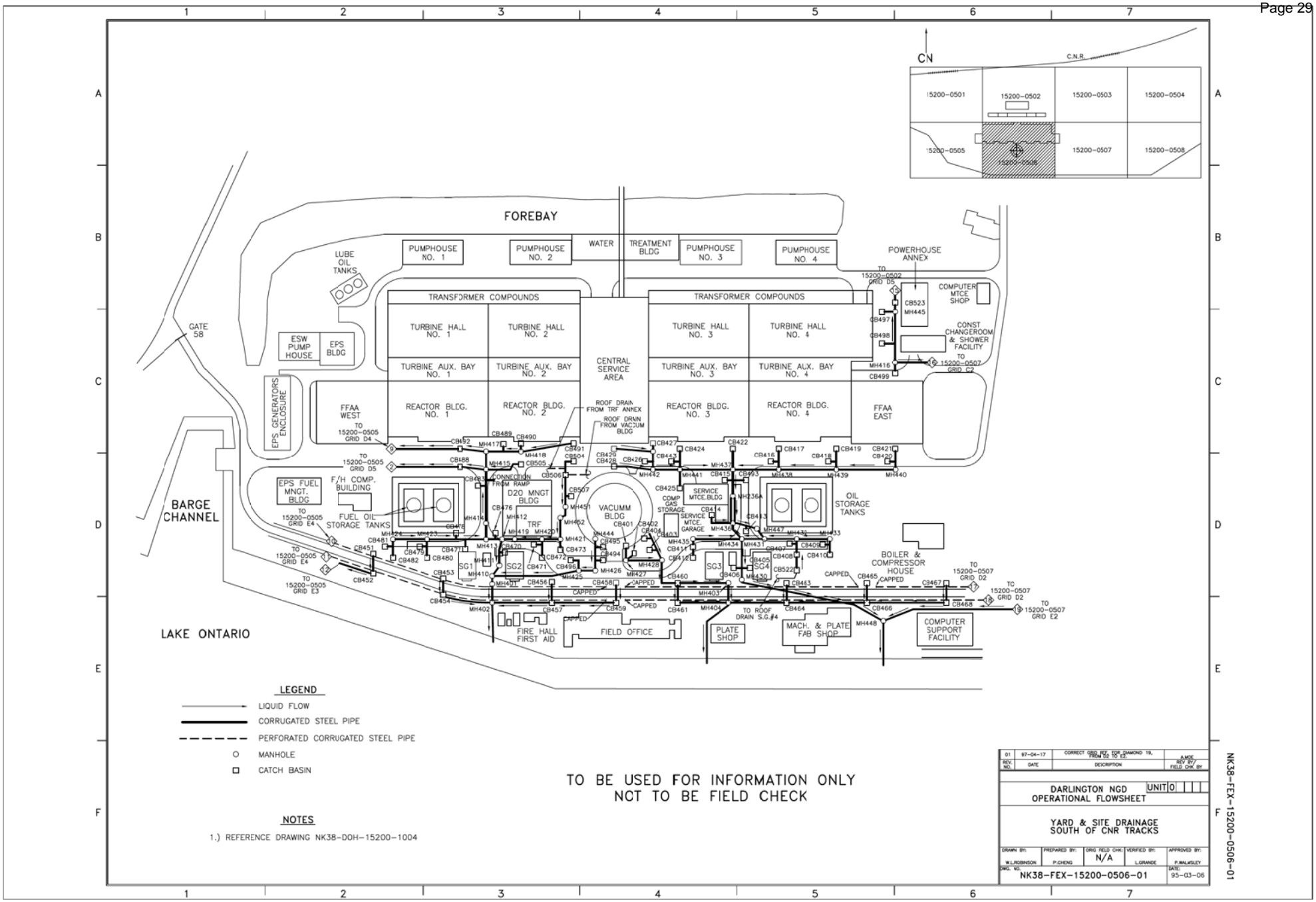
J.J. OVCJAK
100 PROFESSIONAL ENGINEER

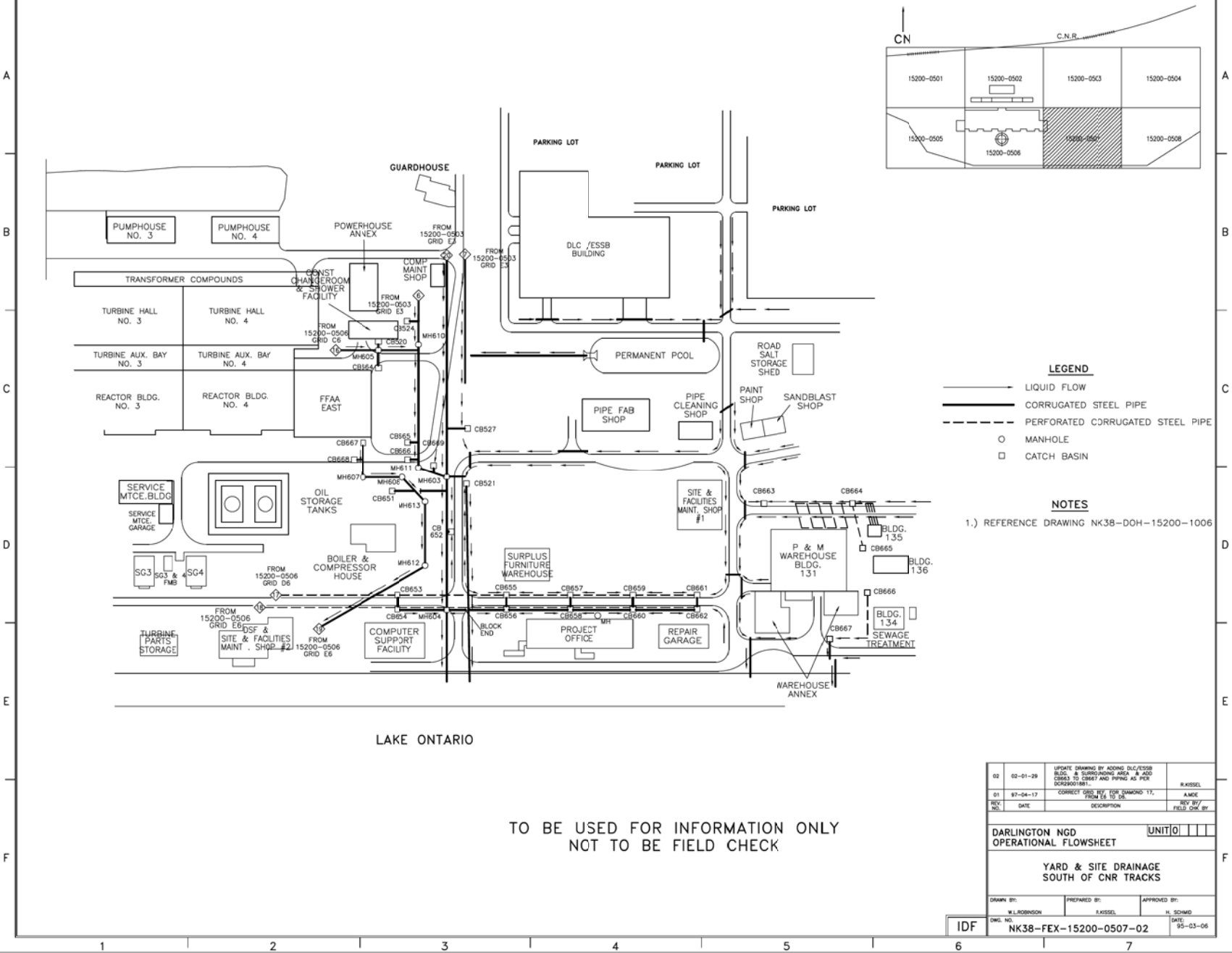
DESIGN BY: JO/TG
DRAWN BY: TG
CHECKED BY: JJ
DATE: 2013/11/12
SCALE: 1:500
FILE NO.: 13119-C1
PROJECT NO.: 13119

Exhibit LED2-02-AMPCO-137 Attachment 139 Page 27 of 54

Filed: 2021-04-19 EB-2020-0290

APPENDIX B


CN
C.N.R.
15200-0501
15200-0502
15200-0503
15200-0504
15200-0505
15200-0506
15200-0507
15200-0508
FOREBAY
LUBE OIL TANKS
PUMPHOUSE NO. 1
PUMPHOUSE NO. 2
WATER TREATMENT BLDG
PUMPHOUSE NO. 3
PUMPHOUSE NO. 4
POWERHOUSE ANNEX
TO 15200-0502 GRID D5
COMPUTER MTCE SHOP
CONST CHANGEROOM & SHOWER FACILITY
TO 15200-0507 GRID C2
GATE 58
ESW PUMP HOUSE
EPS BLDG
EPS GENERATORS ENCLOSURE
TRANSFORMER COMPOUNDS
TURBINE HALL NO. 1
TURBINE HALL NO. 2
TURBINE HALL NO. 3
TURBINE HALL NO. 4
TURBINE AUX. BAY NO. 1
TURBINE AUX. BAY NO. 2
TURBINE AUX. BAY NO. 3
TURBINE AUX. BAY NO. 4
CENTRAL SERVICE AREA
REACTOR BLDG. NO. 1
REACTOR BLDG. NO. 2
REACTOR BLDG. NO. 3
REACTOR BLDG. NO. 4
FFAA WEST
FFAA EAST
ROOF DRAIN FROM TRF ANNEX
ROOF DRAIN FROM VACUUM BLDG
TO 15200-0505 GRID D4
TO 15200-0505 GRID D5
TO 15200-0505 GRID E4
TO 15200-0505 GRID E3
EPS FUEL MNGT. BLDG
F/H COMP. BUILDING
FUEL OIL STORAGE TANKS
BARGE CHANNEL
CONNECTION FROM RAMP
D2O MNGT BLDG
TRF
VACUMM BLDG
SERVICE MTCE.BLDG
COMP GAS STORAGE
SERVICE MTCE. GARAGE
OIL STORAGE TANKS
BOILER & COMPRESSOR HOUSE
TO 15200-0507 GRID D2
TO 15200-0507 GRID E2
SG1
SG2
SG3
SG4
CAPPED
TO ROOF DRAIN S.G.#4
LAKE ONTARIO
FIRE HALL FIRST AID
FIELD OFFICE
PLATE SHOP
MACH. & PLATE FAB SHOP
COMPUTER SUPPORT FACILITY
LEGEND
LIQUID FLOW
CORRUGATED STEEL PIPE
PERFORATED CORRUGATED STEEL PIPE
MANHOLE
CATCH BASIN
NOTES
1.) REFERENCE DRAWING NK38-DOH-15200-1004
TO BE USED FOR INFORMATION ONLY
NOT TO BE FIELD CHECK
01 97-04-17 CORRECT GRID REF. FOR DIAMOND 19, FROM D2 TO E2 A.MOE
REV. NO. DATE DESCRIPTION REV BY / FIELD CHK BY
DARLINGTON NGD OPERATIONAL FLOWSHEET UNIT 0
YARD & SITE DRAINAGE SOUTH OF CNR TRACKS
DRAWN BY: W.L.ROBINSON
PREPARED BY: P.CHENG
ORIG FIELD CHK: N/A
VERIFIED BY: L.GRANDE
APPROVED BY: P.WALMSLEY
DWG. NO. NK38-FEX-15200-0506-01
DATE: 95-03-06
NK38-FEX-15200-0506-01

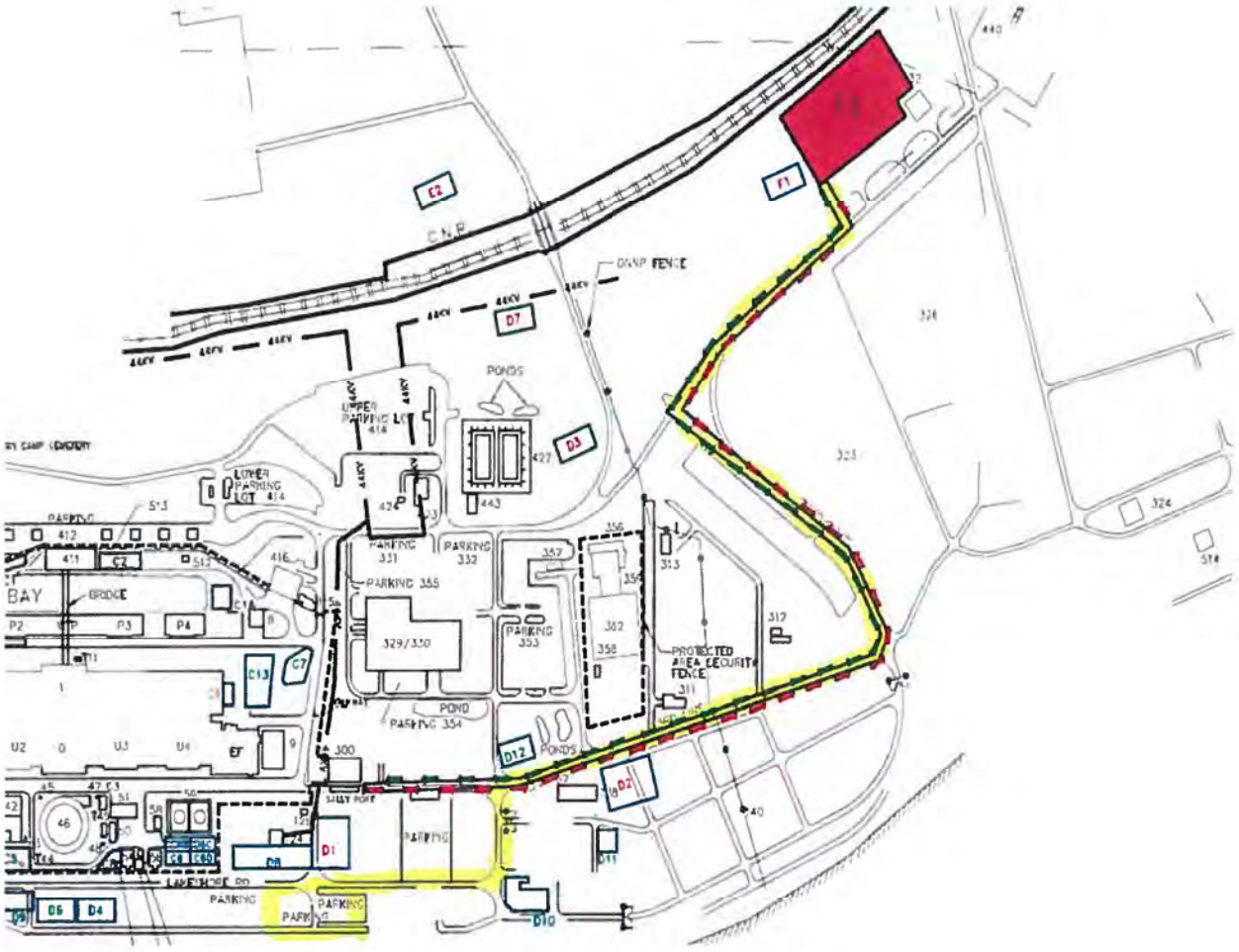

CN
C.N.R.
15200-0501
15200-0502
15200-0503
15200-0504
15200-0505
15200-0506
15200-0507
15200-0508
GUARDHOUSE
PARKING LOT
PARKING LOT
PARKING LOT
PUMPHOUSE NO. 3
PUMPHOUSE NO. 4
POWERHOUSE ANNEX
DLC /ESSB BUILDING
TRANSFORMER COMPOUNDS
CONST CHANGEROOM & SHOWER FACILITY
COMP MAINT SHOP
TURBINE HALL NO. 3
TURBINE HALL NO. 4
TURBINE AUX. BAY NO. 3
TURBINE AUX. BAY NO. 4
REACTOR BLDG. NO. 3
REACTOR BLDG. NO. 4
FFAA EAST
PERMANENT POOL
ROAD SALT STORAGE SHED
PIPE FAB SHOP
PIPE CLEANING SHOP
PAINT SHOP
SANDBLAST SHOP
SERVICE MTCE.BLDG.
SERVICE MTCE. GARAGE
OIL STORAGE TANKS
BOILER & COMPRESSOR HOUSE
SG3
SG3 & 4 FMB
SG4
SURPLUS FURNITURE WAREHOUSE
SITE & FACILITIES MAINT. SHOP #1
P & M WAREHOUSE BLDG. 131
BLDG. 135
BLDG. 136
BLDG. 134
SEWAGE TREATMENT
TURBINE PARTS STORAGE
DSF & SITE & FACILITIES MAINT . SHOP #2
COMPUTER SUPPORT FACILITY
BLOCK END
PROJECT OFFICE
REPAIR GARAGE
WAREHOUSE ANNEX
LAKE ONTARIO
FROM 15200-0503 GRID E3
FROM 15200-0506 GRID C6
FROM 15200-0506 GRID D6
FROM 15200-0506 GRID E6
FROM 15200-0506 GRID E6
MH610
MH605
CB664
CB520
CB524
CB527
CB665
CB669
CB666
CB667
CB668
MH611
MH607
MH608
MH603
CB521
CB651
MH613
CB652
MH612
CB653
CB654
MH604
CB655
CB656
CB657
CB658
MH
CB659
CB660
CB661
CB662
CB663
CB664
CB665
CB666
CB667
LEGEND
LIQUID FLOW
CORRUGATED STEEL PIPE
PERFORATED CORRUGATED STEEL PIPE
MANHOLE
CATCH BASIN
NOTES
1.) REFERENCE DRAWING NK38-DOH-15200-1006
TO BE USED FOR INFORMATION ONLY
NOT TO BE FIELD CHECK
02 02-01-29 UPDATE DRAWING BY ADDING DLC/ESSB BLDG. & SURROUNDING AREA & ADD CB663 TO CB667 AND PIPING AS PER DCR2900188.. R.KISSEL
01 97-04-17 CORRECT GRID REF. FOR DIAMOND 17, FROM E6 TO D8. A.MOE
REV. NO. DATE DESCRIPTION REV BY/ FIELD CHK BY
DARLINGTON NGD OPERATIONAL FLOWSHEET
UNIT 0
YARD & SITE DRAINAGE SOUTH OF CNR TRACKS
DRAWN BY: W.L.ROBINSON
PREPARED BY: R.KISSEL
APPROVED BY: H. SCHMID
IDF
DWG. NO. NK38-FEX-15200-0507-02
DATE: 95-03-06
NK38-FEX-15200-0507-02

APPENDIX C

Transportation Route

Sally Port to F1 and Back

F1 to Catch Basins and Back



APPENDIX D

PGL

BM FORM LIST

Project Information

Project Number: 4325-02.01 F1 Soil Management Plan
Site Address: OPG-DN Bowmanville, ON

Document #	Document	Revision	Date Issued
BM-FORM-000-F1SMP Rev 0	PGL BM Form List	0	22-Jan-14
BM-FORM-001-F1SMP Rev 0	PGL Truck Tracking Form - F1 Laydown Area	0	22-Jan-14
BM-FORM-002-F1SMP Rev 0	PGL Truck Tracking Form - D20 Excavation	0	22-Jan-14
BM-FORM-003-F1SMP Rev 0	PGL Daily Sump Inspection Form	0	22-Jan-14
BM-FORM-004-F1SMP Rev 0	PGL Silt Fence Inspection Form	0	22-Jan-14
BM-FORM-005-F1SMP Rev 0	PGL Vacuum Truck Tracking Form	0	22-Jan-14
BM-FORM-006-F1SMP Rev 0	PGL F1 Laydown Area Pad Grid Form	0	22-Jan-14
BM-FORM-007-F1SMP Rev 0	PGL Soil Pile Sampling Form	0	22-Jan-14
BM-FORM-008-F1SMP Rev 0	PGL Soil Pile Sampling Sketch	0	22-Jan-14

PGL

Truck Tracking Form at F1 Laydown Area

BM-FORM-001-F1SMP Rev0

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

				Truck Information						
Date	Load Number	Time On-Site	Time Off-Site	Company	Truck #	License Plate #	Material	Soil Location (Grid)	Truck Inspected by PGL (Y/N)	Volume (m^3)
									Total Volume	

EXAMPLE

Personnel (Print): _____

Personnel (Signature): _____

Material
(**CS**): Caisson Spoils
(**0 - 3**): 0 - 3 mbgs
(**3 - B**): 3 mbgs - bedrock
(**B**): Bedrock

Soil Location (see F1 Pad Grid Form)

PGL

Truck Tracking Form at D20 Excavation

BM-FORM-002-F1SMP Rev0

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

				Truck Information						
Date	Load Number	Time On-Site	Time Off-Site	Company	Truck #	License Plate #	Material	Soil Destination (Cell)	Truck Inspected by PGL (Y/N)	Volume (m^3)
								Total Volume		

EXAMPLE

Personnel (Print): _____

Personnel (Signature): _____

Material
(**CS**): Caisson Spoils
(**0 - 3**): 0 - 3 mbgs
(**3 - B**): 3 mbgs - bedrock
(**B**): Bedrock

PGL

Sump Inspection Form at F1 Laydown Area

Project Information

Project Number:	4325-02.01	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	
Weather		**Sump ID**	
Notes:	**1. Increase inspection frequency after rain event.**		

				Sample Results			
Date	Time of Inspection	Estimated Volume (fraction full)	Sample Collected (Y/N)	Table C (pass/fail)	Tritium Result	Dilution (Y/N)	Discharge Path

EXAMPLE

Personnel (Print): _____

Personnel (Signature): _____

NA - Not Applicable

PGL

Silt Fence Inspection Form

Project Information

Project Number:	4325-02.01 - F1 Laydown Area
Site Address:	OPG-DN Bowmanville, ON

Notes:
1. **Inspect silt fence weekly, damages must be corrected within 3 days**
2. **Inspect silt fence within 12 hour of rainfall**
3. **Check condition of fence, identify holes, damage, deficiency**

Date:	Name:			Company:	
				Description of Repair Required	Date Defiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

Date:	Name:			Company:	
				Description of Repair Required	Date Defiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

Date:	Name:			Company:	
				Description of Repair Required	Date Defiency Corrected
North	☐ Good	☐ Ok	☐ Repair Required		
South	☐ Good	☐ Ok	☐ Repair Required		
East	☐ Good	☐ Ok	☐ Repair Required		
West	☐ Good	☐ Ok	☐ Repair Required		

EXAMPLE

PGL

Vacuum Truck Tracking Form

BM-FORM-005-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area Sump Discharge	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Notes: **1. Discharge flow rate must be monitored to be <20 L/s.**

Weather:

SUMP ID:		Sample ID:	
SUMP Volume:		Tritium (Bq/L):	TOC (mg/L):	pH:
Date Sampled:		TSS (mg/L):	GG (µCi/L):	O&G (mg/L):
Date Empty:				

Vac Truck #	Date of Discharge	Sample Collection (Y/N)	Volume Discharged (L)	Discharge Time (hh:mm) Start	Stop	Flowrate (L/s)	Discharge Location	Comments
		Total Volume						

General Comments:

EXAMPLE

F1 Laydown Area Pad Grid Form

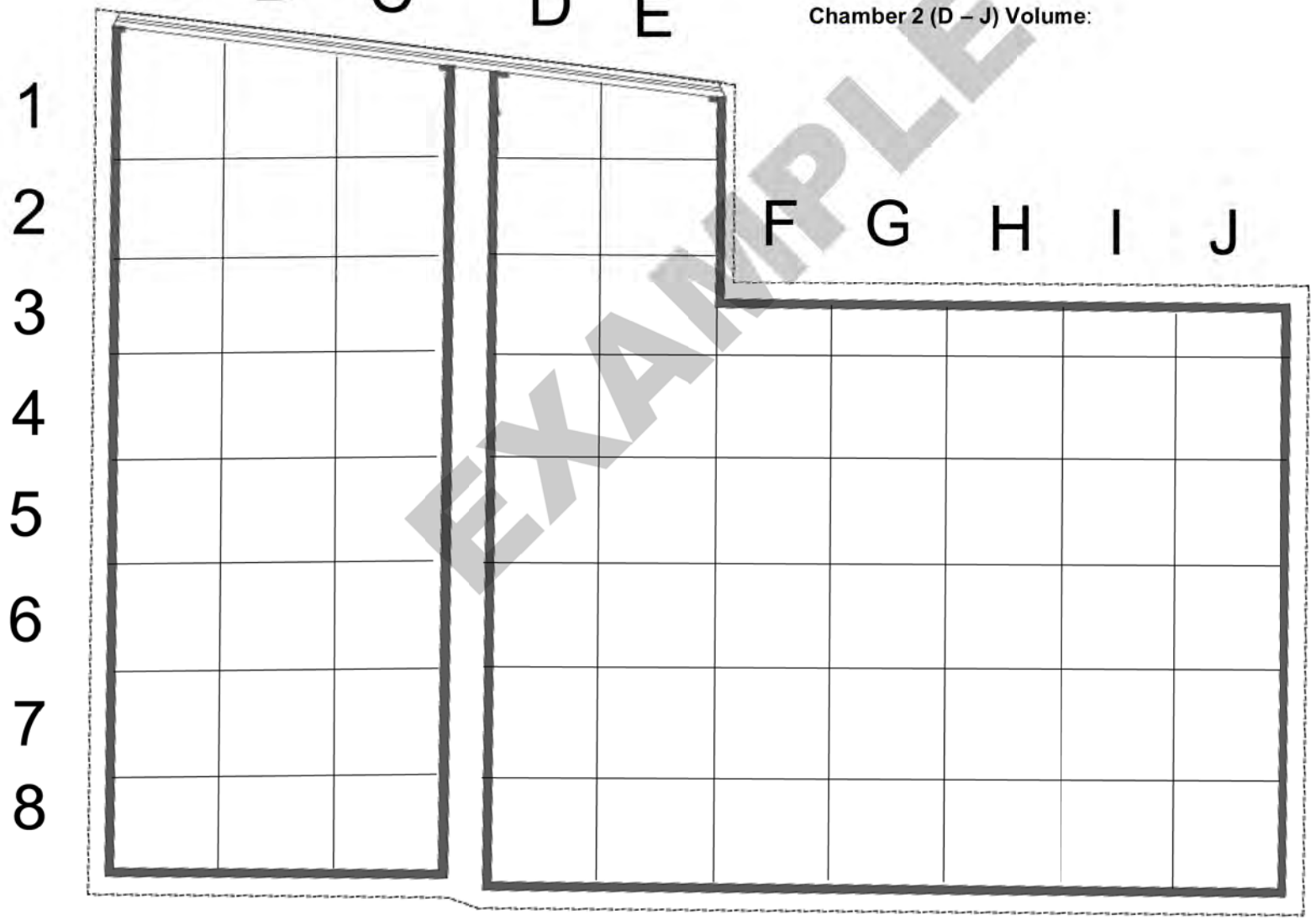
BM-FORM-006-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area	Client: B&M/OPG-DN	Date
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Chamber 1 (A – C) Volume:

Chamber 2 (D – J) Volume:



EXAMPLE

Soil Pile Sampling Form

BM-FORM-007-PSMP Rev0

Project Information				
	Project Number:	4325-02.01 F1 Laydown Area	Client:	B&M/OPG-DN
	Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

SOIL PILE ID: _____ DATE: _____

SOIL PILE ORIGIN: _____ PGL REP: _____

SOIL PILE LOCATION: _____ INSTRUMENT: _____

ESTIMATED SIZE: _____ CALIBRATION DATE: _____

SAMPLING FREQUENCY: _____ EXCAVATOR: _____ REP: _____

Sample Number	Volume (m^3)	Soil Type	OVM (ppmv)	Submitted Sample						Comments
				H_3	GG & GS	PHC	BTEX	VOC	M & I	

EXAMPLE

Soil Description
(minor/major soil type, texture, density, structure, colour, moisture)

A:

B:

C:

D:

E:

F:

Laboratory Parameter Submission

H_3: Tritium

GG & GS: Gross Gamma and Gamma Scan

PHC: Petroleum Hydrocarbons F1 – F4

VOC: Volatile Organic Compounds

BTEX: Benzene, Toluene, Eythlbenzene, Xylene

M & I: Metals and Inorganics

PGL

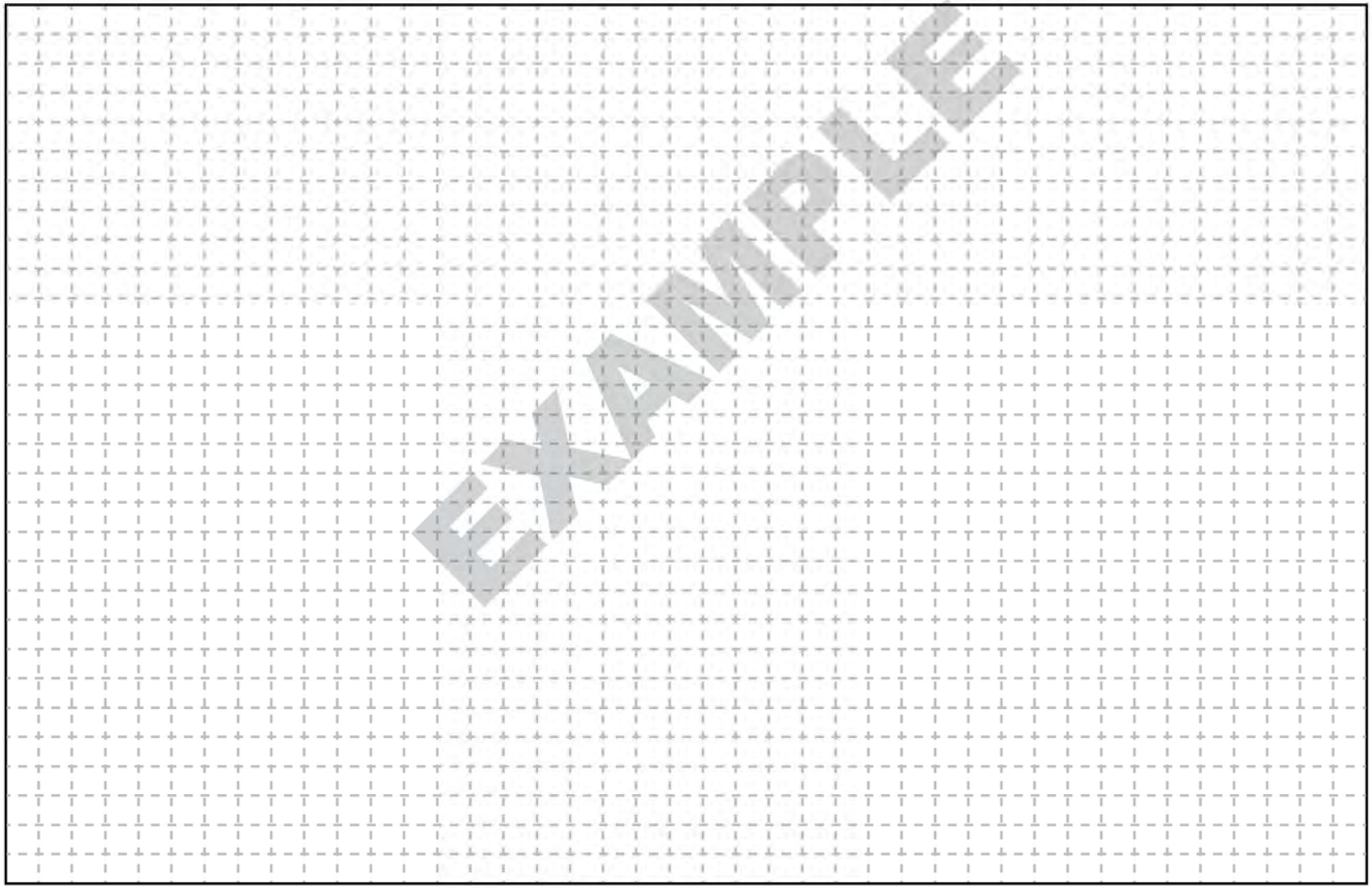
Soil Pile Sampling Sketch

BM-FORM-008-F1SMP Rev0

Project Information

Project Number:	4325-02.01 - F1 Laydown Area	Client:	B&M/OPG-DN
Site Address:	OPG-DN Bowmanville, ON	PGL Staff:	

Dimensions: _____ **Volume:** _____ **Number of Samples:** _____



APPENDIX E

Heavy Water Management Building Project: Campus Plan F1
Background Groundwater Review
Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-004-TM-0004-R00
September 13, 2013

Kinectrics Inc
Analytical and Waste Services

Kinectrics Inc., 800 Kipling Avenue, Unit 2
Toronto, Ontario, Canada M8Z 5G5

Heavy Water Management Building Project: Campus Plan F1
Background Groundwater Review
Ontario Power Generation - Darlington Nuclear (OPG-DN)

Kinectrics Report: K-415072-004-TM-0004-R00
September 13, 2013

Prepared by: Pottinger Gaherty Environmental Consultants Ltd
Unit 102-250 Water Street
Whitby, ON, L1N 0G5

Reviewed by: _____
Ruth Burany, PhD, PEng.
Engineer
Analytical and Waste Services
Kinectrics Inc

Approved by: _____
Otto Herrmann, PhD
Department Manager
Analytical and Waste Services
Kinectrics Inc.

Dated: September 13, 2013

DISCLAIMER

This report was prepared for Black and M^{c}Donald under the Kinectrics Inc ISO 9001 Quality Program Registered with QMI. Kinectrics Inc. takes reasonable steps to ensure that all work performed shall meet the industry standards, and that all reports shall be reasonably free of errors, inaccuracies or omissions. This report was prepared in accordance with Purchase Order Number 48005626 R001.

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REVISIONS

Revision Number	Date	Comments	Approved
R00	September 13, 2013	Initial Release	OH

Pottinger Gaherty
Environmental Consultants Ltd.
250 Water Street, Unit 102
Whitby, ON Canada L1N 0G5
T 905.668.4908
F 905.668.4909
www.pggroup.com

Memo

PGL File #: 3821-01.03

DATE: September 16, 2013

TO: Ruth Burany, Kinectrics Inc.

FROM: Archana Uprety, PGL
Salima Jaffer, PGL
Will Gaherty, PGL

Re: Heavy Water Management Building Project: Campus Plan F1 Background Groundwater Review – Ontario Power Generation – Darlington Nuclear (OPG-DN)

PGL was retained by Black and McDonald to evaluate the existing groundwater condition in the wells near Campus Plan F1 area (F1) and develop a groundwater monitoring program to support the F1 soil management plan.

1.0 INTRODUCTION

F1 will receive soil excavated from the Protected Area during the excavation and construction work associated with the new D2O Heavy Water Management Building. A 2009 spill event in the Protective Area at the Heavy Water Management Building foot-print means excavated soil may be impacted with tritium. Therefore, OPG has requested the development of a groundwater monitoring program for F1.

2.0 PURPOSE

The purpose/objective of this memo is to:

- Review existing reports provided by OPG to determine up and downgradient tritium concentration in groundwater at F1;
- Review the reports to identify overburden and shallow bedrock groundwater-flow directions;
- Identify gaps in available data provided by OPG; and
- Develop a groundwater monitoring program to support the F1 soil management plan.

Our technical memo presents a review of existing wells, results of the groundwater programs from existing reports provided by OPG and the proposed groundwater monitoring program.

3.0 DATA

PGL reviewed specific sections (groundwater flow direction and analytical data) of the below listed reports provided by OPG:

- EcoMetrix Incorporated – *Darlington Nuclear Generating Station Groundwater Monitoring Program Design*, March 2012;
- Genivar – *OPG Darlington Nuclear Site Delineation of Areas of Elevated pH in vicinity of Former Truck Wash Area, August 2009*. OPG File Number: NK38-REP-07010-0266518; and

- CH2M HILL (Excerpt 3 pages) – *Ontario Power Generation Inc. New Nuclear – Darlington Project Geological and Hydrogeological Environment Existing Environmental Conditions* Technical Support Document, 2008. OPG File Number: NK054-REP-07730-00005.

PGL reviewed data from 3 groundwater wells at F1 and 25 wells nearby to determine existing groundwater conditions. The groundwater wells that were selected for review based on groundwater-flow direction, and proximity to F1 (Figure 3 and 4.4). Results were compared to Ontario Regulation 153/04 Table 3 Standards.

In aggregate, data was available from 17 of the 28 wells:

1) EcoMetrix contained maximum values measured from 2008 to 2012 from 12 wells for benzene, toluene, ethylbenzene, and xylenes (BTEX), petroleum hydrocarbons (PHC) fractions F1 to F4, metals/inorganics, volatile organic compounds (VOCs), tritium and gamma.
2) Two wells were analyzed for tritium only in February and June 2008.
3) Groundwater samples collected from the three wells at F1 were analyzed for dissolved metals and inorganic parameters in December 2008.

There were exceedences of:

- Chloride in two wells;
- Selenium in one well;
- PHC fraction F3 in one well which a had concentration of 522 µg/L; and
- One well which had a concentration of 130Bq/L tritium, exceeding the F1 New Build limit of 100Bq/L.

All analytical results in the remaining wells were below the Table 3 Standards (See Table A).

Table A: Data Review

Groundwater Wells (EcoMetrix, March 2012)		
Well ID	**Analyzed Parameters**	**Exceedence**
MW010-18	-	NA
MW011-31	-	NA
MW012-5	-	NA
MW044-34	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW045-10	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW046-6	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW047-92	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (37.2 M µg/L) exceeds the Table 3 Standards (2.3 M µg/L)
MW048-31	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	
MW049-20	-	NA
MW050-7	-	NA

Table A: Data Review (continued)

Groundwater Wells (EcoMetrix, March 2012)		
Well ID	**Analyzed Parameters**	**Exceedence**
MW052-15	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Tritium (130 Bq/L) exceeds the F1 New Build limit of 100 Bq/L
MW053-31	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	PHC F3 (522µg/L) exceeds the Table 3 Standards (500µg/L).
MW054-20	-	NA
MW055-14	-	NA
MW056-85	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (15.3M µg/L) exceeds the Table 3 Standards (2.3M µg/L)
MW057-27	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	Chloride (5.29M µg/L) and Selenium (234.7µg/L) exceed the Table 3 Standards (2.3M µg/L, 63µg/L, respectively)
MW058-6	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW059-12	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW063-98	No analytical	NA
MW064-40	BTEX and PHC F1-F4, Metals/Inorganics, VOC, Tritium and Gamma	None
MW065-25	-	NA
MW066-8	-	NA
MW106-29	-	NA
Groundwater Wells (C2M HILL, 2008)		
MW051-7	Tritium	None
MW105-6	Tritium	None
Groundwater Wells at F1 (Genivar, August 2009)		
MW08-12	Metals and inorganics	None
MW08-13	Metals and inorganics	None
MW08-14	Metals and inorganics	None

Notes: N/A = Not applicable
- = Not analyzed
M = Millions
Results evaluated against Ontario Regulation 135/04 Table 3
Last set of numbers in MW notation refer to depth of well in meters. For example, MW10-18 is 18 meters deep. This does not apply to the three wells at F1

GROUNDWATER FLOW DIRECTION

Based on the EcoMetrix report, overburden groundwater-flow direction is towards the southeast and the shallow groundwater-bedrock flow is towards the south.

3.1 DATA GAPS

PGL reviewed groundwater data from 28 wells; 11 wells did not have any analytical results available and 3 of the wells (at F1) were only analyzed for metals and inorganics. Therefore, a total of 14 wells did not have background tritium results available for review. The groundwater wells with no tritium results include the following wells: F1 wells (MW08-12 to MW0 8-14), and 1 1 downgradient wells (M W010-18, MW011-31, MW012-5, MW49-20, MW050-14, MW054-20, MW055-14, MW063-98, MW065-25, MW066-8, and MW106-29).

4.0 PROPOSED GROUNDWATER MONITORING PROGRAM

As part of the long-term strategy for groundwater protection at F1, PGL recommends a groundwater-monitoring and sampling program. No new wells are required. Eight existing groundwater wells were selected for the monitoring program which includes existing wells near and downgradient of F1 and wells with limited or no available analytical results. This includes the following wells:

- One upgradient well (MW105-6);
- Three F1 wells (MW08-12 to MW08-14); and
- Four downgradient wells (MW050-14, MW051-7, MW058-6, and MW059-12).

PGL recommends that the wells selected for the monitoring program that do not have baseline tritium results (MW08-12 to MW08-14, and MW050-14) be sampled for tritium before any soil is staged at F1.

PGL recommends quarterly monitoring and sampling as presented in Table B. The monitoring and sampling will begin approximately four months after F1 is in use and will be continued for as long as soil is staged at F1.

Table B: F1 Groundwater Monitoring program

Objective	Monitor tritium concentrations in wells in close proximity to F1.		
Monitoring Well	**Frequency**	**Analysis Parameter**	**Considerations**
MW08-12	Quarterly	Tritium	At F1
MW08-13	Quarterly	Tritium	At F1
MW08-14	Quarterly	Tritium	At F1
MW050-14	Quarterly	Tritium	South Site Boundary
MW051-7	Quarterly	Tritium	South Site Boundary
MW058-6	Quarterly	Tritium	Southeast Site Boundary
MW059-12	Quarterly	Tritium	Southeast Site Boundary
MW105-6	Quarterly	Tritium	North Site Boundary
Method detection limit for tritium:		100 Bq/L	

5.0 STANDARD LIMITATIONS

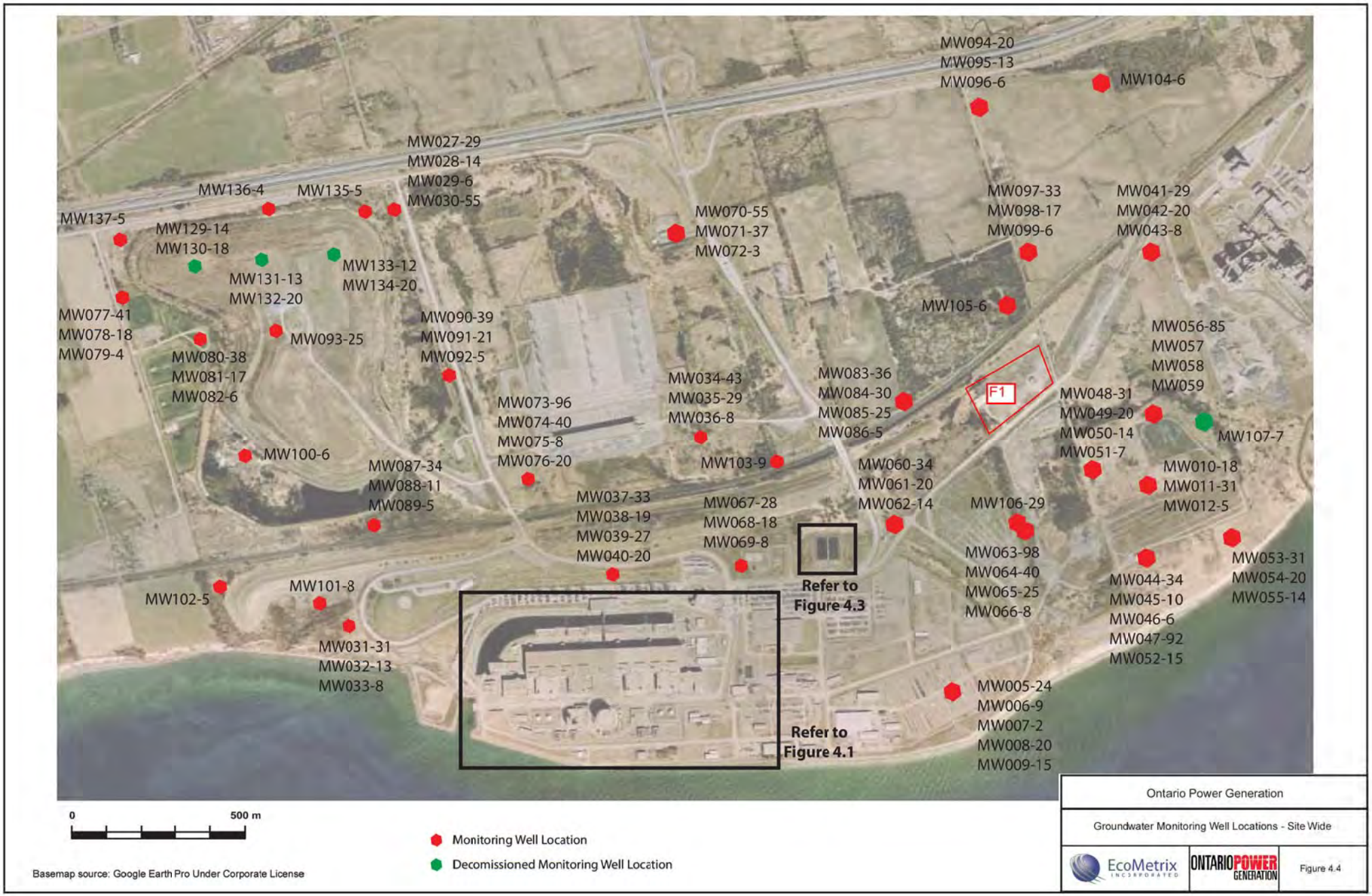
PGL prepared this memo for our client and its agents exclusively. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report. The memo's purpose is to transmit and interpret monitoring data and so will need to be used in conjunction with previous reports by PGL or others. As is true for all environmental investigations, potential remains for the presence of unknown, unidentified, or unforeseen surface or subsurface contamination. More or different investigation may be required if other risks are identified. The data presented in this report is valid for the date of sampling, but site conditions may change with time.

The findings and conclusions are Site-specific and were developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions in the area. Changing assessment techniques, regulations, and site conditions means that environmental investigations and their conclusions can quickly become dated, so this memo is for use now. The memo should not be used after that without PGL review/approval.

The project has been conducted according to our instructions and work program. Additional conditions and limitations on our liability are set forth in our work program/contract. No warranty, express or implied, is made.

Attachments: Figure 3 – Genivar – Groundwater Monitoring Wells Locations
Figure 4.4 – EcoMetrix – Groundwater Monitoring Wells Locations

DATE : June 2009	**Groundwater Flow Direction**	GENIVAR
SCALE : See Map		
FILE No. : MA-08-256-00-MA	**OPG Darlington Nuclear Site**	FIG No.: 3 / REV
APP'VD : M.H.		


MW094-20
MW095-13
MW096-6
MW104-6
MW027-29
MW028-14
MW029-6
MW030-55
MW136-4
MW135-5
MW137-5
MW129-14
MW130-18
MW131-13
MW132-20
MW133-12
MW134-20
MW070-55
MW071-37
MW072-3
MW097-33
MW098-17
MW099-6
MW041-29
MW042-20
MW043-8
MW105-6
MW077-41
MW078-18
MW079-4
MW080-38
MW081-17
MW082-6
MW093-25
MW090-39
MW091-21
MW092-5
MW034-43
MW035-29
MW036-8
MW083-36
MW084-30
MW085-25
MW086-5
F1
MW056-85
MW057
MW058
MW059
MW048-31
MW049-20
MW050-14
MW051-7
MW107-7
MW073-96
MW074-40
MW075-8
MW076-20
MW100-6
MW087-34
MW088-11
MW089-5
MW103-9
MW060-34
MW061-20
MW062-14
MW010-18
MW011-31
MW012-5
MW037-33
MW038-19
MW039-27
MW040-20
MW067-28
MW068-18
MW069-8
MW106-29
MW063-98
MW064-40
MW065-25
MW066-8
MW053-31
MW054-20
MW055-14
MW044-34
MW045-10
MW046-6
MW047-92
MW052-15
MW102-5
MW101-8
MW031-31
MW032-13
MW033-8
Refer to Figure 4.3
Refer to Figure 4.1
MW005-24
MW006-9
MW007-2
MW008-20
MW009-15
0
500 m
Monitoring Well Location
Decomissioned Monitoring Well Location
Basemap source: Google Earth Pro Under Corporate License
Ontario Power Generation
Groundwater Monitoring Well Locations - Site Wide
EcoMetrix INCORPORATED
ONTARIO POWER GENERATION
Figure 4.4

Scope of Work

(This document does not preclude the ES MSA, COIR or Other Contractual requirements)

1. Project Overview

Project #: 16-31555 **Project Title:** Darlington Heavy Water Management Building

Facility: Darlington **Document #:** NK38-SOW-38000-10014 **Revision #** 000

Problem Statement/Background:

Ontario Power Generation (OPG) requires a Construction Contractor ("Contractor", hereafter), to decommission the F1 Soil Management Facility and restore the area to original conditions. The F1 Soil Management Facility was built to support on-going construction of the new Heavy Water Management Building (HWMB) West Annex located at the Darlington Nuclear Generating Station (DNGS). Potentially contaminated soil excavated from the HWMB West Annex footprint was placed in one of the facility's two chambers for remediation and testing prior to disposal; however, as all soil has been remediated and removed, the F1 Soil Management Facility is no longer required to support construction activities. OPG is requesting fixed priced quotes that include salvage value of material removed from F1.

2. Scope Overview

Description of Work:

The scope of the Contractor's work is to decommission the F1 Soil Management Facility and restore the area to original conditions per, NK38-PLAN-38000-10016, *F1 Soil Management Plan*; this includes the following:

- Removal and disposal of multilayered geotextile pad consisting of geotextile material, impermeable Enviro Liner, sand, Geoweb filled with granular A, limestone aggregate, and soil
- Removal and disposal of concrete blocks with the exception of 135 blocks that shall be left on the concrete pad north of the F1 chambers
- Removal and disposal of three 57m^3 concrete sumps
- Removal and disposal of concrete curb at entrance of both chambers
- Removal and disposal of drainage piping
- Backfilling and grading of area using original soil staged east of the F1 Soil Management Facility ensuring positive drainage to southern ditch
    - Note that sampling of the soil underneath the geotextile pad must be performed prior to backfilling the area; the Contractor is not responsible for this sampling but shall coordinate with OPG to ensure allow sampling to be performed safely.
- Hydroseeding of area
- Removal and disposal of any material remaining from construction of the F1 Soil Management Facility
- Removal and disposal of silt fence

Contracting Services Required: Construction

Contractor/Owner Interface Requirements:

☐ As per ES MSA COIR (N-COI-00120-00001) unless otherwise stated on the List of Deviations

ES MSA Work Request #: _____

☒ Non-ES MSA vendor to be used (See remainder of SOW for details).

Online/Outage: Online **Specify Outages (If Applicable):** _____

Work Location: Outside Protected Area

Work will take place outside the Protected Area (PA) at OPG Campus Plan Area F1.

*Associated with N-MAN-00120-10001-SCOPE, Nuclear Projects Scoping Process

3. Approvals

	Signature	Date
Prepared by: William Tannous Project Intern	WTann	4 - Aug - 2016
Reviewed by: Jeff Ezard Technical Officer	JEzard	8-AUG-2016
Approved by: Anthony Colella Manager	AColella	2016-08-09.

4. Description of Engineering Work

Contract Engineering Services Required:

☒ **NO (Remainder of this section is not applicable)**

☐ **YES (Check all Applicable Engineering Services and Complete Remainder of this section)**

Conceptual Engineering:	☐ YES	☐ NO
Modification Planning:	☐ YES	☐ NO
Detailed Engineering:	☐ YES	☐ NO
Procurement Engineering Support:	☐ YES	☐ NO
Installation/Commissioning Support:	☐ YES	☐ NO
Available for Service & Project Closeout Support:	☐ YES	☐ NO
Other Engineering/Technical Support:	☐ YES	☐ NO

Additional Comments/Details:

5. Description of Procurement Work

Contract Procurement Services Required:

☐ **YES (Complete remainder of this section)**

☒ **NO (Remainder of this section is not applicable)**

Procurement Responsibility: All materials procured by Contractor.

Miscellaneous Materials, Tools and Equipment: Provided by Contractor.

Additional Comments/Details:

6. Description of Construction and Commissioning Work

Contract Construction/Commissioning Services Required:

☒ **YES (Complete remainder of this section)**

☐ **NO (Remainder of this section is not applicable)**

Construction and Commissioning Strategy:

In addition to tasks of Section 2, the Contractor shall be responsible as follows:

- Maintain housekeeping at all times to station standards (N-STD-MA-0008).
- Providing resources and equipment/tools/scaffolding as required supporting civil construction activities.
    - Add responsible for washrooms & or water supplies as required
    - Temporary power / lighting as required
    - Supply and removal of any required trailers.
    - Follow SATM process (no issue we own it but it drives housekeeping)
    - Site EAC process to be followed (dig card required)
    - ISP process to be followed
    - Gaining Work Authorizations
    - OPG SWP generation required
    - BTU Mark up required by contractor (should be all laborers work) – (BTU Training Requirements – N-TQD-510-00001
    - Add a key contacts list so we know who is responsible at the workface & we can pre-review who the contractor is assigning to site
- All staff working on site must be security cleared and have appropriate training

Note: Commissioning services are not required for this contract

7. Specific Details of Work to be Performed

Modification Design Requirements:

☐ **Complete**

Reference MDR and Modification Outline (if available):

☒ **MDR Not Available**

Technical/Performance Details:

NOTE: See Section 16 for references.

8. Other Information

This document does not preclude the ES MSA, COIR or Other Contractual requirements.
Contents of the MDR shall NOT be duplicated in this section.

Environmental:

The Contractor shall adhere to OPG environmental requirement guidelines per N-GUID-09701-10013, *Nuclear Projects – Environmental Requirements Guideline.*

Waste disposal shall be controlled and executed per D-INS-79000-10001, *Waste Disposal Guidelines for Oil And Chemical Wastes at Darlington*, and D-INS-79000-10002, *Waste Disposal Guidelines for Solid Waste and Recycling at Darlington.*

Spill prevention, assessment, and response to spills shall be controlled and executed per D-INS-07290-10000, *Darlington Spill Prevention and Contingency Plan*. All spills shall be immediately reported to the Contractor Management Office (CMO).

NOTE: This section provides guidance only. The responsibility resides with the vendor to include all conditions that may apply to the project.

9. Schedule

Schedule Constraints/Requirements:

This scope of work shall be completed by 30-Sep-2016.

Need Dates:

Description	Date
Restoration of F1 area to original conditions.	30-Sep-2016

10. Meetings and Communications

☐ As per ES MSA Worksheet unless stated otherwise on the List of Deviations.

☒ Other (Provide Details Below)

Meeting/Communication	Frequency/Timing	Objective
Kick-off Meeting	Within 5 business days of PO award	Review SOW, Contact List
Daily Progress Reporting	Daily	Report daily construction Activities and Safety Issues.
Weekly Construction/Project Meeting	Weekly	Report on weekly activities and track progress against schedule.
Self Reporting using the SCR process for any adverse conditions	Daily, as required	SCR must be submitted to document adverse condition by end of shift

11. Training and Qualification

The Contractor shall ensure that all applicable personnel meet training and qualification requirements for working at DNGS.

12. Quality Assurance Program

☐ See Section 2 of the ES MSA Worksheet.

☒ Other (Provide Details Below)

Comments/Details:

N/A for this scope of work.

13. Applicable Laws, Standards and Codes

14. OPG Procedures and Standards

15. Other

16. References

Reference #	Document Name	Document #
[1]	F1 Soil Management Plan	NK38-PLAN-38000-10016
[2]	Nuclear Projects – Environmental Requirements Guideline	N-GUID-09701-10003
[3]	Waste Disposal Guidelines for Oil And Chemical Wastes at Darlington	D-INS-79000-10001
[4]	Waste Disposal Guidelines for Solid Waste and Recycling at Darlington	D-INS-79000-10002
[5]	Darlington Spill Prevention and Contingency Plan	D-INS-07290-10000
[6]	Ignition Source Procedure	N-PROC-RA-0057
[7]	Hoisting & Rigging Procedure	OPG-MAN-09180-0001
[8]	SATM Procedure	N-INS-09070-10001
[9]	Safe Workplan Procedure	OPG-PROC-0120
[10]	Excavation Concrete Drilling And Anchoring Processes	N-GUID-01983-10001
[11]	Excavation And Backfill Practices	N-STC-02110-10000
[12]	F1 Soil Laydown Area - Exception to FMOD	NK38-CORR-38000 - 0480393

17. Appendices

		$	22,438,721.99
Timesheet	**Reference**	**Approved Amount in ONCORE**	
A00004/SNC-NL/00007	Munters Canada Inc. JV Inv # A00004/SNC-NL/00007 CAT 5.1	$	203,953.77
A00004/SNC-NL/00001	Gutor Electronic LLC JV Inv #A00004/SNC-NL/00001 CAT 6.1	$	194,591.83
A00004/SNC-NL-00002	CCI Thermal Technologies Inc JV Inv #A00004/SNC-NL-00002 CAT 6.1	$	617,213.62
628411/SNC-NL/00086	Cummins Eastern Canada LP, JV Inv # 628411/SNC-NL/00086 CAT 5.1	$	996,325.80
628411/SNC-NL/00090	Cummins Eastern Canada LP, JV Inv # 628411/SNC-NL/00090 CAT 5.1	$	-
628411/SNC-NL/00064	SCHNEIDER ELECTRIC CANADA INC., JV Inv # 628411/SNC-NL/00064 CAT 6.1	$	68,727.67
628411/SNC-NL/00063	SCHNEIDER ELECTRIC CANADA INC., JV Inv # 628411/SNC-NL/00063 CAT 6.1	$	1,284,465.60
628411/SNC-NL/00010	Gutor Electronic LLC JV Inv # 628411/SNC-NL/00010 CAT 6.1	$	48,647.96
628411/SNC-NL/00042	GUTOR ELECTRONIC LLC JV Inv # 628411/SNC-NL/00042 CAT 6.1	$	194,591.83
628411/SNC-NL/00033	ATLAS COPCO CANADA INC. JV Inv # 628411/SNC-NL/00033 CAT 6.1	$	57,763.75
628411/SNC-NL/00070	ATLAS COPCO CANADA INC., JV Inv # 628411/SNC-NL/00070 CAT 6.1	$	38,509.16
628411/SNC-NL/00078	ATLAS COPCO COMPRESSORS CANADA, JV Inv # 628411/SNC-NL/00078 CAT 6.8	$	250,309.57
628411/SNC-NL/00072	EATON INDUSTRIES (CANADA) COMPANY, JV Inv # 628411/SNC-NL/00072 CAT 6.1	$	869,533.38
628411/SNC-NL/00027	CUSTOM CONTROL PANELS INC. JV Inv # 628411/SNC-NL/00027 CAT 5.1	$	321,879.60
628411/SNC-NL/00048	CUSTOM CONTROL PANELS INC., JV Inv # 628411/SNC-NL/00048 CAT 5.1	$	321,879.60
628411/SNC-NL/00083	CUSTOM CONTROL PANELS INC., JV Inv # 628411/SNC-NL/00083 CAT 5.1	$	95,481.44
628411/SNC-NL/00008	MAXI THERM INC. JV Inv # 628411/SNC-NL/00008 CAT 5.1	$	86,844.74
628411/SNC-NL/00014	KSB Pumps Inc. JV Inv # 628411/SNC-NL/00014 CAT 6.1	$	32,074.54
628411/SNC-NL/00016	MARSH INSTRUMENTATION LTD. JV Inv # 628411/SNC-NL/00016 CAT 6.1	$	21,618.91
628411/SNC-NL/00023	MAXI THERM INC. JV Inv # 628411/SNC-NL/00023 CAT 5.1	$	309,547.98
628411/SNC-NL/00026	CUSTOM CONTROL PANELS INC. JV Inv # 628411/SNC-NL/00026 CAT 5.1	$	110,706.40
628411/SNC-NL/00030	MARSH INSTRUMENTATION LTD. JV Inv # 628411/SNC-NL/00030 CAT 6.1	$	21,618.91
628411/SNC-NL/00032	R&W CRANE & HOIST LTD JV Inv # 628411/SNC-NL/00032 CAT 5.1	$	35,873.58
628411/SNC-NL/00034	KSB PUMPS INC. JV Inv # 628411/SNC-NL/00034 CAT 6.1	$	70,563.99
628411/SNC-NL/00036	MARSH INSTRUMENTATION LTD. JV Inv # 628411/SNC-NL/00036 CAT 6.1	$	21,618.91
628411/SNC-NL/00035	MARSH INSTRUMENTATION LTD. JV Inv # 628411/SNC-NL/00035 CAT 6.1	$	48,343.82
628411/SNC-NL/00050	AAF INTERNATIONAL, JV Inv # 624811/SNC-NL/00050 CAT 5.1	$	187,560.31
628411/SNC-NL/00028	CANBERRA CO. JV Inv # 628411/SNC-NL/00028 CAT 5.1	$	148,232.02
628411/SNC-NL/00012	Munters Canada Inc. JV Inv # 628411/SNC-NL/00012 CAT 5.1	$	178,790.45
628411/SNC-NL/00011	Johnson Controls Inc. JV Inv # 628411/SNC-NL/00011 CAT 6.1	$	477,153.06
628411/SNC-NL/00021	Johnson Controls Inc. JV Inv # 628411/SNC-NL/00021 CAT 6.1	$	954,306.13
628411/SNC-NL/00049	JOHNSON CONTROLS INC., JV Inv # 628411/SNC-NL/00049 CAT 6.1	$	477,153.06
628411/SNC-NL/00024	RADIATION MEASUREMENT SYSTEMS JV Inv # 628411/SNC-NL/00024 CAT 5.1	$	953,089.46
628411/SNC-NL/00015	EH Price JV Inv # 628411/SNC-NL/00015 CAT 5.1	$	156,409.13
628411/SNC-NL/00037	PRICE INDUSTRIES LIMITED JV Inv # 628411/SNC-NL/00037 CAT 6.1	$	234,613.69
628411/SNC-NL/00044	PRICE INDUSTRIES LIMITED JV Inv # 628411/SNC-NL/00044 CAT 6.1	$	886,634.85
628411/SNC-NL/00051	PRICE INDUSTRIES LINITED, JV Inv # 628411/SNC-NL/00051 CAT 6.1	$	190,263.22
628411/SNC-NL/00084	BOT Engineering Ltd., JV Inv # 628411/SNC-NL/00084 CAT 5.1	$	76,320.00
628411/SNC-NL/00017	CCI Thermal Technologies Inc. JV Inv # 628411/SNC-NL/00017 CAT 6.1	$	617,213.62
628411/SNC-NL/00019	CCI Thermal Technologies Inc. JV Inv # 628411/SNC-NL/00019 CAT 6.1	$	91,849.00
628411/SNC-NL/00009	CCI Thermal Technologies Inc. JV Inv # 628411/SNC-NL/00009 CAT 6.1	$	154,303.41
628411/SNC-NL/00045	CCI THERMAL TECHNOLOGIES INC. JV Inv # 628411/SNC-NL/00045 CAT 6.1	$	617,213.62
628411/SNC-NL/00065	CCI THERMAL TECHNOLOGIES INC., JV Inv # 628411/SNC-NL/00065 CAT 6.1	$	34,715.00
628411/SNC-NL/00074	CCI THERMAL TECHNOLOGIES INC., JV Inv # 628411/SNC-NL/00074 CAT 6.1	$	325,948.41
628411/SNC-NL/00054	AIR POWER PRODUCTS LIMITED, JV Inv # 628411/SNC-NL/00054 CAT 6.1	$	960.04
628411/SNC-NL/00022	AAF INTERNATIONAL, JV Inv # 628411/SNC-NL/00022 CAT 5.1	$	137,929.46
628411/SNC-NL/00056	AAF INTERNATIONAL, JV Inv # 628411/SNC-NL/00056 CAT 5.1	$	93,780.15
628411/SNC-NL/00043	CCI THERMAL TECHNOLOGIES INC. JV Inv # 628411/SNC-NL/00043 CAT 6.1	$	29,862.00
628411/SNC-NL/00020	ROSEMOUNT NUCLEAR INSTRUMENTS, INC. JV Inv # 628411/SNC-NL/00020 CAT 5.1	$	595,861.87
628411/SNC-NL/00077	CUSTOM CONTROL PANELS INC., JV Inv # 628411/SNC-NL/00077 CAT 6.8	$	23,987.80
628411/SNC-NL/00055	CCI THERMAL TECHNOLOGIES INC., JV Inv # 628411/SNC-NL/00055 CAT 6.1	$	82,664.10
628411/SNC-NL/00038	KSB PUMPS INC., JV Inv # 628411/SNC-NL/00038 CAT 6.1	$	12,829.82
628411/SNC-NL/00073	EATON INDUSTRIES (CANADA) COMPANY, JV Inv # 628411/SNC-NL/00073 CAT 6.1	$	38,569.39
628411/SNC-NL/00075	CCI THERMAL TECHNOLOGIES INC., JV Inv # 628411/SNC-NL/00075 CAT 6.1	$	325,959.01
628411/SNC-NL/00089	Electrical Safety Authority, JV Inv # 628411/SNC-NL/00089	$	1,120.42
628411/SNC-NL/00061	DAVID SAUVE, JV Inv # 628411/SNC-NL/00061 CAT 3.1	$	14,310.00
628411/SNC/NL/PO-00003	Bentley Canada Inc JV Inv #628411/SNC-NL/PO-00003 CAT 6.8	$	64,364.62
628411/SNC/NL/PO-00004	Cansel Survey Equipment Inc JV Inv #628411/SNC-NL/PO-00004 CAT 6.8	$	6,572.00
628411/SNC-NL/00076	CANSEL SURVEY EQUIPMENT INC., JV Inv # 628411/SNC-NL/00076 CAT 6.8	$	8,374.00
628411/SNC-NL/00088	Technical Standards & Safety Authority, JV Inv # 628411/SNC-NL/00088	$	9,820.90
628411/SNC-NL/00067	Jensen Hughes Consulting Canada Ltd., JV Inv # 628411/SNC-NL/00067 CAT 6.1	$	16,006.00
628411/NL/PO-00006	Jensen Hughes Consulting Canada Inv JV Inv #628411/NL/PO-00006 CAT 6.1	$	5,830.00
628411/SNC-NL/00058	Professional Loss Control Inc., JV Inv # 628411/SNC-NL/00058 CAT 3.1	$	18,020.00
628411/SNC-NL/00062	JENSEN HUGES CONSULTINGCANADA LTD., JV Inv # 628411/SNC-NL/00062 CAT 6.1	$	5,830.00
628411/SNC-NL/00096	SNC - GTSM Business Travel Expenses, JV Inv # 628411/SNC-NL/00096 CAT 6.12	$	-
628411/SNC-NL/00097	SNC - FAT Test Business Travel Expenses, JV Inv # 628411/SNC-NL/00097 CAT 6.12	$	-
628411/SNC-NL/00098	SNC - QA FAT Test Business Travel Expenses, JV Inv # 628411/SNC-NL/00098 CAT 6.12	$	-
628411/SNC-NL/00018	ELLIS & WATTS Global Industries Inc. JV Inv # 628411/SNC-NL/00018 CAT 5.1	$	367,418.18
628411/SNC-NL/00013	ELLIS & WATTS GLOBAL INDUSTRIES INC. JV Inv # 628411/SNC-NL/00013 CAT 5.1	$	370,910.92
628411/SNC-NL/00025	ELLIS & WATTS GLOBAL INDUSTRIES INC. JV Inv # 628411/SNC-NL/00025 CAT 5.1	$	724,214.13
628411/NL/PO-00005	Munters Canada Inv JV Inv #628411/NL/PO-00005 CAT 5.1	$	188,688.59
628411-SNC-NL-00094	SNC - Various Engineering Equipment & 3rd Party Invoices 628411-SNC-NL-00094 CAT 6.1	$	4,711,232.42
628411-SNC-NL-00095	Various Engineering Equipment Part 2 628411-SNC-NL-00095 CAT 6.1	$	1,497,150.04
628411/SNC-NL/00068	Bentley Systems Inc., JV Inv # 628411/SNC-NL/00068 CAT 6.8	$	2,001.33

SNC Accrual File	Amount
Phase 1 (Costs + markup 6%); up to slowdown period	20,557,654.85
Delta between what OPG paid and Accrual	**(1,881,067.14)**

628411 - D20 Project
Weekly Cashflow - Equipment & Misc. Purchase Orders
Last update: November 13, 2017

Table 1: Manufacture & Equipment Purchase Order

Phase	Work Package ID		PO #	Vendor	Equipment (Paid Milestone highligted in Orange)	Currency	Total Forecast (EAC)	%Progress Nov 2017	Total Progress Amount (Nov 2017) excl. markup	PHASE 2 - % Progress Nov 2017	PHASE 2 -Total Progress Amount (Nov 2017)	Milestone	Progressed Completed Pre-Slowdown to Mar 5, 2017	Progressed Amount Pre-Slowdown to Mar 5, 2017	Progressed Completed Slowdown to April 21, 2017	Progressed Amount Slowdown to April 21, 2017	Progressed Completed Transition to June 27, 2017	Progressed Amount Transition to June 27, 2017	Phase 2: Cost Remaining (ETC)		Invoice Amount to OPG (CAD)	rate	Amount (USD)	with & without markup 6%	HST 13%	Grand Total	OPG Status	OPG Cover Sheet Invoice #	OPG Work Package # on Submission Sheet	Status to Paolo	Comments		
Phase 1	Pre-Slowdown	1	628411-K53300-528K-0002	Cummins Eastern Canada LP	90% of PO value delivery to site (up to 85% of original PO value)		939,930.00					MS 1									939,930.00			996,325.80	129,522.35	1,125,848.15	Paid	628411/SNC-NL/00086	315554730	Submitted			1
Phase 1	Pre-Slowdown	2	628411-K53300-528K-0001	Schneider Electric	90% of PO value delivery to site - on Orginal PO value		1,211,760.00					MS 1									1,211,760.00			1,284,465.60	166,980.53	1,451,446.13	Paid	628411/SNC-NL/00063	315554702	315554702		#VALUE!	1
Phase 1	Pre-Slowdown	2	628411-K53300-528K-0001	Schneider Electric	90% of PO value delivery to site - for Change Orders		64,837.42					MS 1									64,837.42			68,727.67	8,934.60	77,662.26	Paid	628411/SNC-NL/00064	315554701	315554701	Submitted Aug 17, 2017	#VALUE!	1
Phase 1	Pre-Slowdown	3	628411-K53300-528K-0003	Gutor Electronic LLC	10% of PO value with PO		45,894.30					MS 5									183,577.20			194,591.83	25,296.94	219,888.77	Paid	628411/SNC-NL/00042	315554703	315554703		#VALUE!	3
Phase 1	Pre-Slowdown	3	628411-K53300-528K-0003	Gutor Electronic LLC	10% upon submital of dwgs		45,894.30					MS 1									45,894.30			48,647.96	6,324.23	54,972.19	Paid	A00004/SNC-NL/00001	315554703	315554703			
Phase 1	Pre-Slowdown	3	628411-K53300-528K-0003	Gutor Electronic LLC	10% up acceptance of dwgs		45,894.30					MS 2									45,894.30			48,647.96	6,324.23	54,972.19	Paid	A00004/SNC-NL/00002	315554703	315554703			
Phase 1	Pre-Slowdown	3	628411-K53300-528K-0003	Gutor Electronic LLC	20% upon sub-supplier order with LOC advance payment		91,788.60					MS 4									91,788.60			97,295.92	12,648.47	109,944.39	Paid	A00004/SNC-NL/00001	315554703	315554703			
Phase 1	Pre-Slowdown	3	628411-K53300-528K-0003	Gutor Electronic LLC	40% upon completion of DDP delivery of equipment		183,577.20					MS 3									45,894.30			48,647.96	6,324.23	54,972.19	Paid	628411/SNC-NL/00010	315554703	315554703		#VALUE!	1
Phase 1	Pre-Slowdown	4	628411-K53300-528K-0004	Eaton	90% of PO value delivery to site (Part 1 - Original PO value)		820,314.51					MS 1									820,314.51			869,533.38	113,039.34	982,572.72	Paid	628411/SNC-NL/00072	315554704	315554704		#VALUE!	2
Phase 1-SD	Slowdown	4	628411-K53300-528K-0004	Eaton	90% of PO value delivery to site (Part 1 - Original PO value)		1,939.89														1,939.89			2,056.28	267.32	2,323.60	Paid	628411/SNC-NL/00073	315554991	315554991			2
Phase 1-SD	Slowdown	4	628411-K53300-528K-0004	Eaton	90% of PO value delivery to site (Part 2 - Change Order value)		34,446.33														34,446.33			36,513.11	4,746.70	41,259.81	Paid	628411/SNC-NL/00073	315554991	315554991			
Phase 1	Pre-Slowdown	5	628411-K60712-528K-0001	Custom Control Panels	15% upon approval of design drawings		130,140.00					MS 1									130,140.00			137,948.40	17,933.29	155,881.69	Paid	628411/SNC-NL/00027	315554705	315554705		#VALUE!	2
Phase 1	Pre-Slowdown	5	628411-K60712-528K-0001	Custom Control Panels	10% upon completion of the equipment build		303,660.00					MS 3									173,520.00			183,931.20	23,911.06	207,842.26	Paid	628411/SNC-NL/00027	315554705	315554705			
Phase 1	Pre-Slowdown	5	628411-K60712-528K-0001	Custom Control Panels	20% upon completion of EMC and Software Qualification		173,520.00					MS 2									303,660.00			321,879.60	41,844.35	363,723.95	Paid	628411/SNC-NL/00048	315554705	315554705	Invoice Pending Step 3 OPG approve in Oncore	#VALUE!	1
Phase 1	Pre-Slowdown	6	628411-K75160-528K-0001	Atlas Copco	15% upon submission of documents and drawings		54,494.10					MS 1									54,494.10			57,763.75	7,509.29	65,273.03	Paid	628411/SNC-NL/00033	315554706	315554706		#VALUE!	1
Phase 1	Pre-Slowdown	6	628411-K75160-528K-0001	Atlas Copco	10% upon approval of dwgs		36,329.40					MS 2									36,329.40			38,509.16	5,006.19	43,515.36	Paid	628411/SNC-NL/00070	315554706	315554706		#VALUE!	1
Phase 1	Pre-Slowdown	6	628411-K75160-528K-0001	Atlas Copco	65% upon notification of shipment net 45 days		236,141.10					MS 3									236,141.10			250,309.57	32,540.24	282,849.81	Paid	628411/SNC-NL/00078	315554706	315554706		#VALUE!	1
Phase 1	Pre-Slowdown	8	628411-K73690-528K-0001	Munters Canada	5% of PO value upon submittal of drawings		28,127.69					MS 1								Exchg	29,668.02	1.17330	21,603.45	31,448.10	4,088.25	35,536.35	Paid	A00004/SNC-NL/00005	315554708	315554708		#VALUE!	2
Phase 1	Pre-Slowdown	8	628411-K73690-528K-0001	Munters Canada	25% of PO value upon SNC full acceptance of design submittal		140,638.46					MS 2								Exchg	148,340.09	1.17330	108,017.25	157,240.50	20,441.26	177,681.76	Paid	A00004/SNC-NL/00005	315554708	315554708			
Phase 1	Pre-Slowdown	8	628411-K73690-528K-0001	Munters Canada	30% of PO value upon start of fabrication		170,273.64					MS 3									170,273.64	1.31363	129,620.70	180,490.06	23,463.71	203,953.77	Paid	A00004/SNC-NL/00007	315554708	315554708		#VALUE!	1
Phase 1	Pre-Slowdown	8	628411-K73690-528K-0001	Munters Canada	10% of PO value upon FAT		56,223.42					MS 4									56,223.42	1.30126	43,206.90	59,596.83	7,747.59	67,344.41	Paid	628411/SNC-NL/00012	315554708	315554708		#VALUE!	2
Phase 1	Pre-Slowdown	8	628411-K73690-528K-0001	Munters Canada	20% of PO value upon delivery of equipment		112,446.81					MS 5									112,446.81		86,413.80	119,193.62	15,495.17	134,688.79	Paid	628411/SNC-NL/00013	315554708	315554708			
Phase 1	Pre-Slowdown	9	628411-K73690-528K-0003	Johnson Control Canada	20% upon submission of design dwgs		450,144.40					MS 1									450,144.40			477,153.06	62,029.90	539,182.96	Paid	628411/SNC-NL/00011	315554709	315554709		#VALUE!	1
Phase 1	Pre-Slowdown	9	628411-K73690-528K-0003	Johnson Control Canada	10% upon approval of design dwgs		225,072.20					MS 2									225,072.20			238,576.53	31,014.95	269,591.48	Paid	628411/SNC-NL/00018	315554709	315554709		#VALUE!	3
Phase 1	Pre-Slowdown	9	628411-K73690-528K-0003	Johnson Control Canada	15% on ordering material		337,608.30					MS 3									337,608.30			357,864.80	46,522.42	404,387.22	Paid	628411/SNC-NL/00021	315554709	315554709			
Phase 1	Pre-Slowdown	9	628411-K73690-528K-0003	Johnson Control Canada	15% upon receipt of material,		337,608.30					MS 4									337,608.30			357,864.80	46,522.42	404,387.22	Paid	628411/SNC-NL/00021	315554709	315554709			
Phase 1	Pre-Slowdown	9	628411-K73690-528K-0003	Johnson Control Canada	20% upon completion of fabrication,		450,144.60					MS 5									450,144.60			477,153.06	62,029.90	539,182.96	Paid	628411/SNC-NL/00021	315554709	315554709	Invoice Pending Step 3 OPG approve in Oncore	#VALUE!	1
Phase 1	Pre-Slowdown	10	628411-K73870-528K-0001	Ellis & Watts	10% upon submission of eng. Dwgs		349,915.96					MS 1									349,915.96	1.31363	266,373.30	370,910.92	48,218.42	419,129.34	Paid	628411/SNC-NL/00013	315554710	315554710		#VALUE!	1
Phase 1	Pre-Slowdown	10	628411-K73870-528K-0001	Ellis & Watts	10% upon dwg approval		346,620.92					MS 2									346,620.92	1.30126	266,373.30	367,418.18	47,764.36	415,182.54	Paid	628411/SNC-NL/00018	315554710	315554710		#VALUE!	1
Phase 1	Pre-Slowdown	10	628411-K73870-528K-0001	Ellis & Watts	20% upon release of major material with LOC advance payment		683,220.88					MS 3									683,220.88	1.28245	532,746.60	724,214.13	94,147.84	818,361.97	Paid	628411/SNC-NL/00025	315554710	315554710		#VALUE!	1
Phase 1	Pre-Slowdown	11	628411-K62321-528K-0001	Canberra Corp.	10% net 30 days after shipment		139,417.00														139,417.00			147,782.02	19,211.66	166,993.68	Paid	628411/SNC-NL/00023	315554712	315554712		#VALUE!	1
Phase 1	Pre-Slowdown	11	628411-K62321-528K-0001	Canberra Corp.	n/a		450.00														450.00			477.00	62.01	539.01	Paid	628411/SNC-NL/00028	315554712	315554712			
Phase 1	Pre-Slowdown	12	628411-K62341-528K-0001	Radiation Measurement Systems	100% after equipment delivery and PDCL submission		899,141.00														899,141.00			953,089.46	123,901.63	1,076,991.09	Paid	628411/SNC-NL/00024	315554713	315554713		#VALUE!	1
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	10% of PO Value upon drawing submittal;		291,138.50					MS 5									291,138.50			308,606.81	80,237.77	697,451.39	Paid	628411/SNC-NL/00045	315554715	315554715			
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	5% of PO value upon submittal of Software qualification Plan;		145,569.25					MS 1									291,138.50			308,606.81	40,118.89	348,725.70	Paid	A00004/SNC-NL/00002	315554715	315554715			
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	10% of PO value upon release by CCI for Procurement and Fabrication;		291,138.50					MS 2									291,138.50			308,606.81	40,118.89	348,725.70	Paid	A00004/SNC-NL/00002	315554715	315554715			
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	20% of PO value upon receipt by CCI of major Materials;		582,277.00					MS 3									145,569.25			154,303.41	20,059.44	174,362.85	Paid	628411/SNC-NL/00009	315554715	315554715		#VALUE!	1
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	20% of PO value upon completion by CCI of mechanical fabrication;		582,277.00					MS 4									582,277.00			617,213.62	80,237.77	697,451.39	Paid	628411/SNC-NL/00017	315554715	315554715		#VALUE!	1
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	20% of PO value upon notification for FAT;		307,498.50					MS 6									307,498.50			325,948.41	42,373.29	368,321.70	Paid	628411/SNC-NL/00074	315554715	315554715		#VALUE!	1
Phase 1-SD		14	628411-K38300-528K-0001	CCI Thermal Technologies	20% of PO value upon notification for FAT;		274,778.50					MS 6									274,778.50			291,265.21	35,721.21	326,986.42		628411/SNC-NL/00075		Submitted			
Phase 1-SD		14	628411-K38300-528K-0001	CCI Thermal Technologies	100% Rev.02 - Design change to VRD system PLC control logic		32,730.00					MS 8									32,730.00			34,693.80	4,254.90	38,948.70	Paid	628411/SNC-NL/00075		Submitted			
Phase 1	Pre-Slowdown	14	628411-K38300-528K-0001	CCI Thermal Technologies	100% Rev.03 - Training		32,750.00					MS 7									32,750.00			34,715.00	4,512.95	39,227.95	Paid	628411/SNC-NL/00065	315554715	315554715	Submitted Aug 17, 2017	#VALUE!	1
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	10% upon all documents and drawings submission		147,555.78					MS 2									221,333.67			234,613.69	30,499.78	265,113.47	Paid	628411/SNC-NL/00037	315554766	315554766			
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	15% upon SNC acceptance of all documents and drawings		221,333.67					MS 3									147,555.78			156,409.13	20,333.19	176,742.31	Paid	628411/SNC-NL/00015	315554766	315554766			
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	60% upon shipment of Equipment		719,648.28					MS 4									719,648.28			762,827.18	99,167.53	861,994.71	Paid	628411/SNC-NL/00044	315554766	315554766		#VALUE!	3
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	60% upon shipment of Filters		165,686.40					MS 4									59,703.69			63,568.93	8,263.96	71,832.89	Paid	628411/SNC-NL/00044	315554766	315554766			
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	5% upon receipt of Equipment at site		59,970.69					MS 5									56,828.09			60,538.74	7,831.04	68,069.78	Paid	628411/SNC-NL/00044	315554766	315554766			
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	5% upon receipt of Filters at project site		13,807.20														165,686.40			175,627.58	22,831.59	198,459.17	Paid	628411/SNC-NL/00051	315554766	315554766	Invoice Pending Step 3 OPG approve in Oncore	#VALUE!	2
Phase 1	Pre-Slowdown	15	628411-K73690-528K-0004	EH Price / Price Industries Limited	10% upon submission and SNC acceptance of History file and docs		147,555.78					MS 7									13,807.20			14,635.63	1,902.63	16,538.25	Paid	628411/SNC-NL/00065	315554766	315554766	Invoice Pending Step 3 OPG approve in Oncore		
Phase 1	Pre-Slowdown	16	628411-K60431-528K-0001	Rosemount	10% upon delivery of equipment and accessories to the Site Submission of invoice upon shipment of all equipments and accessories to the Site Submission of invoice upon shipment of all equipments and accessories to the Site Submission of invoice upon shipment of all equipments

Requisition Tracking Sheet

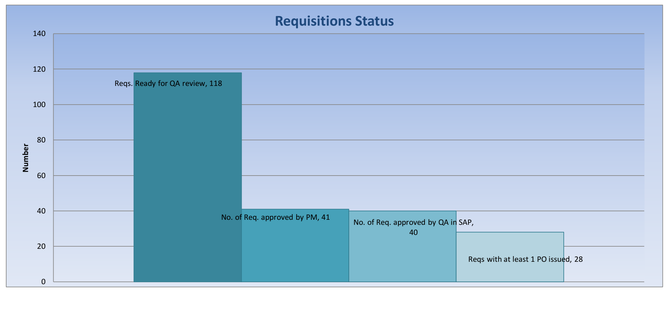
SNC·LAVALIN Nuclear AECON Joint Venture

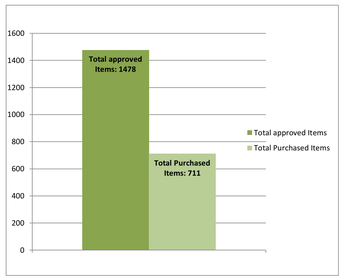
Engineering Process													Procurement Process				Receiving Process								
Project Coordinators						QA		Project Coordinators	Emily	Brian/Cesar	Luigi/Brad														
No.	SAP REQ	EC #	Description	Purchase Requisition Created in SAP	Req. Reviewed for Quality Approval	Priority	Date Traveler Initiated	Date Traveler Closed	To email PM to approve the Req.	Req. Approved by PM in SAP	Req. Approved by QA in SAP (officialy)	Date Traveler Initiated2	PO Issued for the entire Req?	Comment	Number of Purchased Items	Number of approved Items	Item No.	PO Issued?	Item Description	PO #	Purchase Date	Delivery Date	Fab/Site Required	Location	Location Description
1	1000000265	N/A	BALL VALVES - Class 6	5/30/2015	7/23/2015				8/4/2015	8/4/2015	08/04/2015		No	Oct 15:A new PO is issued. will have the review completed on Weston Valve (Swagelok). The quote was provide September 11, 2015	2	3									
2	1000000293	N/A	CHECK VALVES - Class 3	5/30/2015	7/23/2015	PO Issued			8/4/2015	8/4/2015	10/1/2015		Yes 100%	Oct 02:Luigi will update the line item in the commercial evaluation.Oct 02:Luigi: PO's started-based on the proposed tie-in schedule we received from OPG.	1	1									
3	1000000294	N/A	CHECK VALVES - Class 6	5/30/2015	NA					NA	10/16/2015	10/5/2015		Ryan: RFI SNC oct15: 713276 - Tech spec says Z299.4, can we knock down to Z299.4 and revise Aecon SPI's accordingly?	0	1									
4	1000000295	N/A	DIAPHRAGM VALVES - Class 3	5/30/2015	7/23/2015	PO Issued			8/4/2015	8/4/2015	08/04/2015		Yes 100%	Oct 02: Luigi: PO's started-based on the proposed tie-in schedule we received from OPG.	2	2									
5	1000000296	N/A	DIAPHRAGM - Class 6	5/30/2015	7/23/2015	PO Issued			8/13/2015	8/19/2015	10/14/2015		Yes 100%	Oct 15: 708294 – Can we increase quantity to 7 and add tags as required?	5	5									
6	1000000297	N/A	GATE VALVES - Class 6	5/30/2015	7/24/2015				8/13/2015	8/19/2015	10/14/2015	10/5/2015	No	All other CAT ID's are good to go oct 15:712545 - QTY to be changed to 5, Tags to be updated, Quality level to be dropped to Z299.4 per spec and BOM	1	2									
7	1000000299	N/A	NEEDLE VALVES - Class 6	5/30/2015	7/24/2015				8/13/2015	8/19/2015	10/14/2015		No	Oct 15:Please issue PO for CAT ID 627744 only, Swagelok quotes not yet reviewed.	1	5									
8	1000000300	N/A	PRESSURE SEATED AIR VALVES - Class 6	5/30/2015								9/18/2015		Vendor of cat ID no longer maintains required quality level. Luigi to follow up. Requires RFI to SNC/OPG	0	1									
9	1000000301	N/A	RELIEF VALVES - Class 6	5/30/2015	7/24/2015				8/13/2015	8/19/2015	10/14/2015				0	1									
10	1000000371	120421	Hangers for room D-025 - Z299.3 with N	7/7/2015	7/14/2015	High			7/23/2015	8/4/2015	08/05/2015	10/13/2015	No	Oct 13: traveler req. in the system for your review on the SA307 TW Metals not qualified to supply until audit is completed. Therefore purchase from Tioga or Dubose as audit is not	10	54									
11	1000000373	120421	Hangers for room D-025 - Z299.3 remai	7/7/2015	7/14/2015	High			7/21/2015	10/2/2015	7/22/2015	9/22/2015	No	Oct 02:item 30 approved by PM-Oct01:Item 30 not released-Sep 25RFI response from SNC regarding hex nuts material grade. Luigi: This req. was Z299.3 Floor did not pass to Z299.3	1	6									
12	1000000374	120421	Hangers for room D-025 - Z299.4	7/7/2015	7/14/2015	High			7/23/2015	10/2/2015	8/5/2015	09/22/2015 10/13/2015	No	Brian to advise on Tuesday Oct. 20.Oct 13: traveler 100000374 Material for CAT ID 12270-3 - The comment listed pertains to quality.	5	8									
13	1000000375	120421	Hangers for room D-025 - QA Level N/A	7/7/2015	7/14/2015	PO Issued			7/21/2015	10/2/2015	7/22/2015	9/21/2015	Yes 100%	Oct 02: line 90 is approved by PM - Oct 01:Not released – see below Item 90	9	9									
14	1000000410	120421	Hangers for room D-025 - Hilti Products	7/7/2015	7/14/2015	PO Issued			7/21/2015	7/22/2015	7/22/2015	9/21/2015	Yes 100%	requisitions issued-currently awaiting responses from Suppliers-given them a tentative dates of Friday September 25th by Noon EST	4	4									
15	1000000417	120577	QA Level: N/A	7/29/2015	7/31/2015	Medium	9/19/2015	9/21/2015	10/9/2015	10/21/2015	10/21/2015	10/13/2015	No	change item 450 on REQ10000000417 to match the part Brad will purchase. It released again. Sep 30: Shane: waiting to hear back from engineering about a	67	79									
16	1000000414	120577	QA Level: Z299.4	7/29/2015	7/31/2015	Medium	9/19/2015	9/21/2015	10/9/2015	10/13/2015	10/13/2015	9/21/2015	No	Oct 09:Dispositions accepted by Brad B. Sep 30: Shane: waiting to hear back from engineering about a FIC and an RFIShane for this REQ we are going to use the	27	35									
17	1000000434	120577	QA Level: Z299.2	7/29/2015	7/31/2015	Medium	9/18/2015							Oct 09: still on hold. Shane C. has sent an RFI to SNC to provide direction. Please mark this REQ as on HOLD until this RFI is answered											
18	1000000413	N/A	BALL VALVES - Class Exempt	30/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor. Ryan D.: The quotes are taking a long time and so is the receipt of vendor info.											
19	1000000402	N/A	BALL VALVES - Class 6 - Phase 2	30/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
20	1000000401	N/A	CHECK VALVES - Class Exempt	30/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
21	1000000403	N/A	CHECK VALVES - Class 6 - Phase 2	30/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
22	1000000431	N/A	CHECK VALES - Class 3 - Phase 2	31/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
23	1000000421	N/A	DIAPHRAGM VALVES - Class 6 - Phase 2	31/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
24	1000000432	N/A	DIAPHRAGM VALVES - Class 3 - Phase 2	31/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
25	1000000433	N/A	GATE VALVES - Class 6 - Phase 2	31/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
26	1000000405	N/A	GLOBE VALVES - Class 6 - Phase 2	31/07/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
27	1000000422	N/A	NEEDLE VALVES - Class 6 - Phase 2	4/8/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
28	1000000424	N/A	RELIEF VALVES - Class 6 - Phase 2	4/8/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
29	1000000425	N/A	PLUG VALVES - Class Exempt	4/8/2015										Waiting fpr Quote back-Technical Evaluation- They require more info from vendor											
30	1000000450	120422	EC 120422 - QA Level: Z299.3 with Nucle	17/08/2015	28/08/2015	High	9/22/2015	9/25/2015	9/28/2015	9/29/2015	9/30/2015	10/5/2015	No	requisitions issued-currently awaiting responses from Suppliers-given them a tentative dates of Friday September 25th by Noon EST	88	116									
27	1000000460	120422	QA Level: Z299.4	19/08/2015	28/08/2015	High	9/23/2015	9/30/2015	10/5/2015	10/6/2015	10/7/2015	09/21/2015 10/09/2015	No	Oct 19: manufacturer and parts numbers needed,sep30-Derek:Base on the email from MAJEWSKI Krzysztof -NUCLEAR Sent: Tuesday, September 29, 2015 2:16 PM	41	74									
28	1000000470	120422	QA Level: Hilti Products	20/08/2015	28/08/2015	PO Issued	9/23/2015	9/25/2015	9/28/2015	9/29/2015	10/7/2015		Yes 100%	Will be issued early next week: Sep 21 2015	4	4									
29	1000000471	120422	QA Level: N/A	20/08/2015	28/08/2015	PO Issued	9/23/2015	9/25/2015	9/28/2015	9/29/2015	9/30/2015		Yes 100%	Oct 05: in item 30 1 out of 2 is in the PO. Will be issued early next week: Sep 21 2015	36	36									
30	1000000480	120423	QA Level: Z299.3 with Nuclear Class	20/08/2015	28/08/2015	High	9/23/2015	9/25/2015	9/28/2015	9/29/2015	9/30/2015	10/5/2015	No	Oct 06:received comments for req 480 from Purchasing. Izzy has dispositioned the comments and we need QC to review the dispositions and "resolve"	92	110									
31	1000000472	120423	QA Level: Z299.4	21/08/2015	28/08/2015	High	9/23/2015	10/5/2015	10/8/2015	10/8/2015	10/9/2015		No	requisitions issued-currently awaiting responses from Suppliers-given them a tentative dates of Friday September 25th by Noon EST	49	81									
32	1000000473	120423	QA Level: Hilti Products	21/08/2015	28/08/2015	High	9/21/2015	10/5/2015	10/8/2015	10/8/2015	10/9/2015			requisitions issued-currently awaiting responses from Suppliers-given them a tentative dates of Friday September 25th by Noon EST	0	5									
33	1000000474	120423	QA Level: N/A	21/08/2015	28/08/2015	PO Issued	9/21/2015	9/25/2015	9/29/2015	9/29/2015	9/30/2015		Yes 100%	requisitions issued-currently awaiting responses from Suppliers-given them a tentative dates of Friday September 25th by Noon EST	38	38									

| | | |

| | | |

121	1000000671	120488	HILTI PRODUCTS	10/13/2015	10/13/2015	Low																			
122	1000000672	120489	QA Level:Z299.3 Pressure Boundary	10/13/2015	10/13/2015	Low																			
123	1000000673	120489	QA Level:Z299.3 Remainder	10/13/2015	10/13/2015	Low																			
124	1000000674	120489	QA Level:Z299.4	10/13/2015	10/13/2015	Low																			
125	1000000680	120489	QA Level:N/A	10/13/2015	10/13/2015	Low																			
126	1000000681	120489	HILTI PRODUCTS	10/13/2015	10/13/2015	Low																			
127	1000000682	120341	QA Level: Z299.4	10/15/2015	10/15/2015	Medium																			
128	1000000648	120341	QA Level: N/A	10/15/2015	10/15/2015	Medium																			
129																									
TOTAL	3552			131	118				43	41	40		28		711	1478									
				Number of Created Reqs	90.08% Reqs. Ready for QA review				No. of Req. approved by QA	No. of Req. approved by PM	No. of Req. approved by QA in SAP		Reqs with at least 1 PO issued		Total Purchased Items	Total approved Items			48.1% Percentage of Purchased item						



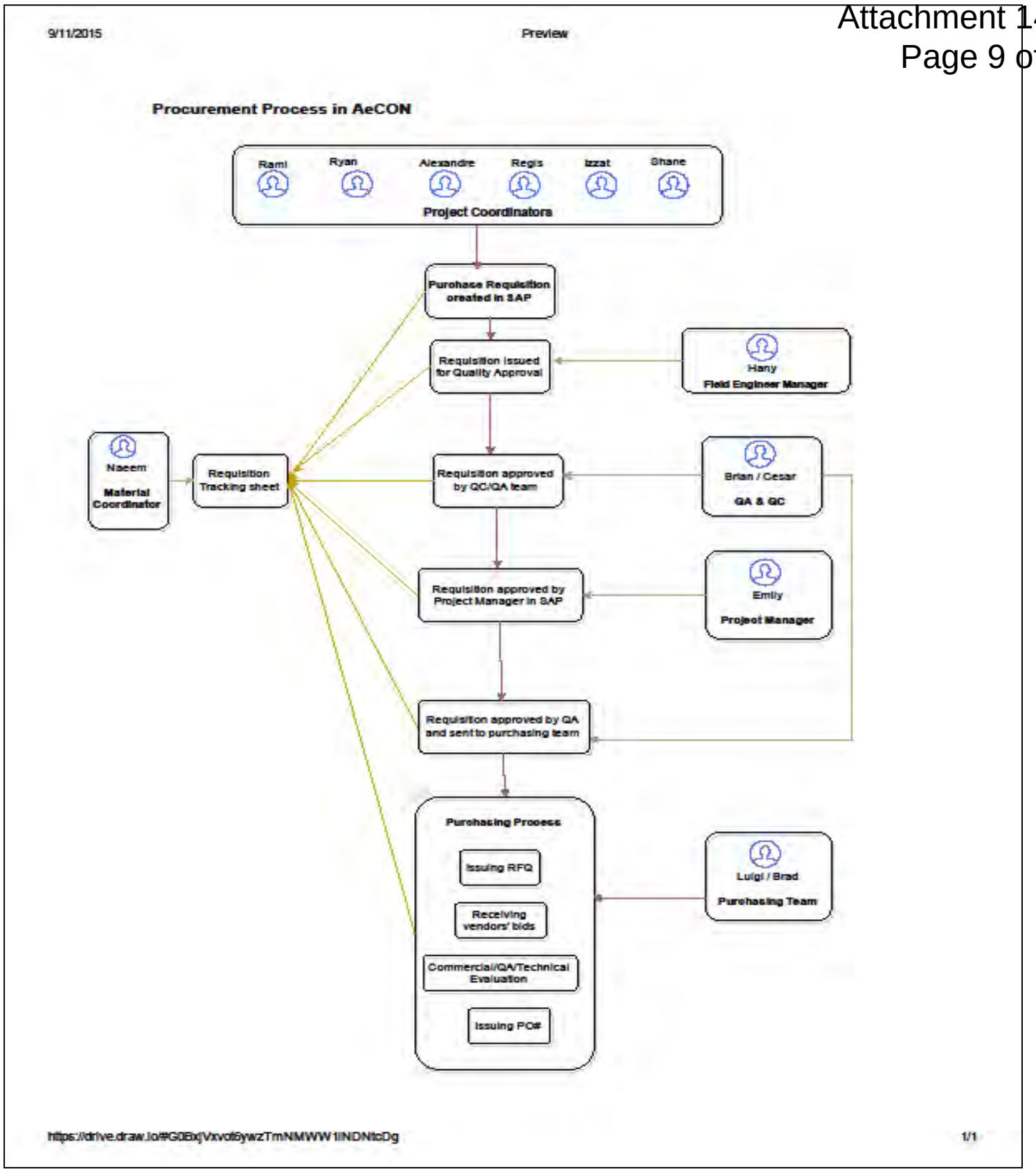


Number	PO Number	Value
1	4500041478	$ 5,209.00
2	4500041651 (2)	$ 9,142.91
3	4500041664 (2)	$ 7,399.15
4	4500041785 (2)	$ 3,162.86
5	4500041813 (2)	$ 1,350.00
6	4500041825	$ 1,204.58
7	4500041950 (2)	$ 750.00
8	4500042085	$ 1,522.79
9	4500042194 (2)	$ 185,104.75
10	4500042197	$ 145,382.20
11	4500042562 (2)	$ 304.87
12	4500043374	$ 1,294.92
13	4500043457	$ 624.08
14	4500043726	$ 493.13
15	4500043972	$ 514.15
16	4500044102	$ 7,312.92
17	4500044242	$ 265.56
18	4500044352	$ 50.79
19	4500044367	$ 173.34
20	4500044369	$ 5,000.25
21	4500044374 (2)	$ 906.90
22	4500044488	$ 33,636.91
23	4500044616	$ 3,538.64
24	4500044740	$ 250.00
25	4500044827 (2)	$ 32,181.08
26	4500045156	$ 1,452.00
27	4500045330	$ 6,731.71
28	4500045352	$ 11,177.10
29	4500045627	$ 283.65
30	4500046189	$ 88.14
31	4500046311	$ 12,967.52
32	4500046340	$ 166,859.00
33	4500046402	$ 4,750.00
34	4500046431	$ 15,195.97
35	4500046621	$ 26,316.52
36	4500046648 (2)	$ 24,030.50
37	4500046662	$ 703.93
38	4500047182	$ 3,707.93
39	4500047202	$ 14,679.63
40	4500047206	$ 8,480.00
41	4500047212	$ 1,410.00
42	4500047286 (2)	$ 9,352.42
43	4500047542	$ 13.56
44	4500047608	$ 675.57
45	4500047661	$ 30,504.64
46	4500047674 (2)	$ 14,433.90

47	4500047677	$	91.08
48	4500047682	$	162.55
49	4500047684	$	5,182.66
50	4500047811	$	331,804.40
51	4500029071 (2)	$	458.78
52	4500029605	$	1,188.00
53	4500029759 (3)	$	95,020.00
54	4500036631	$	65.33
55	4500036845	$	16,280.40
56	4500038074	$	1,980.55
57	4500038383 (2)	$	43,000.00
58	4500040112	$	600.48
59	4500040155	$	180.27
60	4500047900	$	896.13
61	4500048587	$	3,036.10
62	4500048004	$	319.56
Total		**$**	**1,300,855.76**

CAT ID	**1000000371**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000373**	Req. Item	PO Issued?	QTY	U-bolts		
CAT ID	**1000000374**	Req. Item	PO Issued?	QTY	Hilti Item w/ Luigi	Green highlights = Support Materials	
CAT ID	**1000000375**	Req. Item	PO Issued?	QTY	ORDERED	Yellow highlight = Pipe Materials	
CAT ID	**1000000410**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000450**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000460**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000470**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000471**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000480**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000472**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000473**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000474**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000490**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000491**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000501**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000512**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000493**	Req. Item	PO Issued?	QTY	SAMPLING CABINET REMAINS		
CAT ID	**1000000600**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000596**	Req. Item	PO Issued?	QTY	ORDERED		
CAT ID	**1000000610**	Req. Item	PO Issued?	QTY			
CAT ID	**1000000621**	Req. Item	PO Issued?	QTY			

Priority	Low
	Medium
	High
	PO Issued
Audit	Required
	Not Required
	Completed
POissued	Yes 100%
	No
Fab/Site	Fab Required
	Site Required
Location	Fab shop
	Industrial
	Site
	Not Received


Procurement Process in AeCON
Rami
Ryan
Alexandre
Regis
Izzat
Shane
Project Coordinators
Purchase Requisition created in SAP
Requisition issued for Quality Approval
Hany
Field Engineer Manager
Naeem
Material Coordinator
Requisition Tracking sheet
Requisition approved by QC/QA team
Brian / Cesar
QA & QC
Requisition approved by Project Manager in SAP
Emily
Project Manager
Requisition approved by QA and sent to purchasing team
Purchasing Process
Issuing RFQ
Receiving vendors' bids
Commercial/QA/Technical Evaluation
Issuing PO#
Luigi / Brad
Purchasing Team

CCC Interrogatory #32

Interrogatory

Reference: Exhibit D2/T2/S 10/ pp. 39-41, p. 110-111

When OPG determined to proceed with planning for DRP it investigated alternative solutions for addressing heavy water storage. Two approaches were considered: construction of a new building at a different location at or around Darlington, and adding storage to an existing Darlington building. During development of the 2012 Full Release Definition BCS (discussed below in Section 13.3) (see Attachment 2m), two additional alternatives were considered: limiting the project to the 1,700 m3 required to support refurbishment and construction of a drum warehouse to hold the approximately 7,200 drums that would be required to store the heavy water drained from two units undergoing overlapping refurbishment.

The 2015 Superseding Release Execution BCS also analyzed three alternatives for completing the project in light of its progress to date and compared them to the preferred alternative (Alternative 1).

a) Please confirm that the alternatives described in Ex. D2/T/2/S 10/ pp. 39-41 and 110-111 comprise all of the alternatives to the D20 Storage Project that OPG considered. If additional alternatives were considered, please provide details of those alternatives including when they were considered, the estimated cost of those alternatives, and the reasons why those alternatives were rejected;
b) Please confirm that the alternatives detailed in Ex. D2/T/2/S 10/ pp. 39-41 were all considered in relation to the D20 Storage Project at an estimated cost of $108.148M pursuant to the 2012 Full Release Definition BCS, and that the alternatives detailed in Ex. D2/T/2/S 10/ pp. 110-111 were all considered in relation to the D20 Storage Project at an estimated cost of $381.1M pursuant to the 2015 Superseding Release Execution BCS;
c) Please advise which, if any, of the examined alternatives to the D20 Storage Project would, as compared to the total claimed cost of $510M, have been preferable had the full cost of the D20 Storage Project been known at time the alternatives were considered. If none of the alternatives would have been preferable despite the final cost of the D20 Storage Project please explain why not.

Response

a) Not confirmed. As discussed in Ex. D2-2-10, at p. 42, in the spring of 2011, OPG convened a value engineering workshop whose purposes included to “review the alternatives being considered and attempt to augment them.” For information on

the alternatives considered there, see the response to Ex. L-D2-02-AMPCO-97 and the materials attached to that response.

b) Not confirmed. The alternatives examined in the BCS were evaluated on a qualitative basis and on a NPV basis against the operational improvement scope. (Ex. D2-2-10, Attachment 2o, pp. 8-9 and Attachment 2p, pp. 8-9).

c) OPG cannot answer the hypothetical question as posed. What OPG can say is throughout the project's life, including at the time of the 2018 Superseding Release Execution BCS (Ex. D2-2-10, Attachment 2q), which estimated the project's cost at up to $510M, the D2O Storage Project was evaluated as the best solution to address OPG's need to store heavy water for DRP and for operational improvement purposes.

CCC Interrogatory #33

Interrogatory

Reference: Exhibit D2/T2/S11/ Attachment 3, pp. 5, 44

This report presents our cost estimate for the engineering design, procurement, construction, and commissioning of the D2O Storage Project, as it would have been calculated before construction began. The cost estimate assumes what might be called "perfect knowledge" with respect to project scope, design requirements, and actual site conditions encountered. The estimate comprises the cost to pay a construction contractor to engineer, procure, and construct ("EPC") the D2O Storage Project, and OPG's in-house cost ("owner's cost") for contract administration, procurement support, and engineering oversight and approval through project turnover, commissioning, and contract close-out, but does not include any costs associated with post-commissioning operations and maintenance ("O&M").

a) Please confirm that Bates White Economic Consulting was provided with full details of OPG's actual costs to bring the D20 Storage Project into service and a full description of the issues experienced by OPG during the course of bringing the D20 Storage Project into service as a result of having received the 507 documents listed at Appendix B of its study prior to Bates White Economic Consulting developing its own cost estimate.
b) Please confirm that Bates White Economic Consulting was not asked to and did not consider alternatives to the D20 Storage Project in order to determine whether there were alternatives that, in light of Bates Economic Consulting's cost estimate of the D20 Storage Project, may have been preferable.
c) Please confirm that Bates White Economic Consulting's study does not purport to have examined OPG's or OPG's contractors' actual performance in bringing the D20 Storage Project into service.

Response

a) OPG is unable to confirm because the question is unclear in its use of the term "full details." The material that was provided to Bates White is listed in Ex. D2-2-11, Attachment 3, Appendix B. As this extensive list makes clear, the Bates White team asked for and received all the information they deemed necessary during the course of developing their independent estimate of the costs to construct the D2O Storage Project. Among these 507 documents are OPG's Business Case Summaries ("BCS") (see Ex. D2-2-10, Attachments 2k-2q). These BCS describe issues encountered during the project and request the funding necessary for the project.

b) – c)

The scope of Bates White's assignment is set out in paragraphs one and two of Ex. D2-2-11, Attachment 3, p. 5. OPG confirms that neither considering alternatives to the D2O Storage Project nor assessing contractor performance were included in this scope.

CCC Interrogatory #34

Interrogatory

Reference: Exhibit D2/T2/S 11/ Attachment 3, pp. 5, 44

This report presents our cost estimate for the engineering design, procurement, construction, and commissioning of the D2O Storage Project, as it would have been calculated before construction began. The cost estimate assumes what might be called "perfect knowledge" with respect to project scope, design requirements, and actual site conditions encountered. The estimate comprises the cost to pay a construction contractor to engineer, procure, and construct ("EPC") the D2O Storage Project, and OPG's in-house cost ("owner's cost") for contract administration, procurement support, and engineering oversight and approval through project turnover, commissioning, and contract close-out, but does not include any costs associated with post-commissioning operations and maintenance ("O&M").

a) Please confirm that Bates White Economic Consulting was provided with full details of OPG's actual costs to bring the D20 Storage Project into service and a full description of the issues experienced by OPG during the course of bringing the D20 Storage Project into service as a result of having received the 507 documents listed at Appendix B of its study prior to Bates White Economic Consulting developing its own cost estimate.
b) Please confirm that Bates White Economic Consulting was not asked to and did not consider alternatives to the D20 Storage Project in order to determine whether there were alternatives that, in light of Bates Economic Consulting's cost estimate of the D20 Storage Project, may have been preferable.

Response

a) – b)

This question duplicates Ex. L-D2-02-CCC-033 a) and b). See OPG's response there.

CCC Interrogatory #35

Interrogatory

Reference: Exhibit D2/T2/S 10/ pp. 2-3, 65

The evidence also explains how the risks and complexity of the project were underestimated by two experienced nuclear industry contractors retained to engineer, procure materials for and construct the project. Both contractors significantly under-forecast the project's duration and cost. The first of the two contractors was terminated by OPG based on performance. The second contractor ultimately agreed to complete the project for a maximum price that was tens of millions of dollars lower than the contractor's final cost to complete the project.

By spring 2014, with the project schedule extending and cost rising, OPG became increasingly dissatisfied with B&M's performance on the D2O Storage Project. The failure to meet the schedule for delivery of design documents and the delay in completing the LPSW relocation had pushed the construction schedule and increased costs. OPG was having difficulty getting B&M to commit to a new schedule and a firm estimate of cost at completion. Moreover, with the move into the excavation phase of the project, OPG also observed that the working relationship between B&M and EllisDon, which was responsible for both excavation and construction of the seismic dike, was not well-coordinated. In addition, the schedule delay meant that construction of the seismic dike would occur during winter, exposing the project to additional weather delays.

a) Please quantify the "increased costs" associated with B&M's performance issues that ultimately led to the termination of the B&M contract. Please discuss the extent to which any such increased costs have been included in the applied for D20 Storage Project costs sought for recovery.

Response

a) The question misstates OPG's evidence. OPG does not claim that B&M was terminated for "increased costs." Instead, as discussed in the evidence (see Ex. D2-2-10, pp. 65-68), OPG grew dissatisfied with B&M's performance on the project and, in particular, its inability to produce firm cost and schedule estimates and its unwillingness to have its payments tied to project cost beyond the performance fee in the ESMSA. As OPG's evidence makes clear, the cost increases experienced were largely attributable to the increased scope and complexity of the project as design progressed and construction conditions were better understood.

Since the costs OPG seeks to recover are consistent with the independent estimate of the costs to engineer, procure materials for, construct and commission the D2O Storage Project produced by Bates White (see Ex. D2-2-11, Attachment 3), OPG's position is that the amounts it seeks to recover in this application do not include excess costs, whether characterized as being related to B&M performance or otherwise.

CCC Interrogatory #36

Interrogatory

Reference: Exhibit D2/T2/S 10/ p. 69

In September 2014, OPG convened a series of meetings with B&M as a final attempt to reach a firm agreement on cost and schedule for the D2O Storage Project. OPG had concluded that unless B&M assumed greater risk for the cost of the completed project, there could be no cost certainty. B&M and its Tier 1 subcontractors were willing to set a target price for completion and reduce their recovery of the performance fee under the ESMSA if the target price was exceeded. However, they were unwilling to assume any financial responsibility for cost overruns if the project's cost exceeded the target price.

. . .

Negotiations with B&M continued into October. B&M offered the additional concession of eliminating the performance fee in the event the target price was exceeded, but remained unwilling to accept any responsibility for increases in the target price itself. OPG continued to reject this approach.

a) Please provide the target price under the B&M ESMSA that B&M was willing to accept in relation to their performance fee but were unwilling to accept responsibility for in the event there were increases in the target price.

Response

a) The question misapprehends the evidence. Since OPG and B&M were unable to agree on the structure of the contract to complete the project, they never reached the point of negotiating a target price. OPG sought a structure whereby B&M would bear some financial responsibility (beyond the performance fee under the ESMSA) if the project exceeded the negotiated target price at completion. B&M was willing to put the ESMSA performance fee at risk if the target price was exceeded, but was unwilling to bear any financial risk for project execution beyond the performance fee. As OPG was unwilling to move forward unless B&M assumed some financial risk for completing the project at the target price and B&M was unwilling to accept additional financial risk, the parties never reached the point of negotiating on a target price that B&M was willing to accept. B&M's final estimate of the cost to complete the EPC contract, $286.6M, is shown in the last line of Chart 3 (Ex. D2-2-10, p. 66).

CCC Interrogatory #37

Interrogatory

Reference: Exhibit D2/T2/S 10/ p. 79

The increased weighting of technical merit in this work request, as compared to the first work request issued in 2012, reflected the fact that as design, engineering and construction progressed, the project's complexity was better understood. As a result, OPG assigned greater weight to the technical aspects of the work request.

a) Please explain why it would not be the case that the less a project's complexity was understood by OPG, the more important the technical aspects in a work request would be.

Response

As discussed extensively throughout Ex. D2-2-10, the project's complexity became more apparent as the design progressed and the various construction challenges detailed in the evidence emerged. By the time of the second work request under the ESMSA, OPG had been overseeing the project for more than two years and experienced first-hand the challenges in designing the D2O Storage Project facility, integrating it with the HWMB/TRF and constructing it. Based on this experience, OPG determined to adjust the technical factor/price weighting from 50/50 to 75/25.

CCC Interrogatory #38

Interrogatory

Reference: Exhibit D2/T2/S10/ p. 91.

In October 2016, CanAtom issued Project Change Notice ("PCN") 67. This PCN sought a cost increase of $37.4M for engineering redesign and delays to procurement and construction arising primarily from the changes to the building's steel superstructure and the ground level (elevation 100 m) slab atop the seismic dike. This notice was OPG's first indication of the magnitude of the additional cost claim, despite frequent reports from CanAtom on the status of the project.

In addition to the funds requested by PCN 67, by December 2016, CanAtom had issued several other smaller PCNs, which together totaled about $7.5M. Thus, by the end of 2016 CanAtom was claiming some $45M in additional costs.

A series of meetings occurred early in 2017 to better understand the basis for CanAtom's cost claims and to explore ways to jointly mitigate them. Through commercial discussions between the parties, OPG accepted responsibility for about $7.5M for claims related to scope or estimation issues, leaving some $37.5M in dispute. This sum related primarily to redesign of the steel superstructure and seismic dike top slab.

OPG refused to accept the costs of the redesign. OPG's position was that it had agreed to the redesign based on the CanAtom's confirmation that it would not adversely impact the project's cost and schedule and, in any event, the engineering and project management costs claimed were excessive. As noted previously, OPG also took the position that since this design change occurred before finalizing the SOW underpinning the PO with CanAtom for the project, all costs related to the design change were already included in the negotiated PO amount.

a) Please quantify how much of the $37.5M redesign costs that OPG refused to accept were ultimately paid for by OPG and included in the D20 Storage Costs put forward for approval. Please explain the rationale for any such costs put forward for approval.

Response

a) Total costs associated with the redesign work were approximately $34M. These costs were included in the $172M paid to CanAtom according to the terms of the

ESMSA for the work it had completed on the D2O Storage Project before April 21, 2017 and are included within the total project cost of $510M.

OPG's payment to CanAtom for the work it had completed on the project prior to April 21, 2017 formed a part of the settlement reached between the parties in June 2017. Therefore, OPG received consideration in return for making this payment that reduced the total project cost. OPG retained the performance fee of approximately $10M associated with CanAtom's pre-April 21, 2017 work. As explained in Ex. D2-2-10, pp. 95-97, OPG also negotiated a target price/maximum price contract to complete the D2O Storage Project where the target price of $80M was approximately $20M less than the external estimate to complete the project. In addition, OPG negotiated a $20M discount to be applied to the final price (see Ex. D2-2-10, p. 97, Chart 4). The maximum price was effective in capping OPG's costs to complete the D2O Storage Project. CanAtom ultimately exceeded the contract maximum price, which resulted in CanAtom incurring $77M in cost to complete the project that OPG did not pay.

CCC Interrogatory #39

Interrogatory

Reference: Exhibit D2/T2/S10/ p. 102

Construction completion was achieved in November 2019. At that time, almost all of the systems, equipment and the above ground portions of the building itself were placed into service. Additional monitoring and control systems and other miscellaneous equipment were placed in service in 2020 and the building was declared ready to accept heavy water.

At year-end 2019, CanAtom prepared an estimate of its cost to complete the D2O Storage Project. Using the $70M maximum guaranteed payment and an additional $1.9M that OPG had agreed to pay for changes to project scope and a settlement of CanAtom claims to year end 2019. CanAtom estimated its total cost at year-end 2019 to be $148.9M. This figure comprised $145.5M in accrued costs plus approximately $3.4M in pending or forecast costs. Given the maximum cost contract, CanAtom calculated its loss on Phase 2 work at approximately $77M as of year-end 2019.

a) Relative to the total claimed D20 Storage Project claimed capital costs of $509.3M, please break out the total amount paid to B&M, the total amount paid to CanAtom, any incremental amounts claimed by B&M but not paid, and any incremental amounts claimed by CanAtom but not paid.

Response

a) Of the total D2O Storage Project capital cost of $509.3M, $83.8M was paid to B&M and $250.3M was paid to CanAtom with an additional $1.9M to be paid on closeout, which is included in the $509.3M project capital cost.

   Claims by B&M and CanAtom were managed through ongoing contract management. See Ex. D2-2-10, pp. 70-71 for a discussion of the dispute resolution process between OPG and B&M where commercial claims were largely set-off between the parties in reaching a settlement following B&M's termination. See Ex. D2-2-10, pp. 95-97 regarding the settlement discussions with CanAtom where the resolution of commercial claims resulted in a target cost/maximum cost agreement. CanAtom ultimately exceeded the maximum cost, causing it to incur approximately $77M in costs for work on the project that OPG did not pay.

CME Interrogatory #7

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 1.

(a) To the extent that they are not already on the record, please provide all Burns & McDonnell/Modus and Refurbishment Construction Review Board reports/findings/recommendations or other similar documents related to auditing or overseeing the DRP.

(b) Please provide the Burns & McDonnell/Modus evaluation of the process used by OPG in developing the control budget and schedule for Unit 3, which 21 was completed in November 2019.

Response

a) See Ex. L-D2-02-SEC-084.

b) See Ex. D2-2-7, Attachment 3.

CME Interrogatory #19

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 10

With respect to the D20 Storage Project:

(a) Please provide all reports or documents by Modus/Burns McDonnell with respect to the D20 project;

(b) Please provide all reports or other documents created by OPG's P&M group with respect to the D20 project.

Response

(a) All reports by Modus/Burns McDonnell regarding the Darlington Refurbishment Program since EB-2016-0152 have been provided in response to L-D2-02-SEC-084. Of that set, Attachment 2 (confidential) is the only one related to the D2O Storage Project.

Additional Modus/Burns reports regarding the D2O Storage Project were produced as part of OPG's evidence in EB-2016-0152 (see Ex. L-4.3-1-Staff-072, Attachments 1 to 11, 15, and 19, Ex. L-4.5-8-GEC-13, Attachment 1, Ex. J1.1, Attachment 1, and Ex. J2.10, Attachment 2). Those reports not already on the record in this proceeding are re-filed as Attachments 32-42. Attachments 32-35, 37, and 40-42 contain confidential information.

(b) OPG is revising the response to this interrogatory question following the Interrogatories Refusals Discussion meeting on April 23, 2021.

Periodic reports issued by P&M on the D2O Storage Project are provided as Attachments 1-31.

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D2O Storage Project Team D2O Update

Julian Read
June 6, 2012

Scope Overview

EPC contract to construct:

1. 1700 m^3 of reactor grade D2O storage for refurbishment
2. 400 m^3 of D2O storage for TRF operational improvements
3. Drum handling facility
4. Office space

References

Scope of Work: NK38-SOW-38000-10004

Conceptual Design Report: NK38-REP-38000-10002

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Scope – Storage Requirements

Total operational storage required: 2100 m^3		**Required Storage Capacity**
Refurbishment Needs	Moderator System	700m^3
	Heat Transport System and Auxiliaries	800m^3
Shared Refurbishment and Operational Improvements Needs	Downgraded D2O	200m^3
Operational Improvements Needs	Moderator System, TRF Feed, SUP Product	200m^3
	Heat Transport System and Auxiliaries, TRF Product	200m^3

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Key Business Drivers

- Prerequisite for refurbishment to start
- Required to refurbish two units simultaneously

- Increased TRF efficiency
- Supports TRF Life Extension strategy
- Fleet wide drum reduction

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- ES-MSA Work Request closed on April 27 (bids received)
- Final draft geotechnical report received
- Interim soil and groundwater condition (tritium) report expected early July.
- Evaluation (technical/pricing): TCD June 2012
- PO issue for detailed design phase: TCD June 2012
- Full Definition Release BCS:
  - TCD: June 2012 GRB
- Partial Execution Release BCS:
  - TCD: July 18 GRB
  - TCD: August BOD
- AFS date:15-Apr-15

Risk	Level	Mitigation
Tritium in ground water at preferred site location	Major	Proceeding with Env Site Assessment Phase II under new OM&A project. Interim report due July/12; final report 13-Apr-13 (Owner: P&M). 27 of 29 wells have been installed.
Cost of EPC contract increases due to discovery work or existing systems do not have adequate capacity	Moderate	Accept
The EPC contract may be let before successful implementation assessment is conducted on the initial EPC project.	Critical	Project Manager will be responsible for preparing and overseeing an overall Quality Surveillance Plan. (Owner: P&M) TCD: 30-Sep-12
Dependency on Refurbishment EA for start of construction	Major	Keep communication open with EA personnel, providing timely information into EA process. (Owner: EA / P&M) TCD: 15-Dec-12
Design & Procurement Engineering resources to support thorough & timely reviews	Major	Clear and frequent communication of review expectations with stakeholders. Appropriate in-house or OSS resourcing - project to have dedicated multidisciplinary support and expertise for timely reviews. (Owner: RE & PE) TCD: 10-Sep-12

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D2O Storage Project
Status update and current issues

October 26, 2012

Design Schedule – Modification Planning

- Preliminary Design Complete Milestone of October 29, 2012 will be missed
  - No preliminary engineering deliverable has been submitted for acceptance by OPG
  - RCMT has confirmed that it needs more time to complete deliverables and address comments

    The MDR's required complete revision as a result of quality issues being raised regarding missing information, such as functional and performance requirements not aligning

    Unconsolidated, and some inappropriate commenting from Refurbishment Design requires time to disposition. Some material comments have resulted in major revisions to submitted documents to bring deliverables to required quality level.

    TMOD Modification Outline was rejected due to poor quality, which has resulted in RCMT planning to revise and restructure all Modification Outlines to correct
  - Meeting was held on Tuesday October 23 with Neil Mitchell and commenting issue has been resolved and a new process established for future deliverables.

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Modification Planning Milestone

- B&M has proposed to uncouple the construction support Mod Planning Design work from the Modification Planning Complete payment milestone
  - TMOD for temporary trailers
  - TMOD for temporary “wash car”

    Temporary construction washrooms with running water and electricity will be required to achieve productivities sought during construction
- Current payment milestone is tied to all Modification Planning activities
- Proposal would maintain payment milestone tie to all site preparation and new building mod planning deliverables

Design Schedule – Detailed Design

- Requires assessment on whether May 2013 is the correct date to produce a quality design
  - May 15, 2013 Design Complete milestone is not based on construction schedule needs. Some portions of design are not required until early 2014. Vendor proposes aligning design schedule with construction needs, while ensuring sufficient float is maintained between design complete and construction need
- There is evidence of clear production pressures at RCMT to produce the design in time (error likely situation)
- OPG will be asked to review up to 10 full design packages at a time to meet the May 2013 date
  - Contract specified no more than 4 design EC's per review period
  - Will require substantial resources to accommodate if reviews as outlined in the oversight plan are to be executed

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Site Preparation

- LPSW relocation is required prior to completion of caisson wall installation, and start of soil excavation. Multiple options exist
  - Note, this is an S-98 System Important to Safety
- A decision is required by November 1 because path forward may have major impact to overall schedule and cost
- LPSW service interruption requires min. 2 month TRF outage
  - Long restart is due to the cryogenic processes inside the TRF.
  - TRF requires long run down time to cool and de-gas the column to avoid large tritium emissions to the environment (run down time is typically 36 days)

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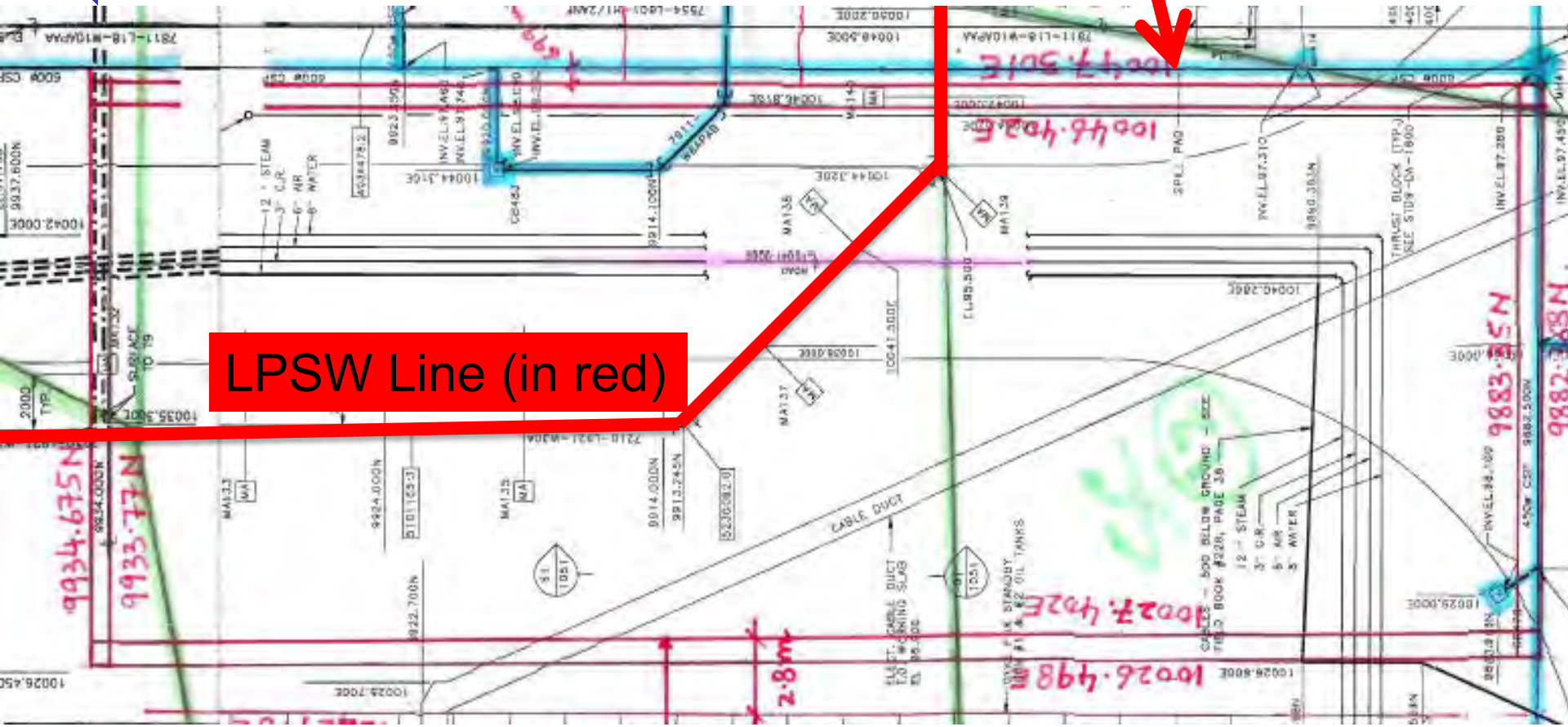
Site Preparation – LPSW Line

Avoiding this reroute is not possible.

N

Building foot print in double red line



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LPSW Option 1 of 4 (Recommended)

Option	Cost Impact	Schedule Impact	Risks
Perform hot taps to relocate LPSW (on 24" portion of line underground)	+ $700k CTP	AFS remains April 15/15 SOI Apr 24/13	- Isolation may not be achieved by inflatable bung, requiring delay of work to TRF outage - Low risk of ice plug failure during cut and cap, resulting in forced TRF outage and LPSW spill and reportable environment spill (low probability, high consequence) - Underground pipe condition is unknown and therefore suitability for hot tap currently unknown

Advantages

- Maintains schedule
- Minimal cost impact of the 3 options, not change in performance fee

Disadvantages

- Complex & risky hot taps on S-98 system
- Cost increase
- Requires more time to execute than standard isolation reroute, limited float
- Requires relocation of Argon tank

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Hot tap Details

The proposed work assignment for this project has three work parties executing the work:

1. TD Williamson: Supply Split Tee and Stopple Valves and Perform Hot Taps
2. CEDA: Install Freeze Plugs
3. B&M: Weld Split Tees to LPSW line

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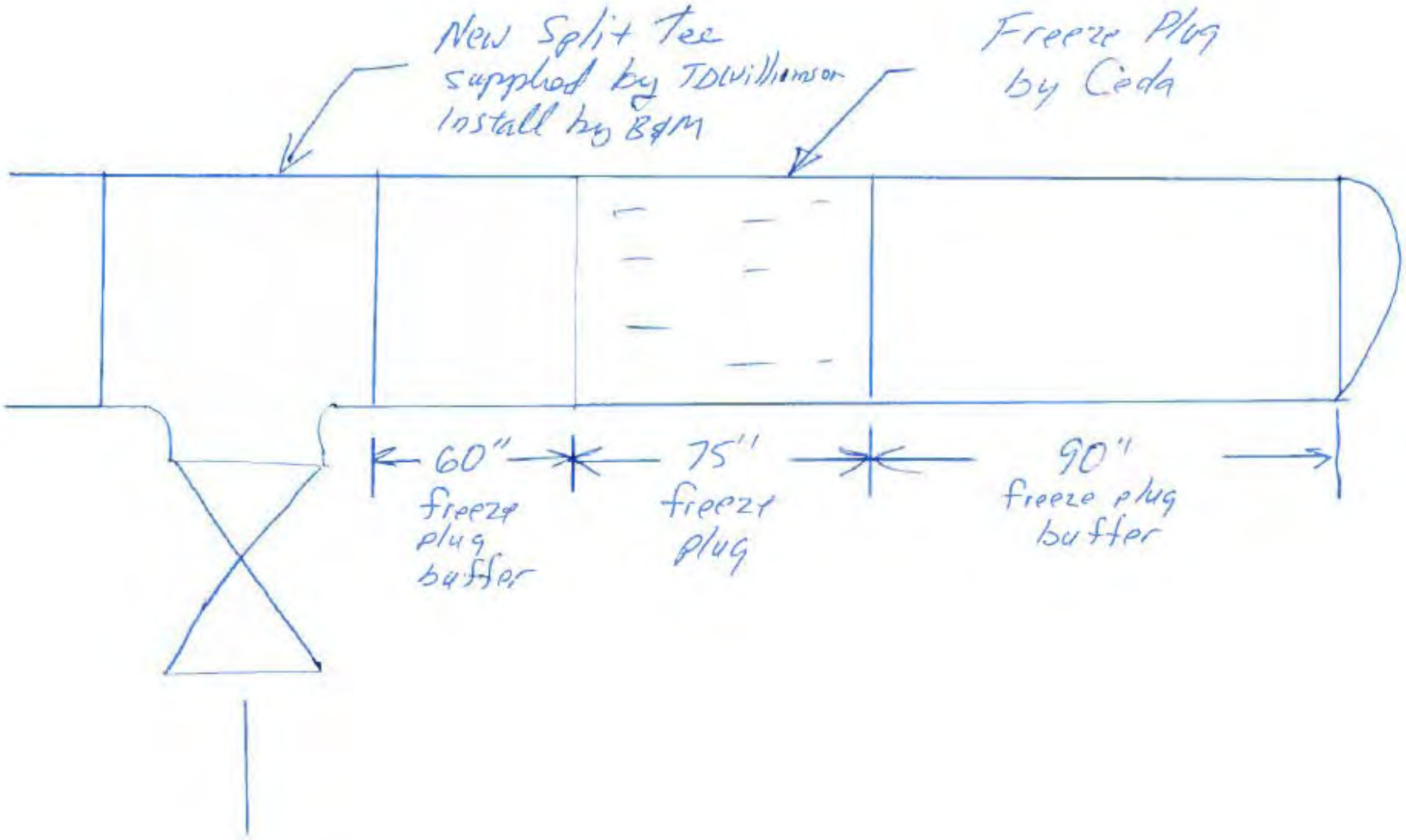
Hot tap OPEX/Status

CEDA

- CEDA has successfully frozen pipes to 42" dia.
- They have Pt Lepreau experience to 36" dia.
- They are confident they can freeze the pipe
  - Subject to a zero flow condition achieved by the Stopple valve.
- A successful freeze plug has considerable space requirements
  - There is space available to complete the hot tap, but it will require relocation of the Argon storage tank (previously was not to be relocated)

OPG INTERNAL USE ONLY

Hot tap space requirements



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Hot tap OPEX/status

TD Williamson

- Have successfully performed hot taps of this size
- Lead time for split tees is 12 weeks, opportunities to improve are being explored by vendor

Black & McDonald

- Would rehearse the welding of the split tee
- Lead time for valves currently being investigated
- *B&M expresses confidence they can be successful with this hot tap approach*

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LPSW Option 2 of 4 (Not recommended)

Option	Cost Impact	Schedule Impact	Risks
Delay to align relocate with TRF outage in October 2013	+ $2.2M	Delays AFS to Sep 1/15 SOI Oct 1/13	- Project schedule extended by 4.5 months, eliminating float to BCS committed Oct 15/15 date

Advantages

- Use of valves for isolation
- Less risky, more predictable modification by eliminating hot taps and ice plugs
- More float in schedule for complex portion of reroute, and site preparation planning
- Allows project to execute all site preparation within MA-22 guidelines

Disadvantages

- Delays schedule, consumes overall float early in project
- Increased costs due to extension of contract (reimbursable costs)
- Shifts excavation and concrete placement to winter months, decreasing productivity for these tasks

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LPSW Option 3 of 4 (Not recommended)

Option	Cost Impact	Schedule Impact	Risks
Advance TRF Outage to complete relocate earlier	$0 to project $4.3M* to OPG	AFS remains April 15/15 SOI Apr 24/13	- Increased risk of TRF outage extension due to expediting of outage planning - Additional TRF resourcing required to meet new timeline

*No cost to project, but costs to OPG. 50% of the cost of the planned TRF outage because the TRF would only operate 5,000 hours from last outage instead of the normal 10,000 hours. TRF Outage would be required to start in February 2013 to meet the SOI outlined in the vendor schedule

Advantages

- Maintains schedule
- Elimination of complex

hot taps and ice plugs

Disadvantages

- Detritiation targets and emissions at Pickering and Darlington at risk due to disruption of detritiation plan
- Increased worker dose across fleet due to unavailability of spring detritiation campaign prior to spring outages
- 5 TRF projects would require schedules to be expedited to meet new advanced schedule
- Forced to have an extra unscheduled TRF Outage in 2014 – (T1501 Outage is tied to SCO)

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LPSW Option 4 of 4 (Not recommended)

Option	Cost Impact	Schedule Impact	Risks
Advance TRF Outage by 36 days to accommodate reroute in TRF outage	Some cost to project, TBD $4.3M* to OPG	AFS delayed to June 15/15 or July 15/15 SOI Aug 15/13	- Increased risk of TRF outage extension due to expediting of outage planning - Additional TRF resourcing required to meet new timeline

*No cost to project, but costs to OPG.

Advantages

- Elimination of complex

hot taps and ice plugs

Disadvantages

- Detritiation targets at Pickering and Darlington at risk due to disruption of detritiation plan
- 5 TRF projects would require schedules to be expedited to meet new advanced schedule
- Risk of increased tritium emissions due to interruption of detritiation campaign
- Forced to have an extra unscheduled TRF Outage in 2014 – (T1501 Outage is tied to SCO)

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What is required to execute Option 1

- SOI would remain January 2013 for start of site preparation, which is achievable with OPG support, but comes with schedule completion risk
- Requires operating outside of N-PROC-MA-0022 and outside the COIR assigned roles and responsibilities
- Will require “hands on” by OPG to support vendor success
  - Facilitation of expedited work plan reviews by stakeholders
  - Facilitation of work control interface in light of missing T-minus milestones
  - OPG will need to create, schedule, and logic WO tasks on the plan in the near term while B&M works at getting appropriate access rights. B&M would provide retain ownership, OPG would input into the systems on their behalf.
  - Station reviews of work plans will be required during the Christmas period

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Examples of Current Site Preparation Plan

Deliverable	TRF Trailer Removal	New SG Cable Duct Bank	6" air line cut and cap	LPSW
Design Complete	Dec 20/12**	Dec 20/12	Dec 20/12	Dec 20/12
Work Plans Complete	Dec 21/12	Jan 4/13*	Feb 1/13	Jan 11/13*
Assessing Complete	Jan 2/13	Jan 11 /13	Feb 8/13	Jan 18/13
CWP Complete	Jan 30/13	Feb 8/13	Mar 11/13	Feb 15 /13
SOI	Jan 16/13	Feb 21/13	March 25/13	April 24/13

*Requires routing, review, and signatures of work plan during Christmas period

** Due to mod planning delay, DEC's cannot be submitted for acceptance, although it will be approved by RCM

- As time goes on work gets more "in the box" to N-PROC-MA-0022. For January, B&M is out of the box, but by the time we hit LPSW in April, plan is mostly inside MA-22 guidelines.

Outstanding items required to start work

- Preliminary engineering complete (TCD pending, could be as late as Dec)
- Design package accepted by OPG (as above)
- Soil and Waste Management Plan (November 26, 2012)
- SATM permits (November 12, 2012)
- Critical Lift and Material Handling Plans (November 12, 2012)
- Site Specific Safety Plan (December 3, 2012)

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Vapour Recovery Unit Issue

- Requires decision on whether proposed design is acceptable prior to PO award, which can occur as early as November 19, 2013
- RCMT has forecasted that proposed solution would result in an incremental increase to site tritium levels by **350 – 430 Ci/year**
  - Represents > 10% increase in overall yearly emissions at Darlington
  - No redundancy in design
- Vendor is assuming design of a new chilled water heat exchanger unit will be sufficient for tritium emissions
  - No validation exercise has been completed, as required in the SOW
  - Evaluation of alternative technologies weighing the cost and performance, according to ALARA principle, has not taken place (design process not being followed)
- EA states that no part of refurbishment will result in a net increase to existing tritium emission levels (D2O Project is part of this EA)
  - Refurbishment Environment indicates it would be hard to declare that this represents the best technology available if it became necessary to publically defend a large tritium emission in the event of failure of this unit (with no redundancy to mitigate)

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Vapour Recovery – Contract Language

Preliminary Design Requirements

- "2.2.2.5 The venting system shall minimize D2O loss and tritium releases to the outside atmosphere such that airborne tritium emissions are below the action levels for DNGS."
- "c) Chilled Water shall be used to satisfy the requirements of 2.1.2.12." (Heavy Water shall be recovered through condensation from the Heavy Water storage tank and drum venting exhaust air and transferred to the Downgraded D2O System.)
- "The West Annex shall minimize adverse impacts on the Environment."

Conceptual Design Report

- "Assumptions and recommendations made in this CDR shall be validated during Detailed Design."
- "Provide a new, stand-alone, chilled water unit, to provide chilled water to the D2O Vapour Recovery System (SCI 38300)."

Scope of Work

- "The Contractor shall also support OPG with the Environmental Assessment for Darlington Refurbishment as required."

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D2O Storage Project Update

December 6, 2012

Preliminary Engineering

BCS Milestone: October 29, 2012
Revised TCD: December 21, 2012

Deliverable	Status
MDR -10004 (Building/Process MDR)	Complete
MDR -10003 (TMOD/Buried Services)	To be submitted for OPG acceptance today
Design Plans 10003/10004/10005	Complete
MEC 118880	DA Approved, pending DOM Approval.
MEC 118632	With DA for approval.
MEC 119824	To be submitted for OPG acceptance on Dec 7/12
MEC 88528	To be submitted for OPG acceptance by Dec 10/12

Procurement Progress

Technical Specification	Status
Process Valves (19 Specs)	OPG comments due Dec 6/12
Vacuum Valves (6 Specs)	OPG commenting complete
Pumps (8 Specs)	OPG commenting complete
Vapour recovery heat exchanger	OPG commenting complete
Tank specs	Complete

Tank Procurement	Status
RFP Process	Complete
Preferred Vendor Selection	Complete
Final Negotiations	In Progress
Purchase Order Issued	December 13, 2012 (contingent on Phase II PO issuance)

Relocation/Buried Services Status

Deliverable	Status
TRF Work plan	Dec 6/12 for OPG Review
TRF DEC Complete	Currently under review. TCD Dec 21/12
Work Order Assessing	In progress
TRF Removal SOI	February 8, 2013

1. Level 1 on following page outlines execution of the work.
2. B&M currently developing work plans.
3. Project will not affect stability (T-8), but is currently outside of normal MA 22 milestones for assessing.
4. Fraser Sword is supporting project interface with work control to keep work on the plan. Currently no issues.

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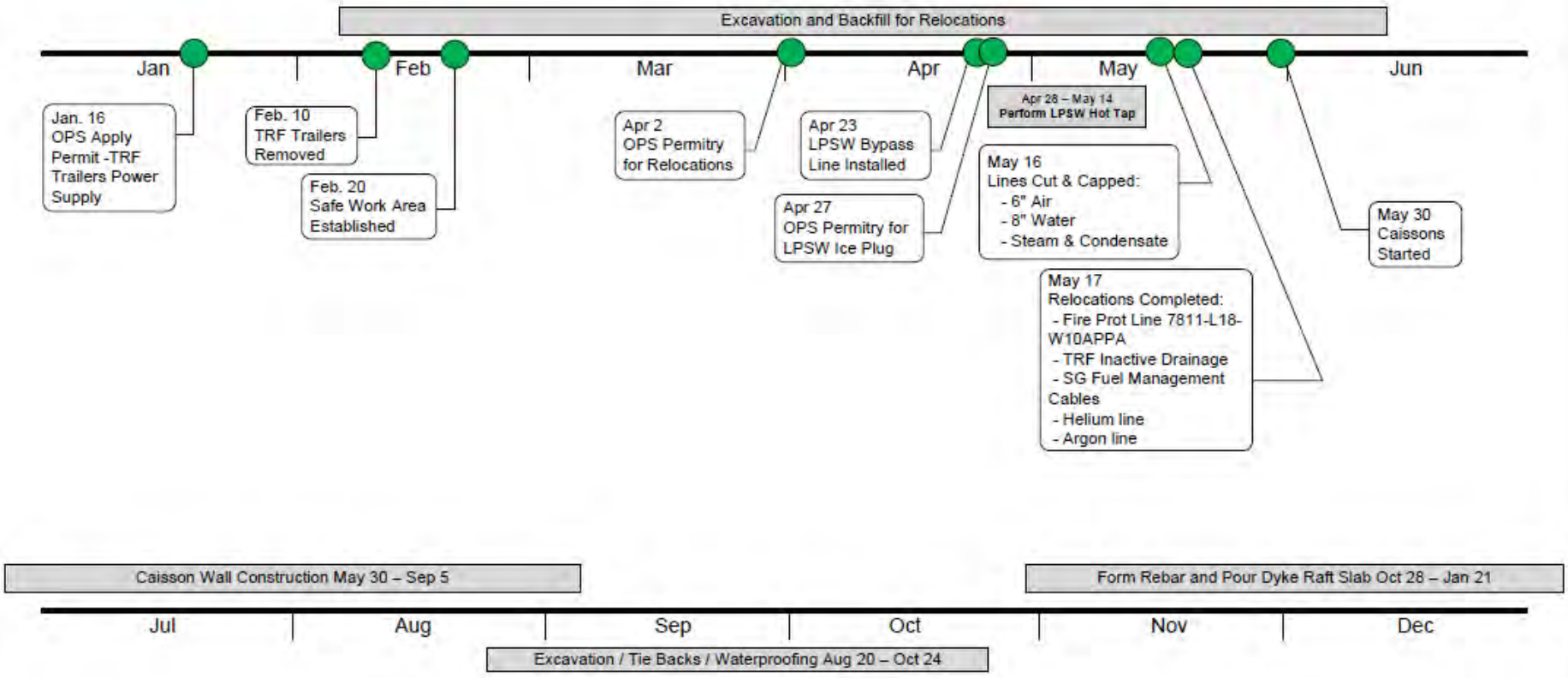
2013 Overall Schedule



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Top Risks

Risk	Mitigation	Concerns
Vehicle access to protected area not sufficient.	Site proposes separate screening area to expedite traffic through sally port.	A firm TCD, plan, and owner is outstanding.
Soil is contaminated.	Vendor will be executing a borehole sampling plan in January to determine extent of condition.	Currently no lay down area secured for worst case to let soil dry if bulk soil excavation is contaminated.
Ground water is contaminated.	Ground water disposal plan is being drafted by vendor.	May require MOE approval, which is time sensitive. Working to expedite.
Readiness to execute site preparation.	Many activities are occurring in parallel (i.e. TRF Trailer work plan drafted while waiting for EC approval).	Work control interface will need to be well managed. As well, ops review of work plans may be a challenge.

OPG INTERNAL USE ONLY

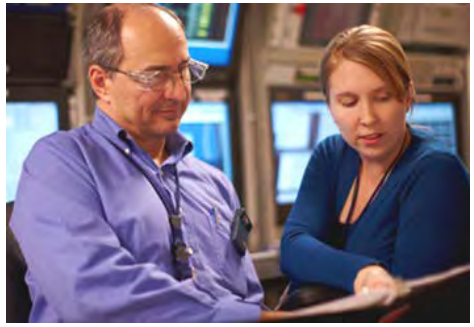
D2O Project Update

Julian Read

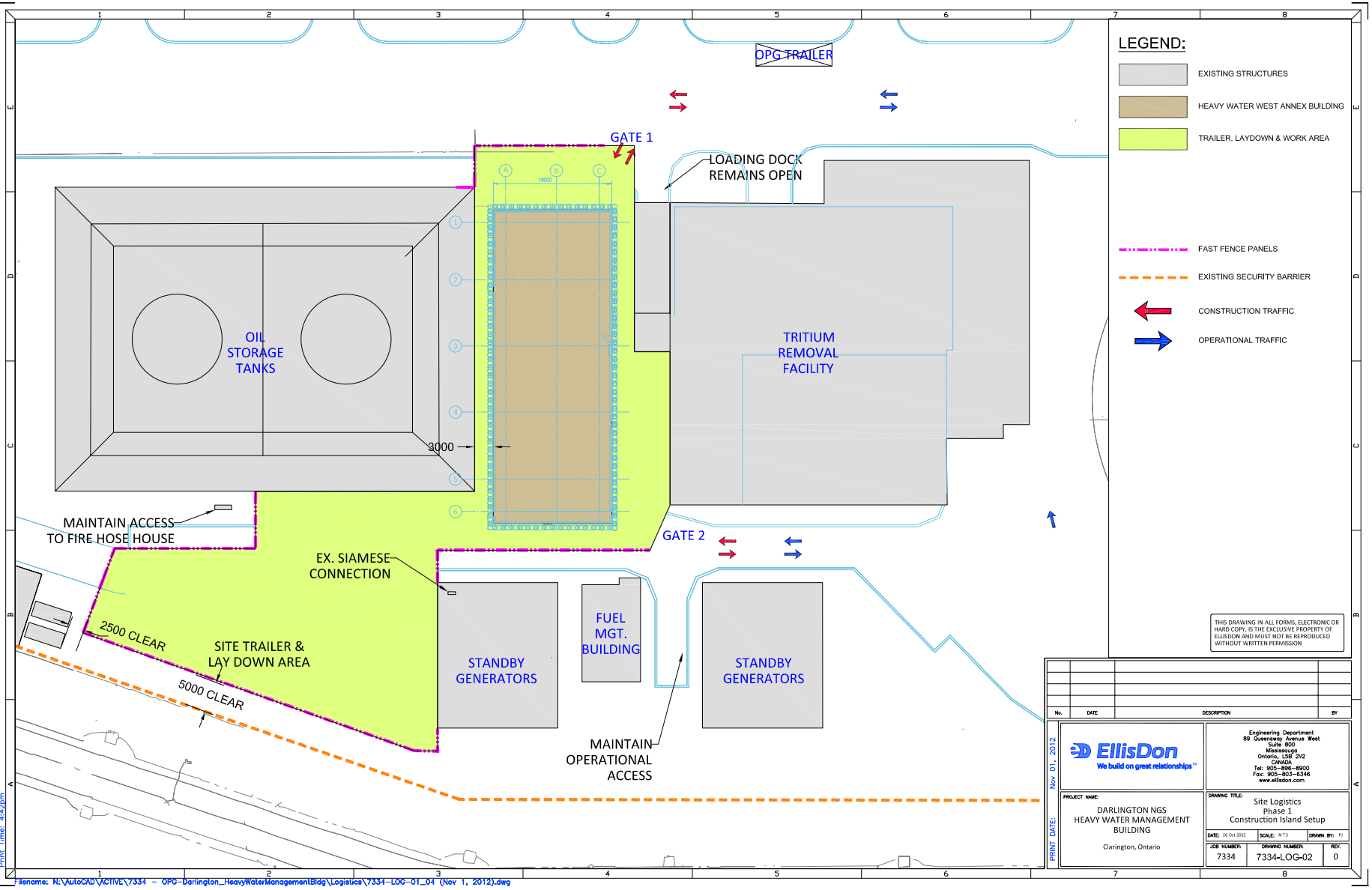
21-Mar-2013

BEHAVIOURS

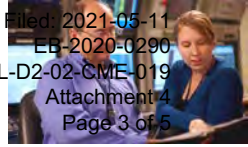
- Integrate & Collaborate
- Think Top & Bottom Line
- Simplify It
- Say It. Do It
- Tell It As It Is

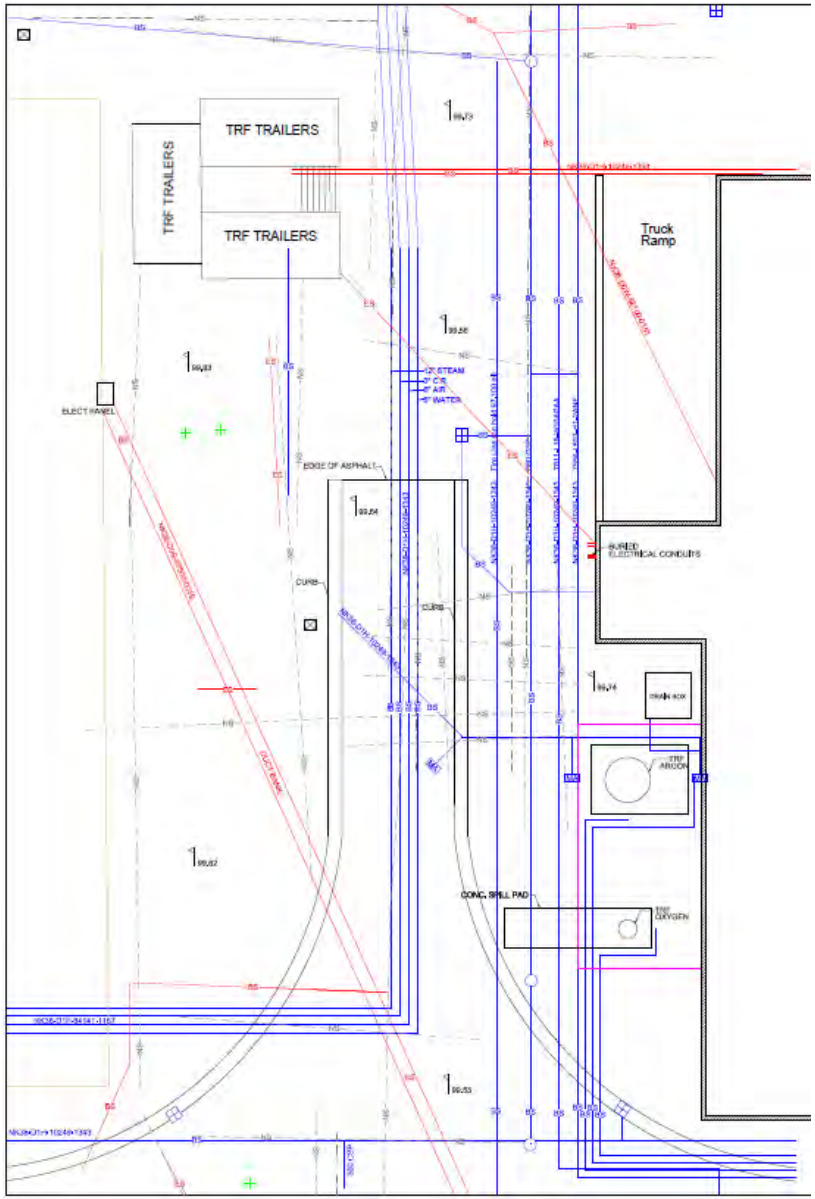


Location of new Facility and Laydown Areas (Approved via Campus Plan)



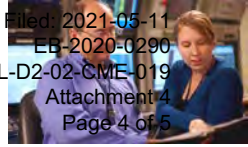
Site Changes due to Project





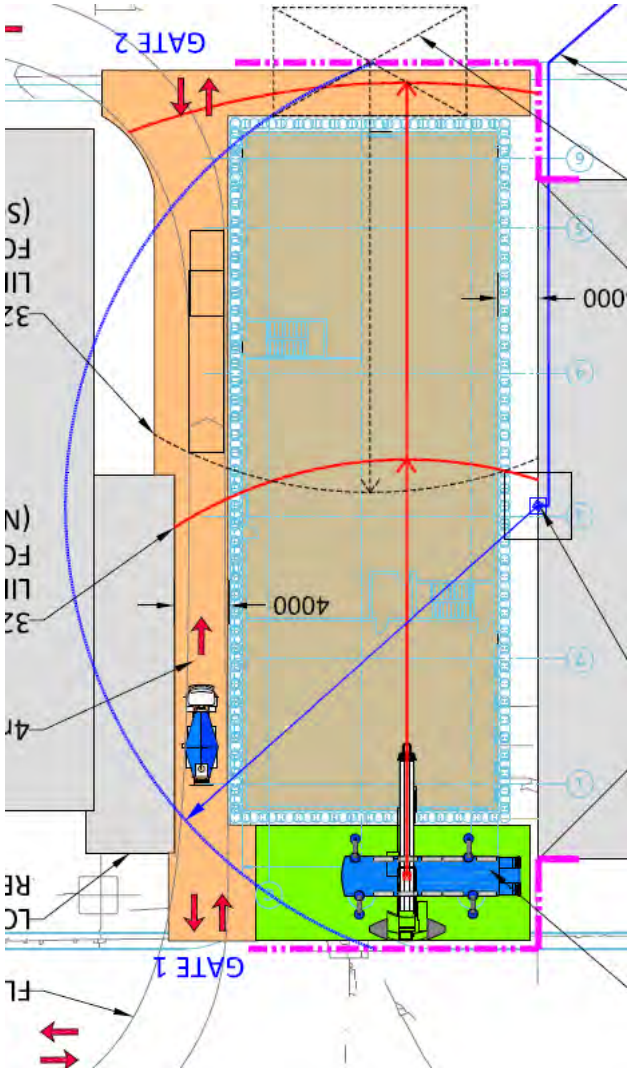
- Many existing and buried services present in new building footprint that will be removal/relocated over next 6 months during Site Preparation Phase
  - TRF Office Trailers (Removal Complete)
  - Standby Generator Cable Duct Bank
  - 6” Underground Air Line
  - Fire Protection Line
  - 12” and 3” condensate lines
  - 8” water line
  - Inactive drainage line
  - Yard Drainage
  - Argon & oxygen tanks
  - 30” Low Pressure Service Water (LPSW) Line
    - Final service to be removed, during fall 2013 TRF outage

Current Status and Future Equipment Laydown



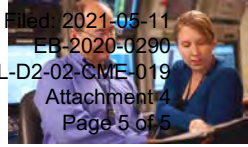
Current Status

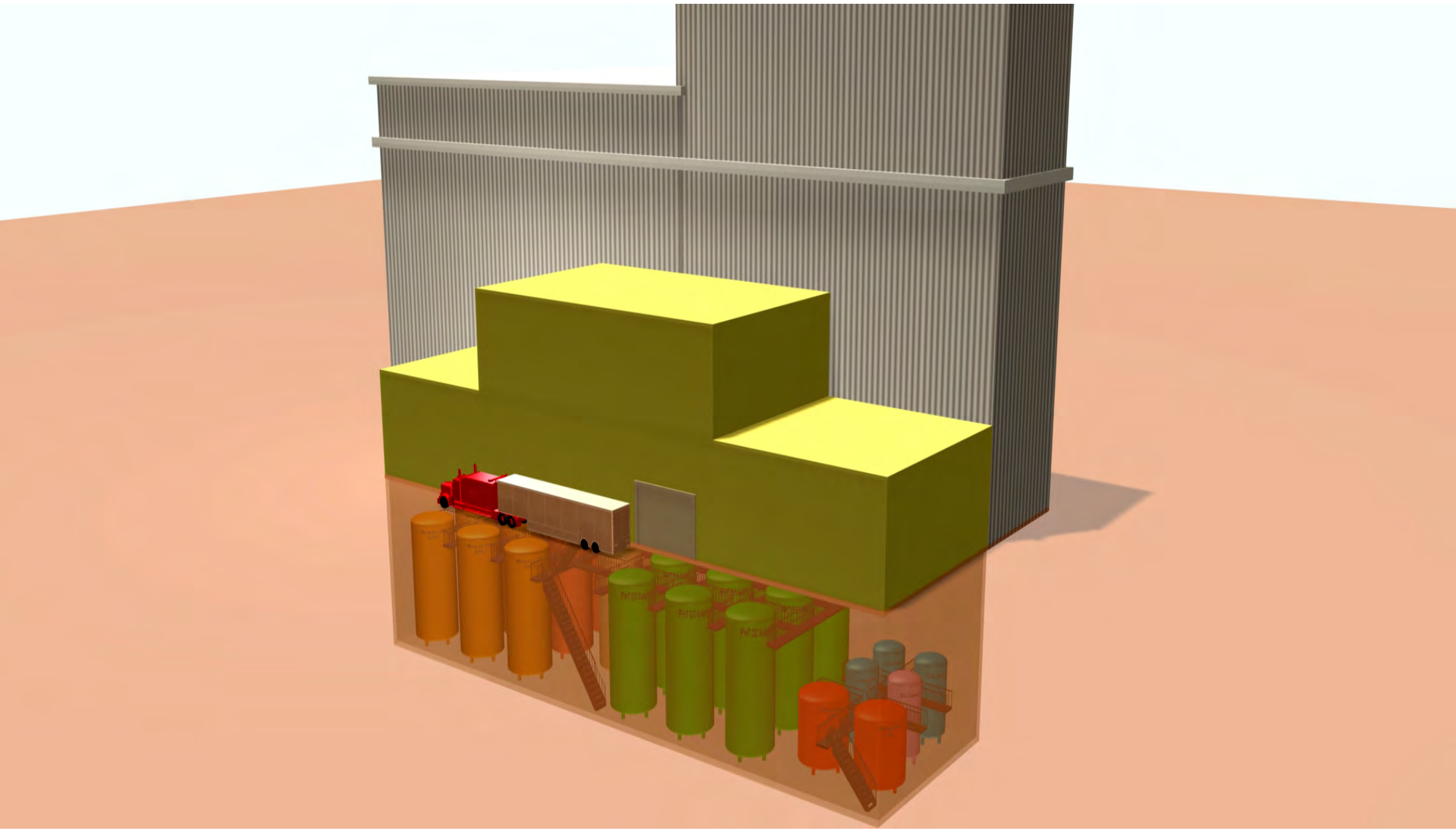
- Currently TRF Office Trailers have been removed and bore hole monitoring underway
- Buried and existing services will then be addressed
- Followed by Caisson installation, foundation pouring, and tank placement prior to completion of process systems and superstructure



Future Equipment Laydown

Approximation of Final Product





Note: Existing truck dock will now remain in its current position adjacent to TRF Facility

Filed: 2021-05-11
EB-2020-0290
Exhibit L-D2-02-CME-019
Attachment 5
Page 1 of 20

Project 16-31555 D_2O Storage and Drum Handling Facility

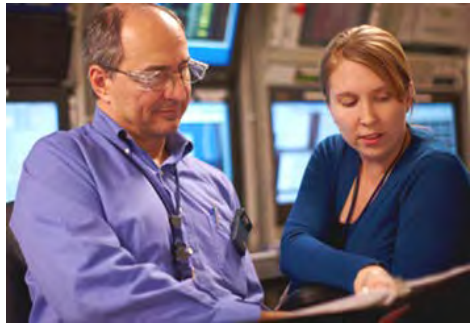
Team D_2O Update

Presented by: Usman Siddiqi, Project MTL

June 12, 2013

BEHAVIOURS

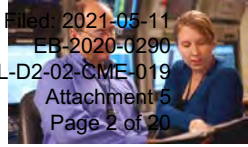
- Integrate & Collaborate
- Think Top & Bottom Line
- Simplify It
- Say It. Do It
- Tell It As It Is



PEOPLE POWERING THE FUTURE OPG NUCLEAR

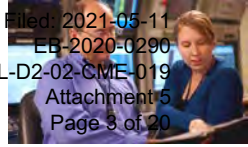
ONTARIO POWER GENERATION

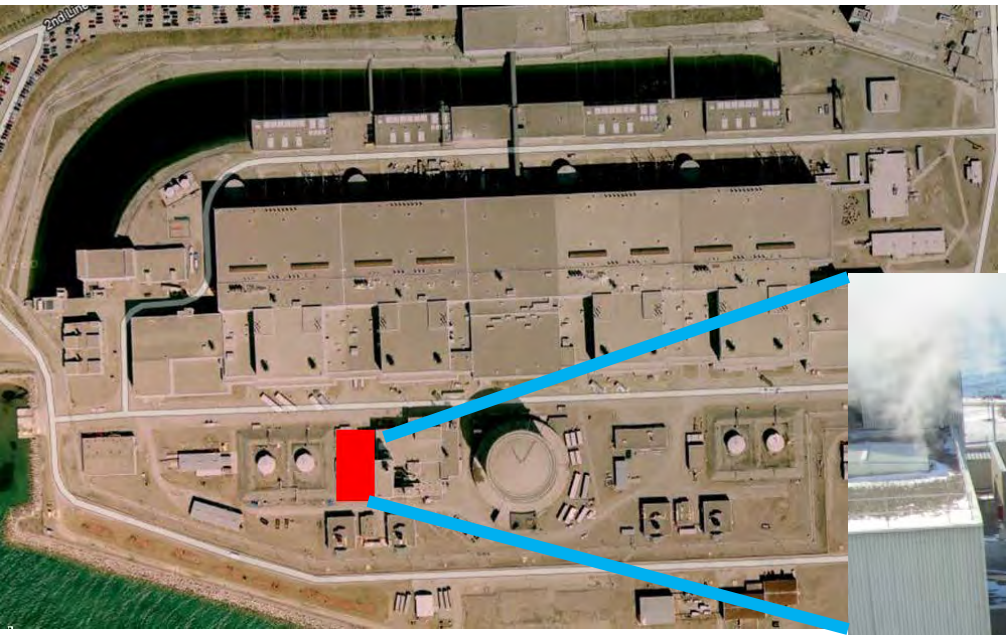
Agenda



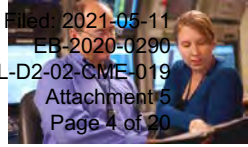
- Intro to the project
- Project Scope
- EPC Contract Overview
- Current status of work
- Work in near future
- Key Issues/Risks
- Conclusion

Project Site





Business Need

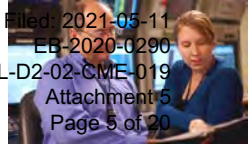


Project has two mandates. They are:

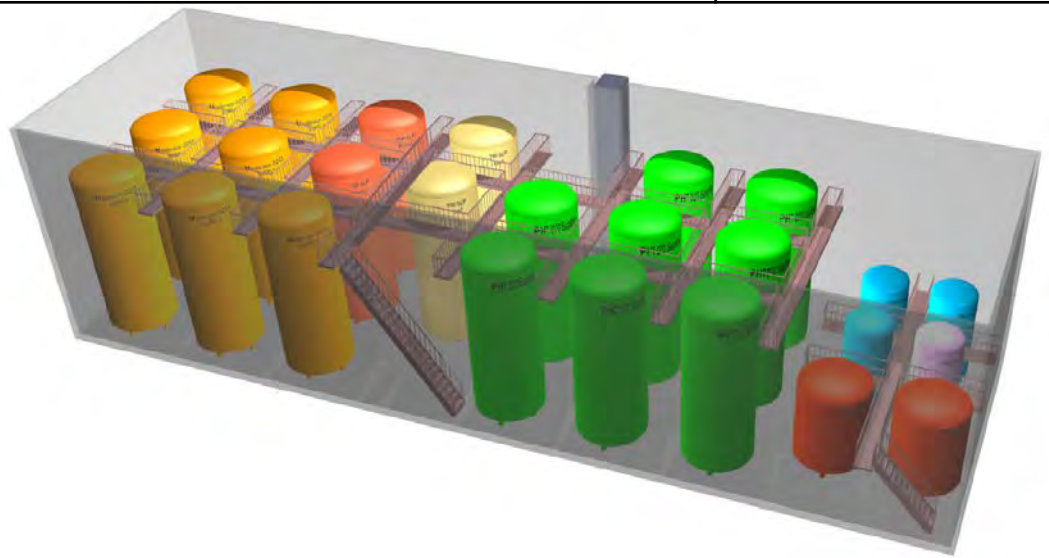
1. Support Refurbishment
   - 1,500 m^3 of storage to support draining of two units simultaneously
   - 200 m^3 of storage to facilitate flushing and other support operations associated with the preparation of the Darlington units
   - Meet Refurbishment Environmental Assessment requirements (for example, not net increase to site tritium emissions compared to current operations)
   - 21 tanks in total

2. Support on-going station and TRF operational improvements
   - 400 m^3 of storage to support TRF feed and product requirements
   - Drum handling, cleaning, and storage facility to support fleet drum reductions
   - Consolidated office space
   - 4 tanks in total

D_2O Storage Tanks



Purpose	Volume
Moderator System	700 m^3
Heat Transport System and Auxiliaries	800 m^3
Downgraded D_2O	200 m^3
Moderator System, TRF Feed, SUP Product	200 m^3
Heat Transport System and Auxiliaries, TRF Product	200 m^3
Total	2100 m^3



Project Scope – Basement

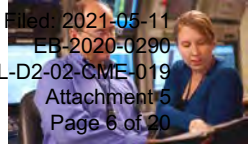


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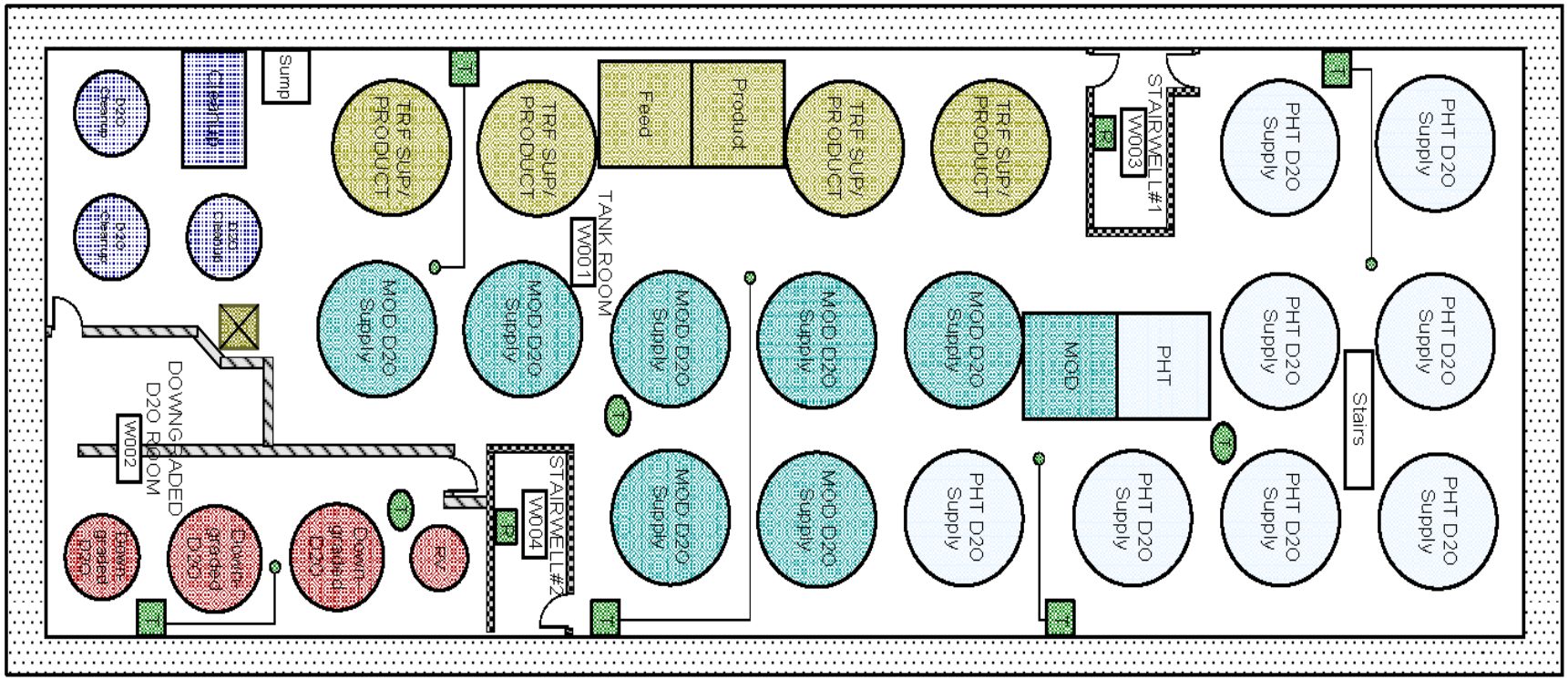
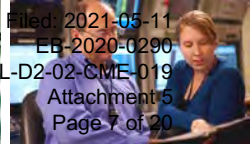
Exhibit L-D2-02-CME-019
Attachment 5
Page 6 of 20



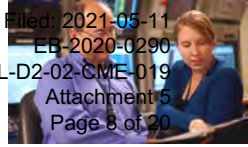
- 8 Class 6 tanks for PHT storage.
- 7 Class 3 tanks for Moderator storage.
- 4 Class 3 TRF feed/product tanks.
- 3 Class 3 downgraded storage tanks.
- 3 Class 3 D_2O cleanup system storage tanks.
- 12 pumps in total to support water movements & redundancy.
- Seismically qualified dike to contain inventory in the event of DBA.

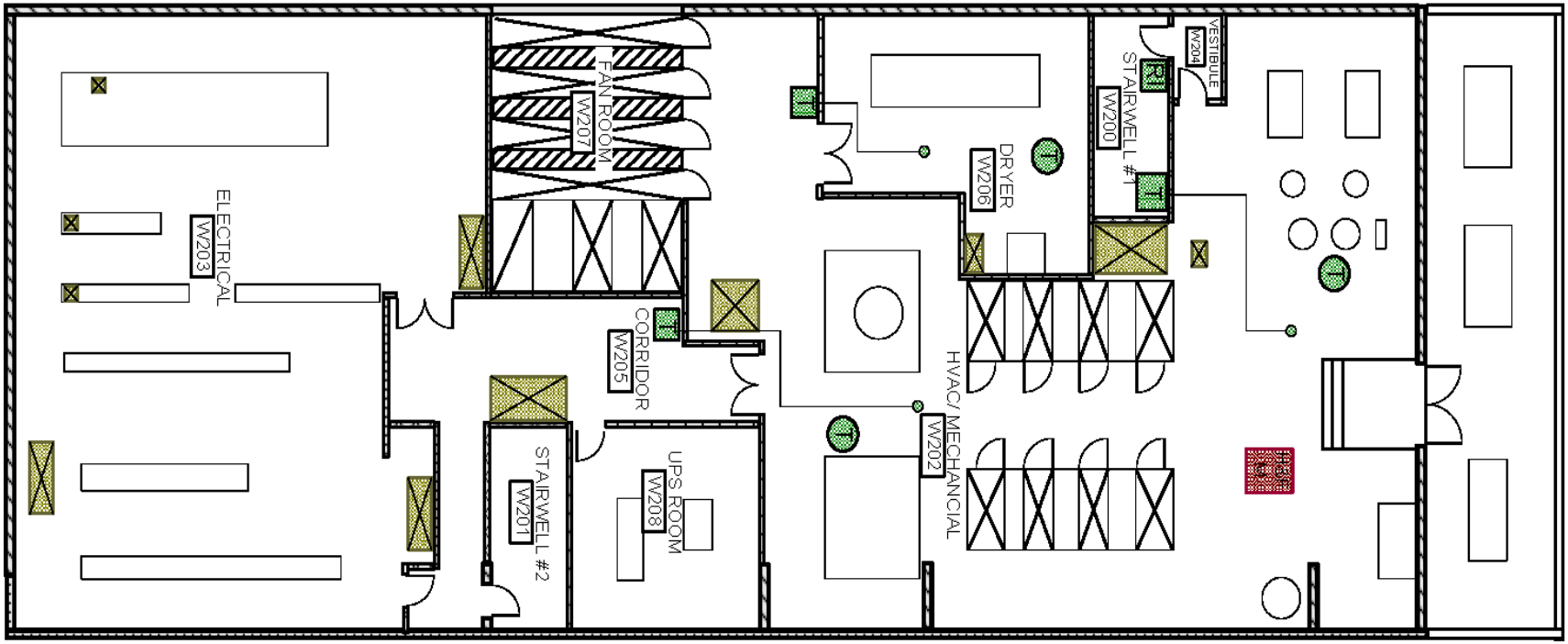
Project Scope – Main Floor



- Zone 2 office space for 9 staff, and 1 conference room.
- Low gamma drum storage area for 225 drums.
- High gamma drum storage area with shielding wall for 75 drums.
- Drum cleaning and testing facility.
- Causeway access/link to existing facility.
- Radiological monitoring to allow movement between zones.

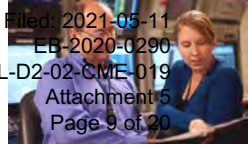
Project Scope – Second Floor

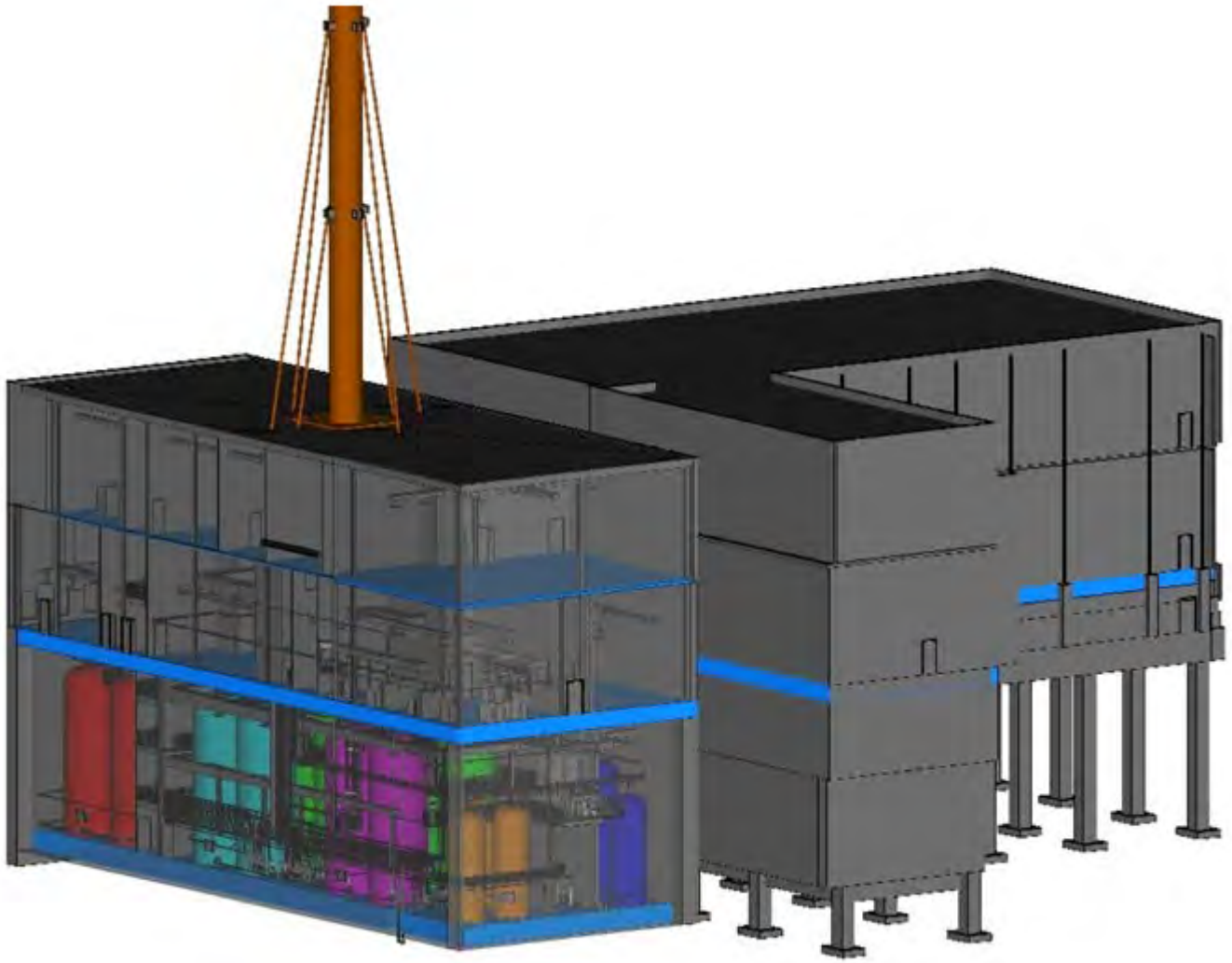




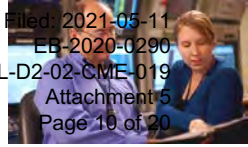
- D_2O Vapour Recovery dryer system to meet 50 Ci/year emission target.
- HVAC equipment for main building & drum handling area.
- HVAC equipment for office space.
- Emergency heating equipment to keep D_2O above 10°C.
- Main electrical room.
- Uninterruptable power supply room.

3D Model



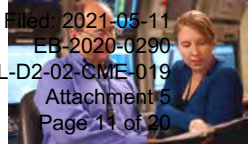


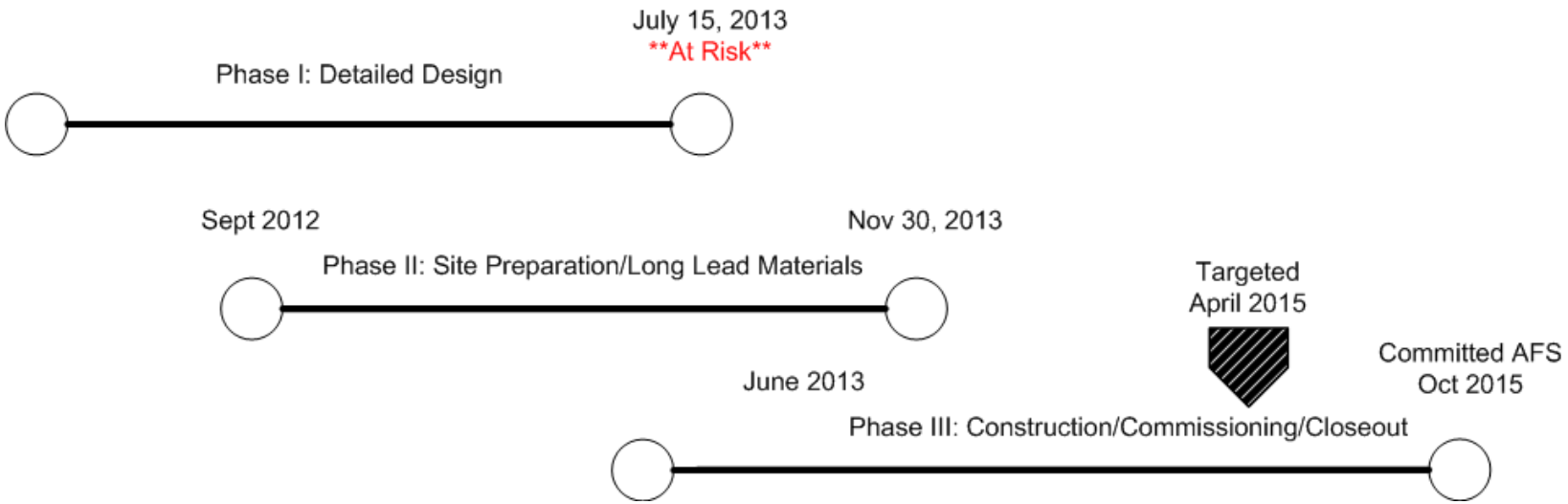
Contracting Strategy



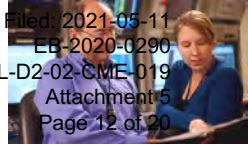
- ES-MSA contract for EPC is being utilized
- OPG is owner & constructor under OH&SA.
- Phase I/II of the EPC contract has been awarded to Black and MacDonald as the prime - Tier 1 subcontractors include RCMT and EllisDon
- Phased EPC Contract release as follows:
  - Phase I: Detailed Design (*currently released and underway*).
  - Phase II: Site Preparation/Construction Planning/Long Lead Materials ordered (*currently released and underway*).
  - Phase III: Completion of Excavation/Construction/Commissioning/ Close-out (BCS Release approved by Board of Directors)

EPC Contract Phase Summary





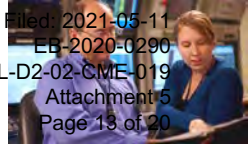
Status of Work – Phase I



What have we achieved so far?

- Award of Phase I and II of EPC contract is complete
- Project Oversight Plan Issued
- Modification Planning is Complete
  - Design Requirements – 3 MDRs are Complete
  - Modification Outlines – 5 Mod Outlines are Complete
  - All (6) Long Lead Material Technical Specifications – Complete
- Detailed Design is in progress
  - 15 design packages out of the 80 for the project have been accepted
  - 12 design packages are in the review cycle with OPG
  - COMS (preliminary & detailed design) completed for 58 ECs

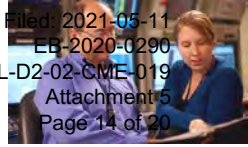
Status of Work – Phase II



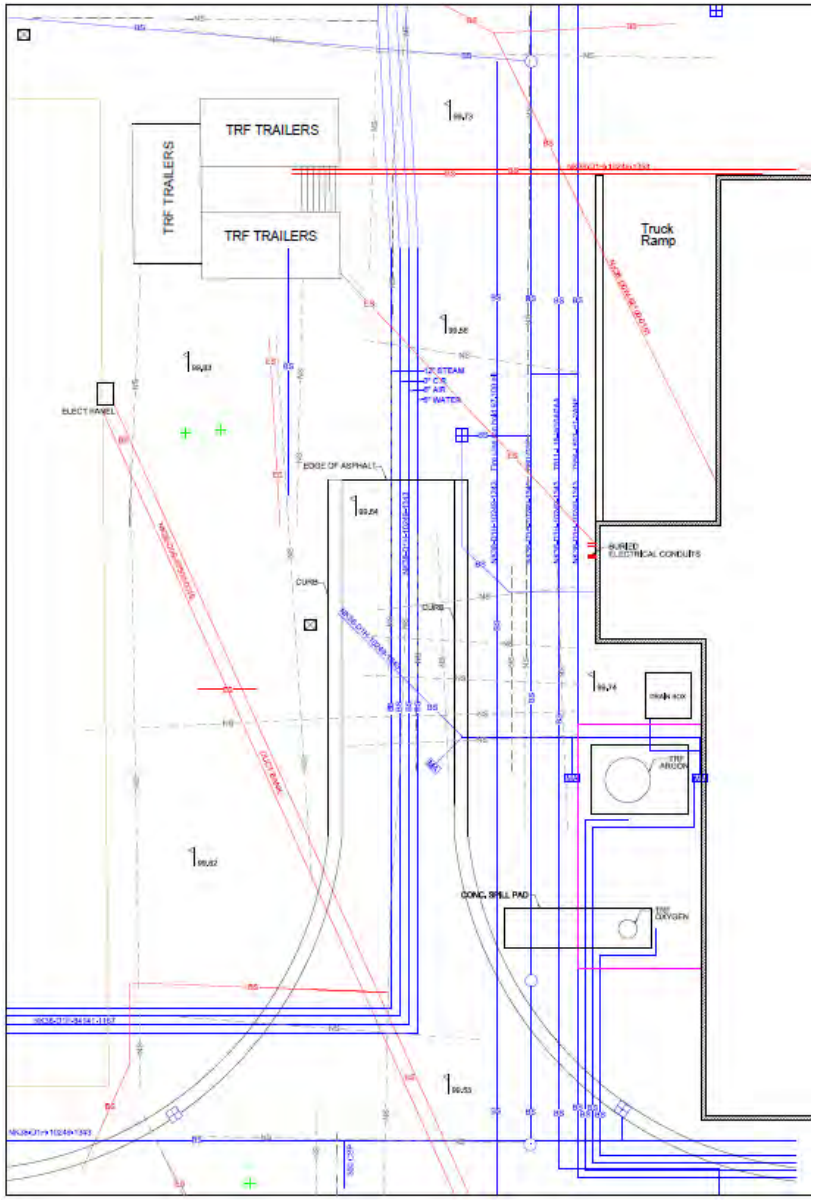
What have we achieved so far?

- Purchase order issued for all key long lead equipment
  - Babcock & Wilcox has PO for all tanks and heat exchangers for portion of vapour recovery system
  - All long lead equipment for TRF outage have been ordered
- Site Preparation is underway
  - TRF Trailers have been removed from site
  - In-situ soil and groundwater sampling has been completed
  - Daylighting to expose buried services and building perimeter - 60% complete
- Work planning/assessing for remaining site preparation activities currently in progress

Project Site today

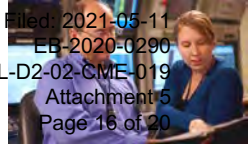


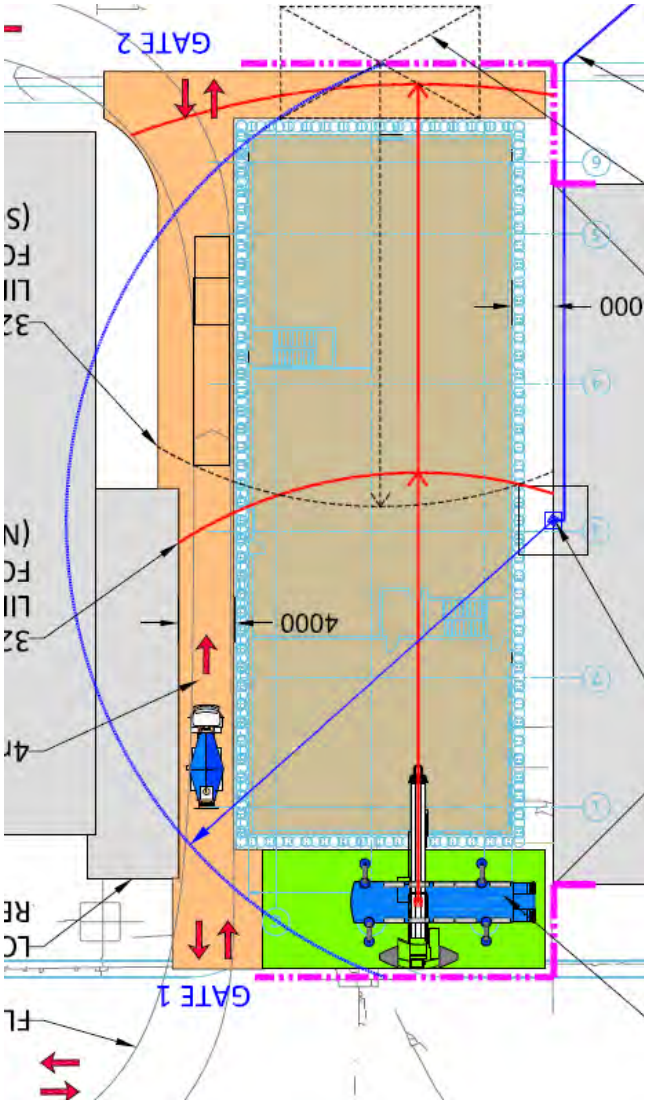
Work in near future – Q3 2013



- TRF Office Trailers (Removal Complete)
- Standby Generator Cable Duct Bank
- Argon & oxygen tanks
- Fire Protection Line
- Four abandoned miscellaneous services lines (water, air, steam & condensate)
- Inactive drainage line
- Yard Drainage
- 30” Low Pressure Service Water (LPSW) Line
  - Final service to be removed, during fall 2013 TRF outage
- Tie-ins for process piping to TRF/HWMB systems during T1301

Work in near future – Q4 2013



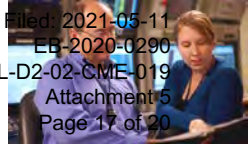


- Limits groundwater ingress
- Acts as form work for seismically qualified dyke

- ~ 18,000 m^3 of soil to be removed from protected area

- Continuous concrete pour for floor slab, foundation wall, &100 m elevation floor pour. (2014)

Key Issues – Soil/groundwater Disposal



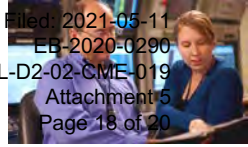
Issue:

2009 IWST spill contaminated the groundwater with tritium. The soil is sitting in this contaminated groundwater, and therefore is also contaminated. Potential for longer term commitment to aerate this soil in order to reduce level of contamination.

What is project doing about it?

- In-situ sampling was completed to characterize the contamination.
- Box drain pump out targeted to start by July 1 to flush contaminated water away from excavation area
- Agreement in principal has been reached to store soil temporarily on New Build lay down area to allow soil to dry (leading to eventual conventional disposal at better cost to OPG)

Key Issues – Vehicle Access to Site



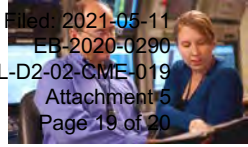
Issue:

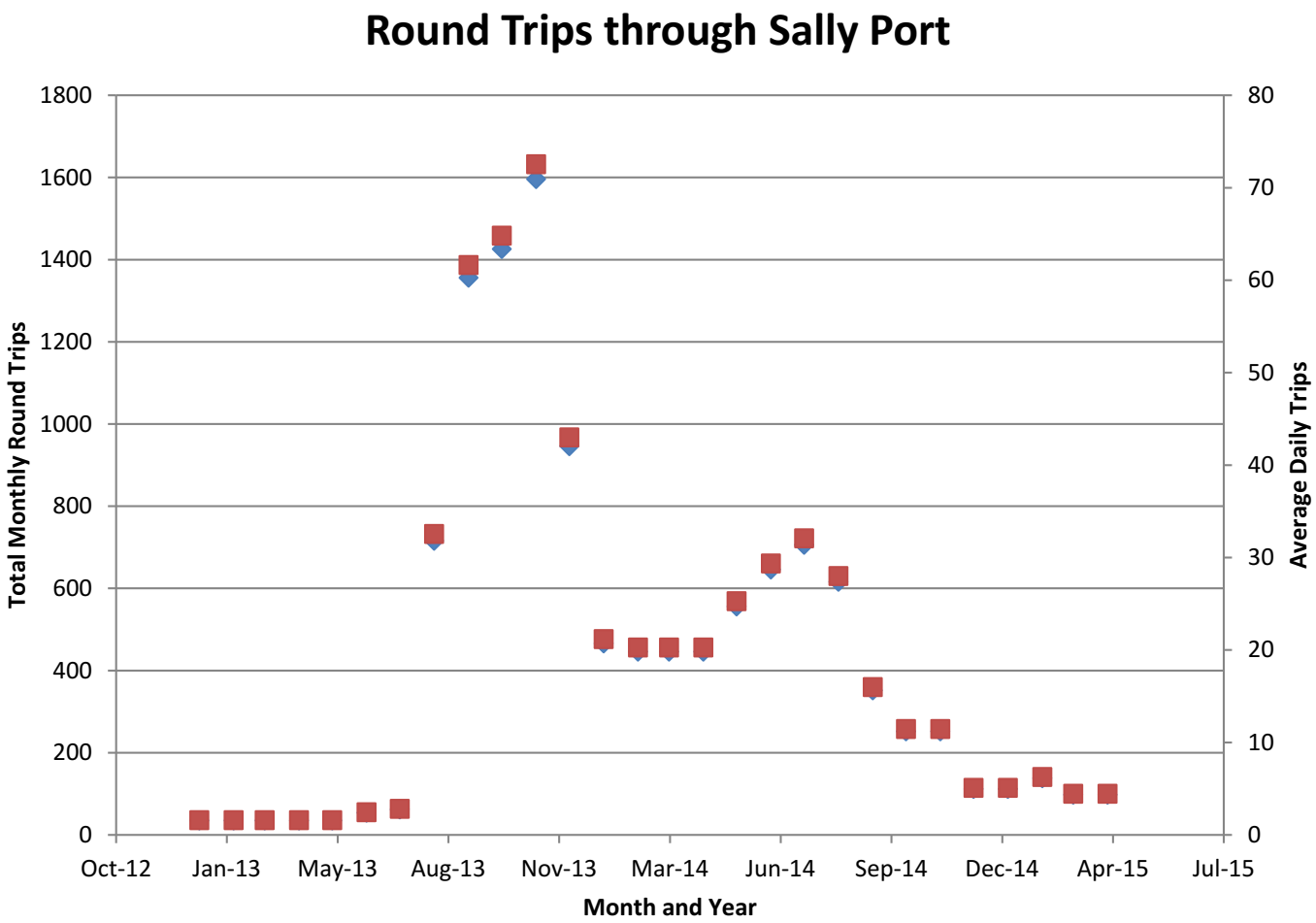
Current sally port does not have sufficient vehicle throughput capacity to meet needs of D_2O project in addition to other project work, outages, and routine plant operations. Significant risk to project cost and schedule if vendor is delayed accessing the site.

What is the project doing about it?

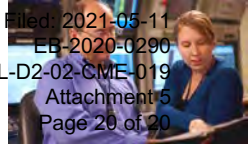
Project is working with campus plan and refurbishment to establish new project to increase sally port through put capacity

Key Issues – Vehicle Access to Site





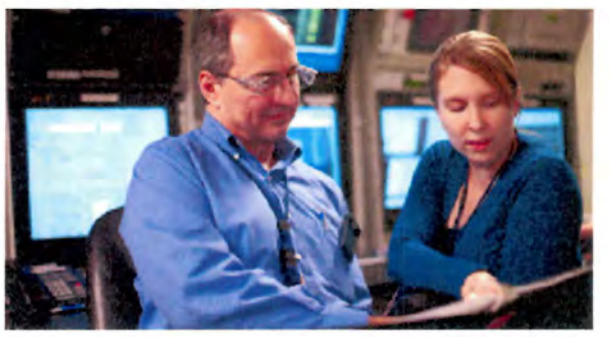
Questions?



D2O Project Update
September 11, 2013

Presented by Julian Read, OPG Project Manager

BEHAVIOURS
- Say It, Do It
- Simplify It
- Think Top and Bottom Line



VALUES • SAFETY • INTEGRITY • EXCELLENCE • PEOPLE & CITIZENSHIP •

PEOPLE POWERING THE FUTURE
OPG NUCLEAR

ONTARIO POWER GENERATION

Achievements this week

- SG Cable TMOD installed (AFS TCD Sep 12)
- Temporary Argon trailer venting completed successfully
- Argon tank venting completed successfully
- LPSW Shoring 37% Complete (as of Tuesday morning)
- LPSW prefab approximately 90% complete
- Approval to vibrate shoring remaining 10 feet granted

- 5 DEC revisions accepted & 2 DP revisions accepted

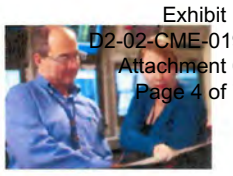
- Vehicle Screening Facility PO Issued to B&M (AFS TCD 31Jan14) – working to expedite project

Help needed

- Scope injections coming soon:
  - Yard drain/Inactive drain modification to line by WW37 (Ops for work protection)
  - Fire protection isolation at powerhouse and cutting line to SG building by WW37 (Ops for work protection)
  - Fire protection isolation at TRF and connection to Siamese connection to supply SG building by WW37 (Ops for work protection)

  - Pre-authorization or phone in work authorization
  - Work plan review/comment/disposition assistance from stakeholders

Materials Status - FYI



DEC	Title	Total EC Cat Id's*	Cat-Id's Outstanding*	PO Still Required*	Construction Need Date**
120404	Relocation of LPSW Line	7	0	0	15-Aug
122210	Relocation of Argon Tank	46	4	1	22-Aug
120670	Relocation of Argon Tanks & Oxy Tanks & Helium Conduit	41	1	1	06-Sep
120400	TMOD for Yard Drainage Temp Provision	55	11	0	12-Sep
121579	Tie-in between Inactive Plant Drainage	10	4	0	10-Oct
120341	Relocating the Underground Inactive Drainage Line	22	1	0	06-Sep
122222	TMOD for relocation of Underground Fuel Pump House#1 FP line	24	0	0	18-Sep
120369	Removal of the Underground Misc. Fire Protection Line	0	0	0	21-Sep
122212	Relocating Oxygen Tank and Underground Line	18	1	1	12-Oct
120415	TMOD for SG cable duct relocation	8	0	0	24-Aug
120719	Tie-in to exist TRF&D2O Mgmt Building Steam & Condensate	36	15	7	21-Sep
120448	Tie-in to TRF Feed & Product	17	8	2	21-Sep
120406	Tie-in to Tritium Removal Facility	27	16	5	10-Oct
123123	Dewatering Piping	13	13	2	24-Aug
	TOTALS	**324**	**74**	**19**	

* Data from Material Status Sheet received Sep 10, 2013

** Construction need date as referenced on Level 1 rev 6 schedule received September 6, 2013.

Project#31555 - D2O Storage Project Recovery Plan - Workplan Reviews DATA AS OF: Tuesday September 3 2013

WPL#	EC/ActivityTitle	Disp	Design EC# (Status/Forecast Acceptance Date)	Workplan #	Workplan Owner	Workplan Submitted for Review	OPG Reviewers (Name/Dept)	Workplan Reviewer Notes	OPG Review & Comments Due	Workplan Approved	Workplan review Notes/Comments
Pre-reqs for LPSW Relocation work during T1301											
20	TMOD DEC for yard drainage temporary provision	C	120400 (Approved)	NK38-WPL-15200-0453544	M. Truong	23-May-13	Greg Lindsay (Field Engineering Mech) Noel Naval (U0 Ops) Andrew Gaskin (DRE) Helena Ha (Refurb Environment) Richard Wolter (Conventional Safety)	Complete - No issues Changed to Catherine Brown (FSOS Ops) from Esther Carlton Review complete - Comments to be addressed by RCMT Review complete - Comments to be addressed by RCMT Complete - No issues	~~27-May-13~~ ~~31-May-13~~ 6-Jun-13	~~29-May-13~~ ~~14-Jun-13~~ ~~26-Jun-13~~ ~~12-Jul-13~~ ~~23-Jul-13~~ ~~30-Jul-13~~ ~~16-Aug-13~~	On route for OPG Signatures 23-Jul-13 Workplan completely signed 30-Jul-13 FICRs 06-Aug-13 Revised Workplan on route for final signature **13-Aug-13** WPL signed approved August 15, 20-Aug-13 **Revision to WPL needed, being discussed if intent change or not 10 Sept-13**
21	DEC for relocating the underground inactive drainage line 7911-W6APAB (Roof Drain)	M	120341 (Approved)	NK38-WPL-79110-0458074	A. Marshman	10-May-13	Nicole Go/Thomas Wong (TRF Technical) Greg Lindsay (Field Engineering Mech) Noel Naval (U0 Ops) Susan Luxton (CMO) Helena Ha (Refurb Environment)		28-May-13	~~20-Jun-13~~ ~~25-Jun-13~~ ~~11-Jul-13~~ ~~1-Aug-13~~ ~~7-Aug-13~~ ~~14-Aug-13~~ ~~28-Aug-13~~ ~~13-Sept-13~~ 20-Sept-13	CDF process, all dispositions accepted with notes. RCMT to make final revisions **23-Jul-13** **Received new revision of workplan with missing TRF comment dispositions resolved, requires TRF review of disposition; out for final signature 30-Jul-13** Workplan writer resources limited to address work in multiple workplans with the same TCD ie. LPSW Drain, LPSW MOD, Inactive Drainage **Relocate are all due on Aug 7 and have the same author. Focus were made on less priority workplan ie LPSWs vs. Inactive Drainage Relocate. 06-Aug-13** **Workplan received additional comments from OPG 13-Aug-13** **There are outstanding comments that still requires dispositions. Will be resolved August 20 2013, 20-Aug-13** **On Track, waiting for TRF comments to be dispositioned, 26-Aug-13** **Final comments have been incorporated, with B&M for final signatures 03-Sept-13** **Meeting 11:00 am Sept 10 to make sure all comments were incorporated properly 10-Sept-13**
90	DEC for relocation of the Argon tank & Line 7555-L901-A 1 1/2 ATC Relocate of theArgon Tanks & Oxy Tanks & Hel. Conduit	M/C I	122210 (Accepted) 120670 (Accepted)	NK38-WPL-75550-0465092	G. Parker	~~13-Jun-13~~ ~~20-Jun-13~~ ~~28-Jun-13~~ ~~9-Jul-13~~ 15-Jul-13	Aaron Gaudon (TRF Maintenance) Glen Barton TRF Ops Nicole Go/Thomas Wong (TRF Technical) Helena Ha (Refurb Environment) Usman Siddiqi (OPG Projects)	 Meeting 30-Jul-13 	~~22-Jun-13~~ ~~28-Jun-13~~ ~~8-Jul-13~~ ~~16-Jul-13~~ ~~24-Jul-13~~ 31-Jul-13	~~27-Jun-13~~ ~~5-Jul-13~~ ~~12-Jul-13~~ ~~22-Jul-13~~ ~~29-Jul-13~~ 2-Aug-13	Workplan issuance delayed due to delay in EC acceptance Currently in CDS Process cycle. Review process being put on hold while revisions are being made. 23-Jul-13 TRF still reviewing dispositioned comments, metting with RCMT **30-Jul-13** Installation of concrete pad will be executed as scheduled **30-Jul-13** **Argon Tank Relocate WPL Accepted 06-Aug-13**
18	TMOD DEC for temporary removal of the underground fuel pump house #1 fire protection line	M	122222 (Accepted)	NK38-WPL-78110-0465131	A. Wiseman	~~20-Jun-13~~ ~~12-Jul-13~~ ~~3-Jul-13~~ ~~24-Jul-13~~ 5-Aug-13	Darryll Styles (SERM) Jeff Ezard(OPG Projects) Noel Naval (OPS) Helena Ha (Refurb Environmental) Nicole Go/Thomas Wong (TRF Technical) Susan Luxton (CMO) Harmhinder Luthra SRE Fire Protection		~~27-Jun-13~~ ~~19-Jul-13~~ ~~10-Jul-13~~ ~~31-Jul-13~~ ~~7-Aug-13~~ ~~14-Aug-13~~ 23-Aug-13	~~2-Jul-13~~ ~~26-Jul-13~~ ~~16-Jul-13~~ ~~7-Aug-13~~ ~~16-Aug-13~~ ~~30-Aug-13~~ 13-Sept-13	Draft Electronic Copy sent . Workplan is ready for OPG Review. Workplan Received by BM. Accepted with comments and sent to OPG for review July 23 2013. Draft copy has been sent to reviewers; this copy will have similar contents with final copy that will be distributed for review; minor changes are being made to the front cover sheet and will be sent to OPG when completed 30-Jul-13 WPL stil in review stage 06-Aug-13 All comments received with exception of TRF Ops and PCC OPS SPOC; these are expected end of day 13-Aug-13 Meeting scheduled August 20 2013 to received and disposition additional comments 20-Aug-13 Revisions being made by RCMT, to be sent to B&M/OPG 6-Sept-13 for accepting dispositions and final signatures 3-Sept-13 **Routing for Final Signatures 10-Sept-13**
	LPSW De-Watering		123123	NK38-WPL-72100-0465378	R.Luck	18-Jul-13	Jeff Ezard (OPG Projects) Nicole Go/Thomas Wong (TRF Technical) James Cleary (LPSW SRE) Helena Ha (Refurb Environment) Tom Fennel (Conventional Safety) Noel Naval (OPS) Susan Luxton (CMO) Darryll Styles (SERM)		1-Aug-13	~~8-Aug-13~~ ~~14-Aug-13~~ 23-Aug-13	Workplan with OPG in review process 23-Jul-2013 No DEC prepared, WPL refers to DEC, some reviewers need to see this 30-Jul-13 EC TCD accepted date Auguest 12 06-Aug-13 Preliminary review completed, Final review to follow EC package release 2-Aug-13 EC expected to be accepted today 13-Aug-13 Signing party scheduled on August 21 2013, 20-Aug-13 **WPL signed and Approved August 21 2013, 26-Aug-13**
	Argon Commisioning		122210	TBD	G. Parker	20-Sep-13	Jeff Ezard (OPG Projects) Nicole Go/Thomas Wong (TRF Technical) Helena Ha (Refurb Environment) Glen Barton TRF Ops Aaron Gaudon (TRF Maintenance)		27-Sep-13	9-Oct-13	Commisioning excluded from original WPL to expedite process, WPL being created 6-Aug-2013 ~~Waiting initial comments from OPG 13-Aug-13~~ **Waiting for Workplan to be submitted for review, 26-Aug-13**
	LPSW Excavation		N/A	NK38-WPL-72100-0466745	R.Luck	31-Jul-13	Jeff Ezard (OPG Projects) Andrew Gaskin (DRE) Heather Rambukkana (Refurb Environment) Barb Allan (Conventional Safety) Noel Naval (OPS) Ted O'Rouke (CMO)	 Review on hold until issue with revised LPSW DEC is accepted 	~~7-Aug-13~~ 23-Aug-13	16-Aug-13	Review process underway 6-Aug-13 Waiting for approved EC to be revised, expected to be completed August 20 2013, 20-Aug-13 **WPL signed and Approved August 21 2013, 26-Aug-13**
	Big Dig Excavation/ De-Watering		N/A	NK38-WPL-72100-0473325	R.Luck	30-Sep-13	Jeff Ezard (OPG Projects) Andrew Gaskin (DRE) Helena Ha (Refurb Environment) Barb Allan (Conventional Safety) Noel Naval (OPS) Susan Luxton (CMO)		6-Oct-13	13-Oct-13	**Waiting WPL submission 10-Sept-13**
T1301 Tie-Ins											
25	DEC for Relocation of LPSW Line 7210-L921-W30A	M	120404 (Approved)	NK38-WPL-72100-0464036 (LPSW MOD)	G. Parker	~~27-May-13~~ 28-May-13	Greg Lindsay (Field Engineering Mech) Noel Naval (U0 Ops) Glen Barton (TRF Ops) Nicole Go/Thomas Wong (TRF Technical) James Cleary (LPSW SRE) Helena Ha (Refurb Environment) Darryll Styles (SERM) Richard Wolter (Conventional Safety)	CDF updated Changed to Catherine Brown (FSOS Ops) CDF updated CDF updated SRE Away on vacation - Julia Petre (SM) reviewed and comments submitted CDF updated Review in progress CDF updated	~~29-May-13~~ ~~3-Jun-13~~ 7-Jun-13	~~31-May-13~~ ~~5-Jun-13~~ ~~14-Jun-13~~ ~~26-Jun-13~~ ~~26-Jul-13~~ ~~7-Aug-13~~ 16-Aug-13	* Reactor Safety review not required * Workplans distributed to all stakeholders on 28th May * Workplan review meeting completed on Monday 3rd June to review workplan with stakeholders and answer any questions * TCD for OPG reviews extended to allow more time for workplan reviews * U0 Operations review completed by David Macdiarmid - 4th Jun **2013** * Complete C&D to be sent back on 5-Jun-13 Final revisions made, en route to B&M for signature. 22-Jul-2013 With OPG for signatures 30-Jul-13 Final revisions made, en route to B&M for signature. 22-Jul-2013 Signature progressing received 7 signatures from 10 reviewers 30-Jul-13
							Greg Lindsay (Field Engineering Mech) Noel Naval (U0 Ops) Glen Barton (TRF Ops)	CDF updated Changed to Catherine Brown (FSOS Ops) CDF updated			

Project#31555 - D2O Storage Project Recovery Plan - Workplan Reviews DATA AS OF: Tuesday September 3 2013

WPL#	EC/ActivityTitle	Disp	Design EC# (Status/Forecast Acceptance Date)	Workplan #	Workplan Owner	Workplan Submitted for Review	OPG Reviewers (Name/Dept)	Workplan Reviewer Notes	OPG Review & Comments Due	Workplan Approved	Workplan review Notes/Comments
			(Approved)	NK38-WPL-72100-0462898 (LPSW Drain)	G. Parker	~~27-May-13~~ 28-May-13	Nicole Go/Thomas Wong (TRF Technical) James Cleary (LPSW SRE) Helena Ha (Refurb Environment) Darryll Styles (SERM) Richard Wolter (Conventional Safety)	CDF updated SRE Away on vacation - Julia Petre (SM) reviewed and comments submitted CDF updated Review in progress CDF updated	~~29-May-13~~ ~~3-Jun-13~~ 7-Jun-13	~~31-May-13~~ ~~6-Jun-13~~ ~~14-Jun-13~~ ~~26-Jun-13~~ ~~26-Jul-13~~ ~~7-Aug-13~~ 16-Aug-13	U0 OPS, TRF, SM and DOM Signatures remaining 06-Aug-13 Shift Manager and DOM has both workplan for final signature 13-Aug-13 **WPL signed approved August 14, 20-Aug-13**
36-1	DEC for Tie-in to TRF Feed and Product	M	120448 (Accepted)	NK38-WPL-39340-0458036	L. Saldanha	~~3-Jun-13~~ ~~4-Jul-13~~ ~~28-Jun-13~~ ~~11-Jul-13~~ ~~30-Jul-13~~ ~~7-Aug-13~~ ~~23-Aug-13~~ ~~29-Aug-13~~ 10-Sept-13	Aaron Gaudon (TRF Maintenance) Jeff Ezard (OPG Projects) Glen Barton TRF Ops Nicole Go/Thomas Wong (TRF Technical) Brad Ellison (ALARA)		~~7-Jun-13~~ ~~18-Jul-13~~ ~~8-Jul-13~~ ~~18-Jul-13~~ ~~7-Aug-13~~ ~~5-Sep-13~~ 20-Sept-13	~~10-Jun-13~~ ~~25-Jul-13~~ ~~12-Jul-13~~ ~~24-Jul-13~~ ~~14-Aug-13~~ ~~13-Sep-13~~ 4-Oct-13	Delay in EC Acceptance. Decreased priority level inorder to meet deadline for relocate's review process RCM COMS/ITF Review 20-Aug-13 Waiting submittal to OPG 3-Sept-13 **Meeting at 1:30 Sept 10 to discuss WPL for submission 10-Sept-13**
38	DEC for Tie-in to TRF Outgoing and Incoming	M	120406 (Accepted)	NK38-WPL-38110-0458078	L. Saldanha	~~3-Jun-13~~ ~~26-Jun-13~~ ~~25-Jun-13~~ ~~30-Jul-13~~ ~~8-Aug-13~~ ~~23-Aug-13~~ ~~28-Aug-13~~ 6-Sept-13	Susan Luxton (CMO) Jeff Ezard (OPG Projects) Andrew Lord Brad Ellison (ALARA) Nicole Go/Thomas Wong (TRF Technical) Tom Fennel (Conventional Safety)		~~7-Jun-13~~ ~~13-Jul-13~~ ~~3-Jul-13~~ ~~12-Jul-13~~ ~~7-Aug-13~~ ~~30-Aug-13~~ 13-Sept-13	~~10-Jun-13~~ ~~20-Jul-13~~ ~~9-Jul-13~~ ~~18-Jul-13~~ ~~25-Jul-13~~ ~~14-Aug-13~~ ~~4-Sep-13~~ 27-Sept-13	Recalling WPL submission due to uncertainty in iceplug requirement which could impact workplan to change. TRF and BM are resolving this. TCD for re-submission 30-Jul-2013. Resolve ice plug and line purging issues by Aug 2nd 30-Jul-13 No Ice Plug required – WP to be updated based on new path forward with valves 20-Aug-13 **Waiting submittal to OPG 10-Sept-13**
50-1	DEC for Tie-In to Plant Drainage (Inactive Drainage)	M	121579 (Accepted)	NK38-WPL-79110-0461501	G. Parker	~~4-Jun-13~~ ~~5-Jul-13~~ ~~2-Jul-13~~ ~~15-Jul-13~~ 26-Jul-13	Noel Naval (U0 Ops) Jeff Ezard (OPG Projects) Brad Ellison (ALARA) Barb Allan (Conventional Safety) Nicole Go/Thomas Wong (TRF Technical) Helena Ha (Refurb Environment)		~~15-Jun-13~~ ~~19-Jul-13~~ ~~9-Jul-13~~ ~~22-Jul-13~~ ~~2-Aug-13~~ 6-Aug-13	~~18-Jun-13~~ ~~26-Jul-13~~ ~~15-Jul-13~~ ~~26-Jul-13~~ ~~9-Aug-13~~ ~~21-Aug-13~~ ~~27-Aug-13~~ ~~6-Sep-13~~ 13-Sept-13	Delay in EC Acceptance. Decreased priority level inorder to meet deadline for relocate's review process Workplan Received by BM. Accepted with comments and sent to OPG for review July 23 2013. 23-Jul-13 Workplan sent to OPG for Review 30-Jul-13 WPL still in review stage 06-Aug-13 Received OPG comments August 8; comments currently being dispositioned,13-Aug-13 Meeting to disposition comments on August 20 2013 rescheduled to prioritize foam fire WPL, 20-Aug-13 RCMT target to provided dispositioned workplan changed to August 29 2013, Target Sign off Date shifted as a result, 26-Aug-13 **RCMT incorporating B&M comments 10-Sept-13**
34	Tie-In design to the existing TRF&D2O Management Building Steam & Condensate	M	120719 (Accepted)	NK38-WPL-73689-0458231	L. Saldanha	~~10-Jun-13~~ ~~8-Jul-13~~ ~~3-Jul-13~~ ~~16-Jul-13~~ ~~24-Jul-13~~ 26-Jul-13	Susan Luxton (CMO) Jeff Ezard (OPG Projects) Barb Allan (Conventional Safety) Brad Ellison (ALARA) Helena Ha (Environmental) Nicole Go/Thomas Wong (TRF Technical)		~~20-Jun-13~~ ~~22-Jul-13~~ ~~10-Jul-13~~ ~~23-Jul-13~~ ~~30-Jul-13~~ 6-Aug-13	~~24-Jun-13~~ ~~29-Jul-13~~ ~~16-Jul-13~~ ~~29-Jul-13~~ ~~7-Aug-13~~ ~~12-Aug-13~~ ~~22-Aug-13~~ ~~28-Aug-13~~ ~~6-Sep-13~~ ~~13-Sept-13~~ 20-Sept-13	Delay in EC Acceptance. Decreased priority level inorder to meet deadline for relocate's review process. Workplan Received July 23 2013 for BM approval. Accepted with comments and sent to OPG for review July 23 2013. 23-Jul-13 Workplan sent to OPG for review 30-Jul-13 WPL still in review stage 06-Aug-13 Received OPG comments August 9; comments currently being dispositioned,13-Aug-13 Meeting to disposition comments on August 20 2013 rescheduled to prioritize foam fire WPL, 20-Aug-13 RCMT target to provided dispositioned workplan changed to August 29 2013, Target Sign off Date shifted as a result, 26-Aug-13 Revisions incorporated, sent to B&M by 9-Sept-13 **Meeting at 1:30 Sept 10 to discuss comments 10-Sept-13**

Notes:-
1. Workplans to be sent for OPG review once Design EC OPG DE acceptance is complete - DA release plan milestone must be signed off and Design EC statussed to APPROVED before the workplan is Issued. Hardcopies of the OPG accepted EC package would be provided to Workplan Reviewers to aid in workplan review.
2. Shift Manager Authorization (SPOC-David MacDiarmid) required on all workplans once reviews are completed by OPG Reviewers and dispositions completed by RCMT

Revision Notes:-
1. 31MAY2013 - SOIs and workplan dates changed based on review with the project team.
2. 4JUN2013 - Updates to Workplans#3, 6-9 submission dates and status of activities completed
3. 7JUN2013 - Updates to yard drainage workplan OPG review completion and TCD for RCMT disposition/workplan approval date
5. All ECs with exception to Oxygen Relocate have been accepted, this has been set to highest priority as well as the submission of its workplan. New Workplan Leader: Al Wiseman. Updated new Target dates based on the acceptance of ECs. Removed Oxygen Relocate from Outage Pre-requisite.
6. 6 workplans are in the review process, 4 workplans on route for signatures; signees are very occupied with reviewing workplans as a result they are also having difficulty reviewing comments that were dispositioned which impedes signature, and signature date commitment
7. Committed date changes, FICR discovery for Yard Drainage TMOD
8. Added new activities, committed dates changes
9. See reviewer notes/comments column

Legend	
	Complete
	On track
	Late/TCD at risk

D20 STORAGE PROJECT TIE IN / RELOCATES IN T1301

Prepared By Ray Typaz
rev 7: Sep 10, 2015

JULY (Saturday 13, 20, 27) | AUGUST (3, 10, 17, 24, 31) | SEPTEMBER (7, 14, 21, 28) | OCTOBER (5, 12, 19, 26) | NOVEMBER (2, 9, 16, 23, 30)

WW 28 | WW 29 | WW 30 | WW 31 | WW 32 | WW 33 | WW 34 | WW 35 | WW 36 | WW 37 | WW 38 | WW39 | WW 40 | WW 41 | WW 42 | WW 43 | WW 44 | WW 45 | WW 46 | WW 47 | WW 48

TRF Window for tie ins
Oct 5 to Oct 21

LPSW Relocates
- Daylight to expose conflicting piping
- Prefab new LPSW pipe
- Excavate & expose existing LPSW line and Installing Shoring
- Excavate to 20 ft
- Excavate below Lines
- Pour Mud Slab
- Run new LPSW line
- Drain LPSW
- Tie in LPSW
- Install hot taps
- Back fill LPSW trench to allow for caisson installation

Argon
- Dewater Setup
- Install brackets for Temporary Argon line west side of TRF
- Install and connect temp piping to tanker
- Remove existing tank & install on flatbed trailer & demo old foundation
- Set in place Argon supply tanker
- Replace With 2nd Tanker
- Inst Argon Piping and I&C from new tank to inside TRF
- S/d Argon, purge & remove old line Connect new Argon piping

Fire Protection
- Install new foundation for tank
- Expose 10" foam fire line
- Remove Foam fire line inside trench
- S/D syst
- Tie in Siamese conn
- Install Fire Prot line inside of LPSW trench & tie in new foam fire line

Yard Drainage
- Install pumps & drain Plug yard drainage manholes
- Run PVC line
- Remove existing yard drainage
- Install yard drainage line inside LPSW trench
- Tie into New yard drain

Inactive Drainage
- Cut hole in west wall of TRF and run pipe thru to yard drainage
- Connect yard drainage & inactive drainage

Oxygen
- Trench from LPSW Trench to existing Oxygen Tank Foundation
- Install new oxygen piping and I&C in trench
- Demo/Remove Roadway
- Install Tank foundation & pad for truck loading
- Install Piping & I&C
- Trench for new Oxygen Line
- Install Tk

Helium
- Relocate Helium Line

SG Cable T-MOD
- Install & Connect Temp cables
- Remove Existing Duct Bank & Conduit West and South Sides
- Backfill Trench for Caison installation

Inactive Drainage
- Prefab Weld & test spool pieces
- Erect Scaff
- Inst Hangers
- Inst Spool Pieces
- Remove existing line & install new tie in pieces

Steam & Condensate
- Prefab Weld & test spool pieces
- Erect Scaff
- Inst Hangers
- Inst Spool Pieces
- Remove existing line & install new tie in pieces

Feed& Product
- Prefab Weld & test spool pieces
- Erect Scaff
- Inst Hangers
- Inst Spool Pieces
- Remove existing line & install new tie in pieces

Outgoing & Incoming
- Prefab Weld & test spool pieces
- Cut and remove six existing lines and Install new tie in pieces

Lan Line
- Trench For New LAN Line
- Install New LAN Line

D1321 - U2 OUTAGE
Sept 05 - Nov 10

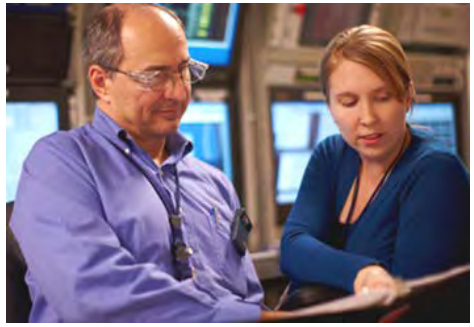
Project 16-31555 D_2O Storage and Drum Handling Facility

Team D_2O Update

Presented by: Julian Read, Project Manager
December 11, 2013

BEHAVIOURS

- Integrate & Collaborate
- Think Top & Bottom Line
- Simplify It
- Say It. Do It
- Tell It As It Is

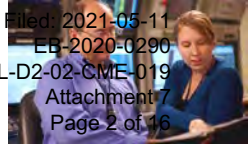


▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

PEOPLE POWERING THE FUTURE OPG NUCLEAR

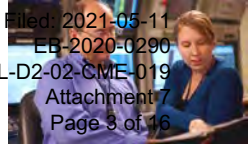
ONTARIO POWER GENERATION

Agenda



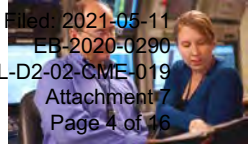
- Progress to date
- Next Steps
- Work in near future
- Status on Key Issues/Risk

Progress to date

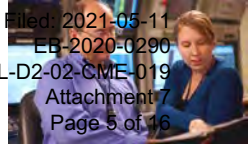


- Tie-in of new LPSW pipe complete
- Relocation of Argon Tank to south of TRF
- Tie-in of Steam & Condensate in TRF
- SG TMOD complete
- Dewatering system installed
- Soil lay down area inside PA installed
- Yard drainage TMOD complete
- 50% of all Design Packages are released for execution
- Soil lay down area on new build land progressing
- Feed and product tie-in progressing

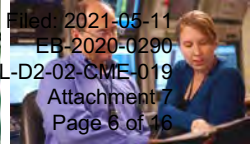
C13 Soil Lay down Area



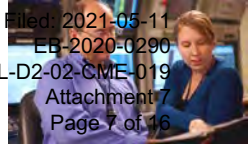
Dewatering System



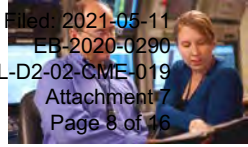
Project At last presentation – June 2013



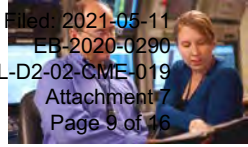
August 2013



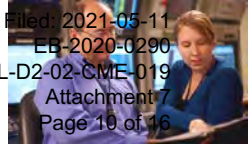
September 2013



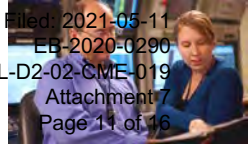
December 2013



New tie-in

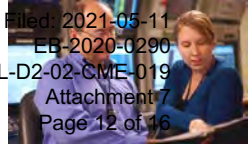


New tie-in



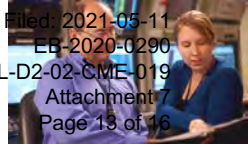
Applying protective coating to LPSW Pipe @ North Off-Set...Looking East in Box#8...
12/08/2013

Next Steps



- Short term (<4 months)
  - Develop lessons learned from this experience and distribute
  - Caisson installation
  - Continue indoor TRF tie-ins
  - Oxygen tank relocation
- Medium term (4 to 12 months)
  - Excavation
  - Civil substructure
- Longer term (> 12 months)
  - Civil superstructure
  - Mechanical/Electrical tie-ins
  - Electrical tie-in
  - Balance of installation

Key Issue Status – Soil/groundwater Disposal



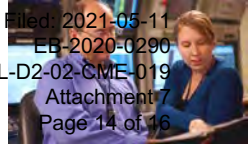
Issue:

2009 IWST spill contaminated the groundwater with tritium. The soil is sitting in this contaminated groundwater, and therefore is also contaminated. Potential for longer term commitment to aerate this soil in order to reduce level of contamination.

Actions taken:

- New F1 soil management pad under construction
- Soil management plan drafted, currently out for review

Key Issue Status – Vehicle Access to Site



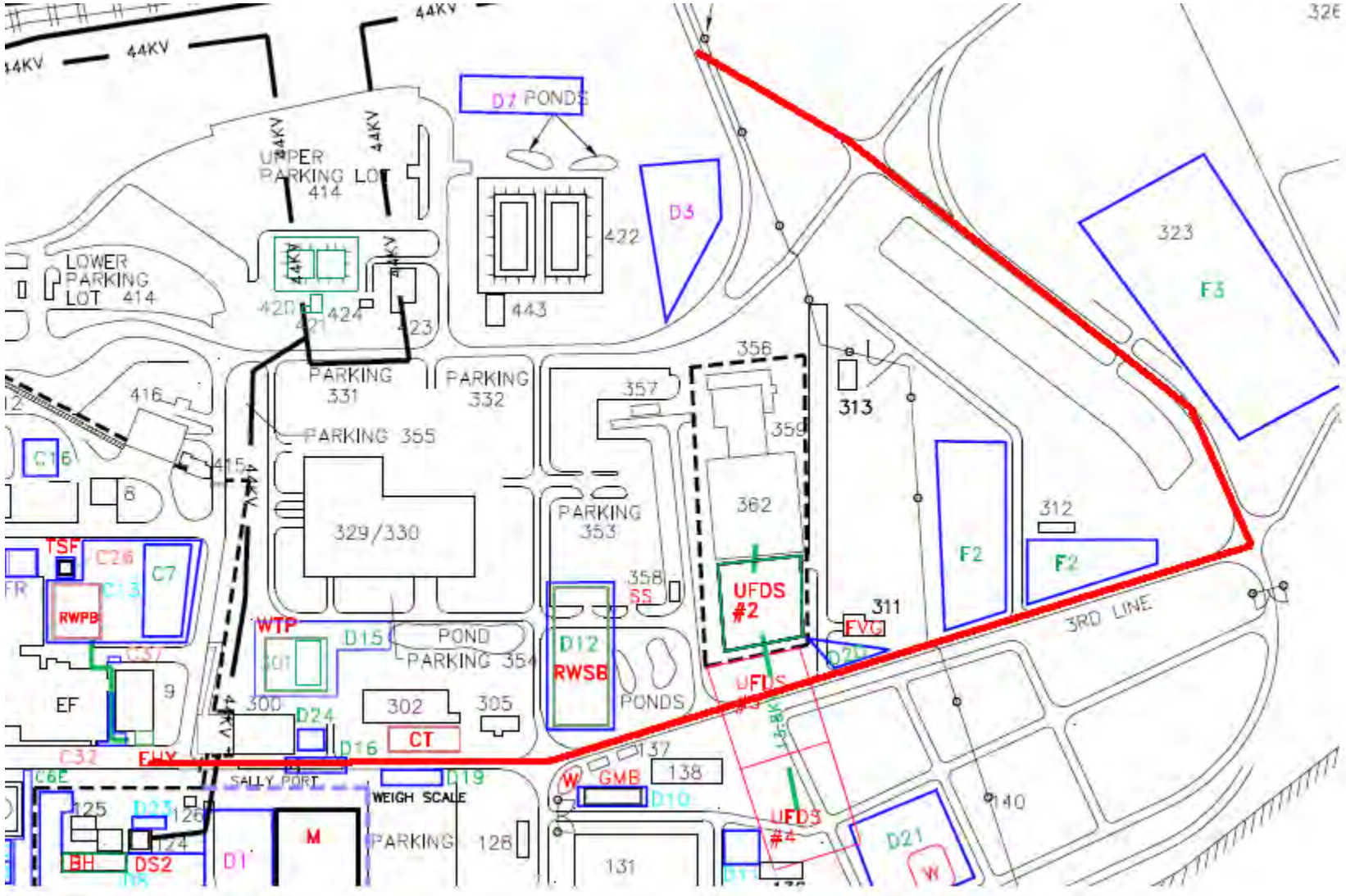
Issue:

Current sally port does not have sufficient vehicle throughput capacity to meet needs of D_2O project in addition to other project work, outages, and routine plant operations. Significant risk to project cost and schedule if vendor is delayed accessing the site.

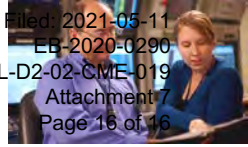
Actions taken:

- New project initiated to expand sally port search capacity
- Priority being installed
- Holt road extension being built to re-direct traffic around ESSB parking lots

New access way to site



Questions?



ONTARIO POWER GENERATION

DNGS Refurbishment - P&M NR Project

D2O Storage Facility

Engineering Status Report as of March 28, 2014

Project Risk [redacted]

Project Detail

Project #: 16-31555 **DSR:** CP100-1 **MEC:** Multiple

Title: D2O Storage Facility

Description: The D2O Storage and Drum Handling Project (#16-31555) will construct an Annex to the Heavy Water Management Building (HWMB) at the Darlington Nuclear (DN) site, to address the expected D2O storage needs for Darlington Refurbishment, Tritium Removal Facility (TRF), and DN Operational Improvements.

Vendor: B&M / RCMT **Vendor PM:** Bruce Smith

Mgr P&M: Julian Read **Eng Lead:** Ralph Branscomb

PM: Mike Marontate **DTL:** Aninda Dutta Ray

Issues/Risks/Mitigation

Issue/Risk	Mitigation	Owner	Due Date	Forecast
Risk- Degree of contamination of soil currently a risk.	Contamination levels are confirmed. Agreement to store contaminated soil on New Build land.	Julian Read	Resolved	Monitor Daily Issue
Issue- Vehicle access capacity currently not sufficient to meet project needs.	DIRT meeting is schedule to determine path forward on Vehicle Screening Facility.	Julian Read	April 4, 2014	April 4, 2014
Issue- Cost and schedule definition not currently meeting expectations.	Full cost and schedule review is underway to further define areas of concern. Superseding BCS forecasted to be submitted to the Board late this year.	Julian Read	April 4, 2014	April 4, 2014
Risk- Weather continues to be an ongoing risk.	Good housekeeping and resources assigned to clean up snow fall	Julian Read	Daily Issue	Daily Issue
Issue- Human factors extent of condition presented to EPC	Action Being taken by EPC to deliver HF documents	Carmin Costache	April 16, 2014	April 16, 2014
Issue- The two main I&C design ECs have not been processed by the OLW group.	Projects and Mods is monitoring this issue with the DO office.	Julian Read	April 16, 2014	April 16, 2014

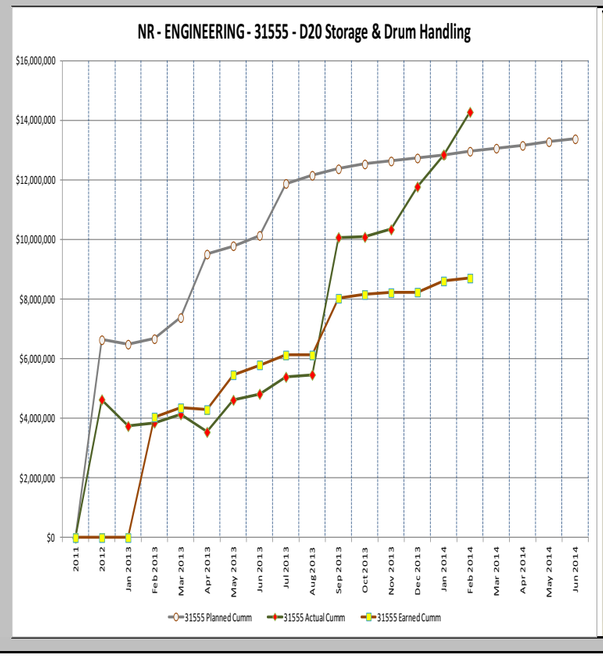
Milestones

Outage: **Online Start Date:** 14-Mar-16

MS	Description	MS Date	Recovery	Forecast
N/A	Detailed Eng Complete	1-May-13	4-Aug-14	23-Oct-14
N/A	Assessing Complete	N/A	23-Oct-14	23-Oct-14
N/A	PC1's Submitted	N/A	N/A	N/A
N/A	All Holds Removed	N/A	N/A	N/A
N/A	Work Package Assessing Comp	TBD	TBD	TBD
N/A	All Materials On Site	TBD	TBD	TBD

* D2O Is not a SIO project and Milestone have not been clearly defined. P&C is working to get a internal schedule.

Performance & Look Ahead



Layout: Alberto_Quad_Chart_1 — Filter All: Alberto_Filter01_Non_Completed, Alberto_Filter02_Two_Weeks_Look_Ahead, Alberto_Filter_03_Engineering_Only

Activity ID	Activity Name	Dur	Start	Finish	% Comple...
31555 - DN - Heavy Water Management Building West Annex (Includi...		0	20-Mar-14	20-Mar-14	
Procurement		0	20-Mar-14	20-Mar-14	
Manufacturing / Contractors Storage		0	20-Mar-14	20-Mar-14	
Manufacture (Vapour Recovery HX Class 3)		0	20-Mar-14	20-Mar-14	
Engineering Milestones		0	20-Mar-14	20-Mar-14	
ENG-60090	CRN Registration Number - for APPROVAL - TSSA	0		20-Mar-14*	0%
ENG-60100	CRN Registration Number - APPROVED - TSSA	0		20-Mar-14*	0%
ENG-60110	Reliability and Maintainability Report - For	0		20-Mar-14*	0%
ENG-60130	Operating and Maintenance Manual - For APPROVAL	0		20-Mar-14*	0%
ENG-60140	Reliability and Maintainability Report - APPROVED	0		20-Mar-14*	0%
ENG-60150	History Docket - APPROVED	0		20-Mar-14*	0%
ENG-60160	Operating and Maintenance Manual - APPROVED	0		20-Mar-14*	0%
ENG-60120	History Docket - For APPROVAL	0		20-Mar-14*	0%

2014: Mar Apr May Jun Jul Aug Sep Oct No

- CRN Registration Number - for APPROVAL - TSSA
- CRN Registration Number - APPROVED - TSSA
- Reliability and Maintainability Report - For
- Operating and Maintenance Manual - For APPROVAL
- Reliability and Maintainability Report - APPROVED
- History Docket - APPROVED
- Operating and Maintenance Manual - APPROVED
- History Docket - For APPROVAL

Risk to Refurbishment Program: Significant Risk [redacted] Moderate Risk [redacted] Recovery Plan In Place [redacted] On Track [redacted]

ONTARIO POWER GENERATION

DNGS Refurbishment – P&M NR Project

D2O Storage Facility

Engineering Status Report as of June 20, 2014

Schedule Health:

- ☒ Vendor Schedule
- ☐ Schedule Resource Loaded
- ☐ in OPG P6 & OPG Compliant
- ☒ Schedule Actualized

	Previous Week	Current Week
Project Status		
Risk to NR Program		

Project Detail

Project #: 16-31555 **DSR:** CP0100-1 **MEC:** 122797, 88528, 118632, 118880, 119824, 119821, 123676

Title: D2O Storage Facility

Description: The D2O Storage and Drum Handling Project (#16-31555) will construct an Annex to the Heavy Water Management Building (HWMB) at the Darlington Nuclear (DN) site, to address the expected D2O storage needs for Darlington Refurbishment, Tritium Removal Facility (TRF), and DN Operational Improvements.

Vendor: B&M / RCMT **Vendor PM:** Bruce Smith

Mgr P&M: Julian Read **Eng Lead:** Ralph Branscomb

PM / MTL: Mike Marontate **DTL:** Aninda Dutta Ray

Issues / Risks

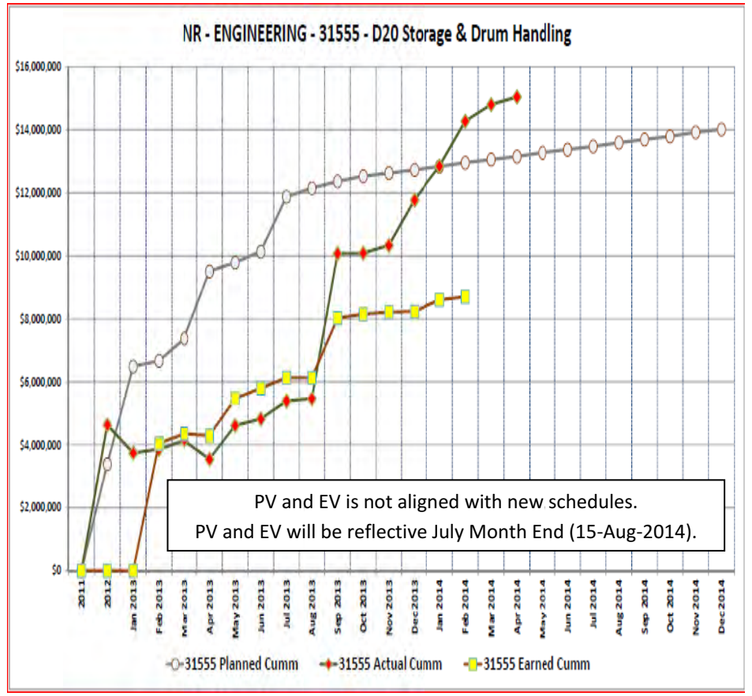
#	Issue or Risk & Impact	Resolution / Mitigation	Owner	Due Date	Forecast
1	Risk-The use of the D20 project dewatering system by other campus plan projects needs focused attention.	Memo has been signed for Dewatering.	Julian Read / Bruce Smith	30-May-14	Complete
2	Risk- Engineering technical deliverables schedule need more detail and clear path to achieve milestones.	OPG and vendor are working together to achieve this schedule. A more detailed schedule and recovery plan is I /P and the consolidation of the two schedules in being completed through the PCC. Daily meetings are held.	R. Branscomb	23-May-14	27-Jun-14
3	Risk- EC's are at risk for progression without the availability of vendor documents. This may cause a schedule impact.	We are holding meetings to progress any EC's that may be able to move forward without having the documentation. Path forward has been provided	Ralph Branscomb	13-June-14	Complete
4	Risk – D20 Storage cost reduction initiative needs approval by executive team. Will have a direct impact on Design deliverables, Cost, & Schedule.	D20 Storage cost reduction initiative assessment is complete. Stakeholders have provided feedback and a memo has been drafted and signed by the team. The memo is now with the executive team for approval.	Julian Read/ R. Branscomb	30-May-14	20-June-14
5	Risk- CNSC staffs were looking to see if a couple of months relaxation was possible for CNSC Code Classification Consent for MEC# 88528	We have submitted to the CNSC and expect a response shortly. This has been raised up through the appropriate channels. We have responded to a request from the CNSC and await their response.	R. Branscomb	27-May-14	Complete

Milestones

MS	Description	MS Date	Recovery	Forecast
EPC	Contracts Awarded	4-Jul-12	4-Jul-12	Complete
DES	Preliminary Design Complete	21-Dec-12	21-Dec-12	Complete
LLT	Long Lead Time Materials Identified	10-Apr-15	1-May-15	1-May-15
ECP	Design Complete	3-Nov-14	3-Nov-14	3-Nov-14
PTA	Work Package Assessment Complete	22-Dec-14	22-Dec-14	22-Dec-14
SOI	Start of Installation	Multiple	Multiple	TBD
AFS	Available/Ready for Service Complete	7-Apr-16	7-Apr-16	7-Apr-16

* Schedule needs validation and will be subject to change (D20 Storage Cost reduction initiative). Cost reduction initiative has completed and memo is to be approved by executive team. This has direct impact on the Schedule dates.

EV Curve, Accomplishments, & Look ahead



Current weeks Accomplishments

- Daily meetings held to discuss and bring schedule back in line with reasonable dates to meet the detailed design completion Milestone.
- Memo for Scope reduction was signed and endorse by the collaborative approach team and has been forwarded to the executive team for a decision.
- Lighting EC for the D20 building was able to save 3 months of design if we decided to use fluorescent lights instead of LED's.
- 5 Technical Specifications were approved and this allows the vendor to go out for quote on Materials

Next Week's Major Activities

- Complete the schedule review and provide compliant dates and assumptions to minimize the further risk of pushing this project.
- Get concurrence and signature on the Dewatering memo.
- Review critical EC's with the collaborative approach team and engage comments in parallel to the design.
- Disposition a response from the vendor to ensure that we can start to get Vendor documents outside of the Equipment PO process. (Pay fee for delivery of vendor documents only.) The price and availability of this option will be known next week.

Project Status: Critical | Caution | Recovery Plan In Place | On Track / Controlled

Risk to Refurbishment Program: Significant Risk | Moderate Risk | Minor Risk | No Risk

Filed: 2021-05-11
EB-2020-0290
Exhibit L-D2-02-CME-019
Attachment 10, Page 1 of 2

Project Status
Risk to NR Program

Project Detail

Project #: 31555 **DSR:** CP0100-1 **MEC:** 122797, 88528, 118632, 118880, 119824, 119821, 123676

Title: D20 Storage Facility

Description: The D2O Storage and Drum Handling Project (#16-31555) will construct an Annex to the Heavy Water Management Building (HWMB) at the Darlington Nuclear (DN) site, to address the expected D2O storage needs for Darlington Refurbishment, Tritium Removal Facility (TRF), and DN Operational Improvements.

Vendor: B&M / RCMT **Vendor PM:** Bruce Smith

Manager: Julian Read **Eng Lead:** Ralph Branscomb

PM / MTL: Mike Marontate **DTL:** Aninda Dutta Ray

Issues and Risks

ID	Issue or Risk and Impact	Resolution / Mitigation	Owner	TCD
130	The vendor for D2O storage has issued 8 RCOs on the fixed price work due to the Scope reduction Initiative.	These RCO's are being reviewed and will be commented on to the vendor useing the approved process. RCO's will be consolidated to include the civil restructure work. -*As per PM, This issue will be resolved this week. 10/1/2014- the approval of the RCO is still with projects and is delaying this work.	**BRANSCOMB Ralph -NUCLEAR**	**06-Oct-14**
124	D2O Storage Project Main Process Piping Issue regarding use of System SCI and DEC Scope to determine isometrics. This will be revised durring the revision for the raised building.	The D2O storage team have been reviewing the isometrics for the D2O Storage Project main process DECs (120421,120422, 120423 and 120424) and we have discovered that the isometrics of the DECs so far (120422 and 120423) show the construction of portions of systems within the system SCI of the Design EC as well as the construction of lines with different USIs that were to be built under different DECs. Meeting to be held with DA to get concurrance and to provide direction to the vendor. RCO needs to be approved for the work on this item.	**BRANSCOMB Ralph -NUCLEAR**	**10-Oct-14**
110	Engineering needs to accelerate the approval process of common field change process. Impact: delayed schedule and increased cost -This is a Ongoing Task.	Meetings are set up and will be discussed with all key stakeholders to come up with a path forward. D.A is meeting to discuss this on-going issue further.	**BRANSCOMB Ralph -NUCLEAR**	**10-Oct-14**

Safety Issues

No Saftey issues to report.

Quality Issues

No Quality issues to report.

Schedule Health

- [x] Vendor Schedule
- [ ] In OPG P6 & OPG Compliant
- [ ] Schedule Resource Loaded
- [x] Schedule Actualized

Milestones

ONTARIO POWER GENERATION

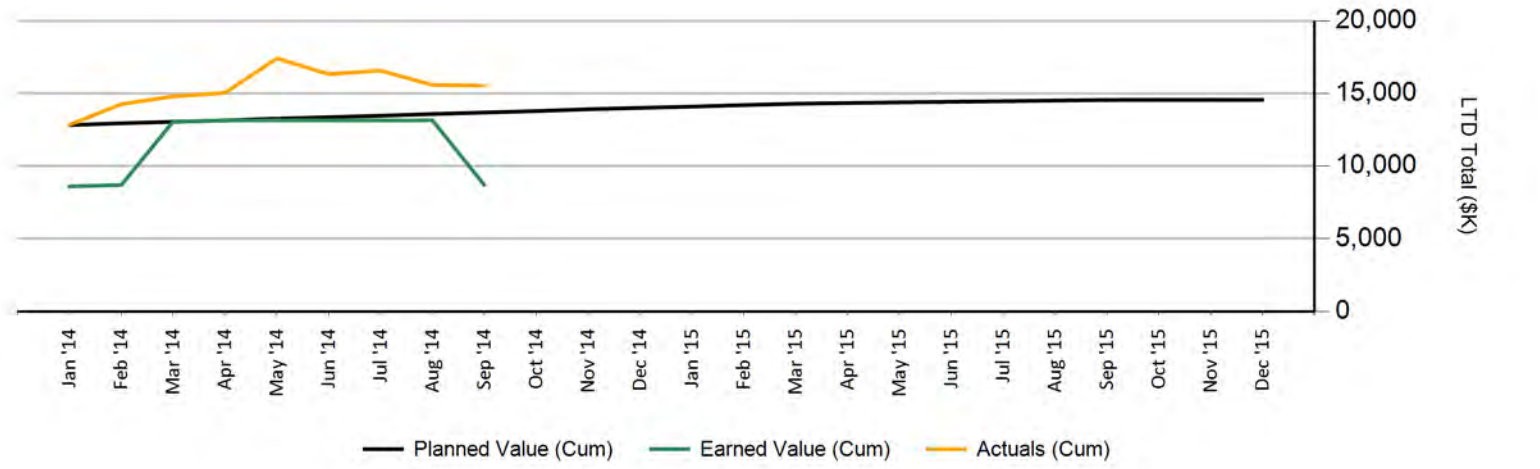
DNGS Refurbishment - P&M NR Project
Bundle: 31555
Engineering Status Report - Ran On: October 10, 2014

Project Status
Risk to NR Program

Type	Activity Name	Baseline Date	Current Date	Status
LLT	EPC Contract Long Lead Materials Identified MS	26-Nov-12	26-Nov-12 A	√√
DES	EPC Contract Preliminary Design Complete DES	21-Dec-12	21-Dec-12 A	√√
SOI	Start of Installation (SOI) Phase III	01-Oct-13	01-Oct-13 A	√√
ECP	EPC Contract 65% of all design EC's Accepted by OPG Complete MS PP7	10-Mar-14	10-Mar-14 A	√√
SOI	Start of Installation (SOI) EXCAVATION	13-May-14	13-May-14 A	√√
ECP	EPC Contract Foundation Excavation Complete	07-Nov-14	17-Mar-15	X
ECP	EPC Contract 75% of all design EC's Accepted by OPG Complete MS PP8	28-Nov-14	26-Mar-15	X
ECP	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Non Vapour Recovery)	02-Feb-15	11-Jun-15	X
ECP	EPC Design Documents Approved and Issued (ECP)	03-Feb-15	11-Jun-15	X
SOI	Start of Installation (SOI) DYKE	18-Feb-15	30-Dec-14	-
ECP	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Vapour Recovery)	26-Feb-15	11-Jun-15	X
SOI	Start of Installation (SOI) INSTALL/POSITION TANKS	30-Jul-15	04-Feb-16	X
SOI	Start of Installation (SOI) CONSTRUCT PIPE CHASE	30-Jul-15	24-May-16	X
SOI	Start of Installation (SOI) BUILDING PIPING	19-Aug-15	04-Feb-16	X
SOI	Start of Installation (SOI) BUILDING STRUCTURE	15-Sep-15	17-Mar-16	X
SOI	Start of Installation (SOI) CONSTRUCT/ERECT CAUSEWAY	15-Jan-16	17-Mar-16	X
CMS	Start of Commissioning (CMS)	08-Feb-16	22-Sep-16	X
AFS	Building Systems Completed (AFS)	19-May-16	20-Dec-16	X
AFS	Gate 4 Process Systems Complete Execution Phase Completed (AFS)	26-May-16	02-Feb-17	X

Legend:						
	√√	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone Threatened
	√	Milestone Completed Late	X	Milestone At Risk	XX	Milestone Missed

Performance and Look Ahead



Current Week's Achievements

1) Held Multiple meeting to discuss and resolve D2O tie-back & Rock Anchor issues.
2) Held a lessons learned meeting with the D2O team and RWPB team.
3) Collaborative team reviewed 4 EC's
4) The team responded to 6 RFI's
5) Hit Team meetings continued to resolve multiple issues.
6) Provided a plan to support OLW
7) Team started a Project Water Hammer Evaluation
8) Started review of Long lead material dates against EC need dates.
9) Scope reduction confirmation memo issued

Next Week's Major Activities

1) Continue the Collaborative reviews of 5 EC's.
2) Work to resolve actions assigned to the HIT team.
3) Continue review Long lead material dates against EC need dates.
4) Work with vendor to ensure Schedule is optimized.
5) Look at possible cost reduction initiatives related to design work.
6) Work with Projects to ensure appropriate funding is released for vendors to provide their documents to complete the DEC's.

Nuclear Refurbishment
Bundle: F&IP - D2O Storage Facility
Report Ran On: December 18, 2014

Executive Summary:

Overall the project continues to execute the transistion to the new commercial strategy following termination of the B&M PO.

Cost Performance

The Project was $116M spent at November month end. With the new PO revisions issued and expected, the project is currently has committed costs of $139M, which remains less than the $160M committment to the Board.

CPI and SPI remain inaccurate as the planned value is currently $110M with a schedule completion of April 2015. Upon re-baseline of the cost and schedule with the next BCS, and subsequent update to the PIF with new earning rules, the indicators will be correct. This is anticipated early in the new year.

Engineering

Engineering continues to progress by RCMT. The current forecast for all ECs at "Rev 0" completion (excluding material vendor technical information) is April 2015. The 4 main process design packages will be accepted at Rev "0" by end of 2014, allowing pre-fabrication to begin upon PO award for the completion of the M&E work.

Procurement

The "small" M&E PO for mechancial and electrical support during the dyke construction and misc near term work has been issued to ES Fox for formal acceptance. Once accepted, the risk to active drainage insatllation in the mud slab will be mitigated as those materials will be progressed as part of this PO.

Preliminary collabrative scope review meetings with Aecon and ES Fox for the completion phase of the project started November 24, 2014. Work is underway to formally issue a Work Request.

Numerous smaller POs for misc support (i.e. scaffolding, equipment rentals, etc) continue to be progressed or re-assigned to EllisDon.

The material procurement risk post mitigation score has increased since last month because active management of the construction activities by the OPG construction team continues to see schedule advances.

While beneficial in the short term, advancing the schedule increases schedule risk in the longer term as procurment of materails and pre-fabrication of the basement piping remains outstanding. Currently this is the scope of the large M&E PO, and this risk will be mitigated upon PO award in 2015.

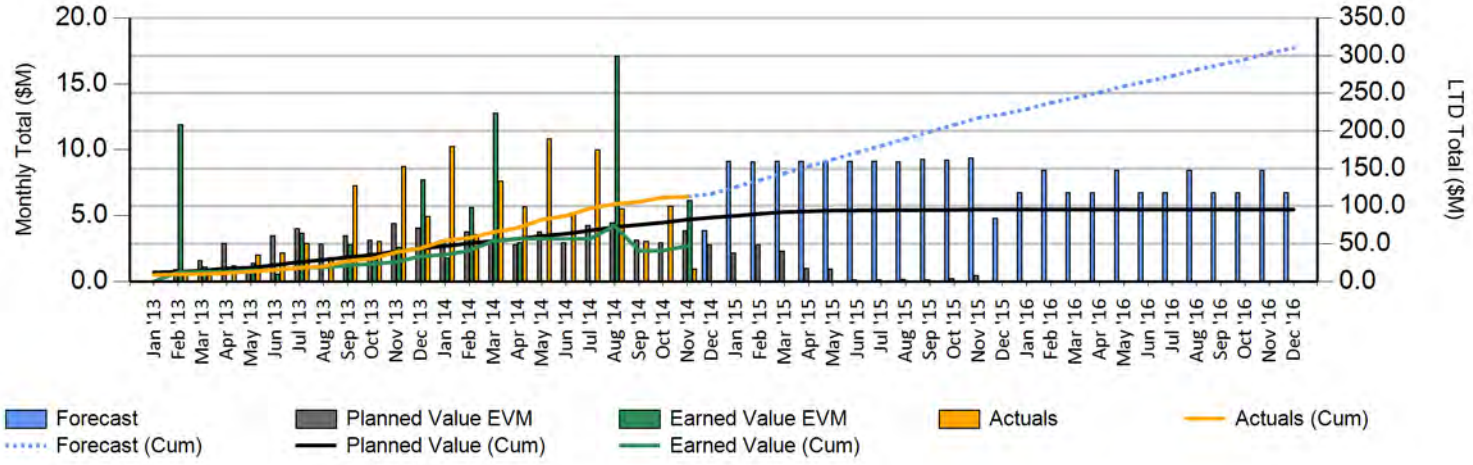
Construction

EllisDon continues to work towards the near term milestonecomplete excavation, with a TCD of January 16, 2015. A stretch target to complete excavation December 24, 2014 is on track.

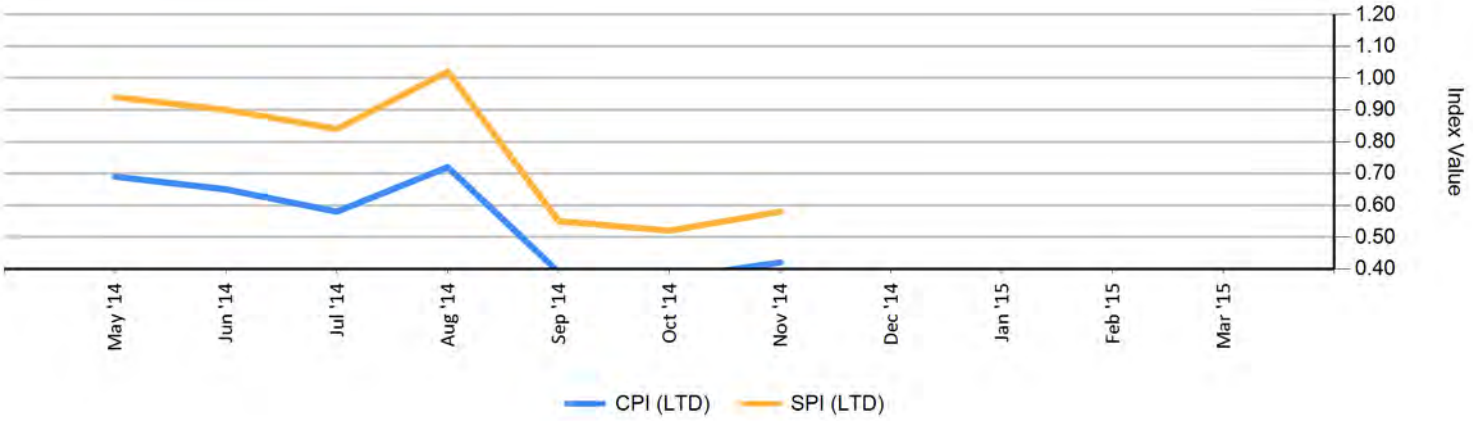
A new stretch target to advance a partial pour of the mudslab prior to year end is now being worked towards. Following installation of the mud slab, the installation of the 221 rock anchors will commence.

Plans are underway to assign space to mobilize Structform to site for the pre-fabrication of the form work. This work will be done on site due to the height of the forms to be fabricated, which supports the schedule for installation. The TCD for mobilize for fabrcation is March 1, 2015.

Cost Performance (EVM)



SPI and CPI Trending (Life to Date EVM)



Nuclear Refurbishment
Bundle: F&IP - D2O Storage Facility
Report Ran On: December 18, 2014

In M dollars	Current Period			Life to Date										At Completion (Life Cycle)				
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	Cost Variance	Budget Variance	CPI	CPI Trend	SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	Approved Funding	EAC Life Cycle
Project & Modification Vendor -							0%	0.0	0.0	-	—	-	—					266.38
Project & Modification Vendor - Close Out	0.0	0.0	0.0	0.0	0.0	0.37	40%	0.37	0.37	-	—	-	—	0.93	0.0	0.93	0.93	0.93
Project & Modification Vendor - Commissioning							0%	0.0	0.0	-	—	-	—	0.3	0.0	0.3	0.3	0.3
Project & Modification Vendor - Construction	2.17	4.68	-0.16	45.55	25.19	77.35	146%	52.16	31.8	0.33	↑	0.55	↑	44.91	8.06	52.97	52.97	52.97
Project & Modification Vendor - Engineering	0.13	1.49	0.17	13.92	10.2	16.25	112%	6.06	2.33	0.63	↑	0.73	↑	14.57	0.0	14.57	14.57	14.57
Project & Modification Vendor - Not Assigned	0.0	0.0	0.46	0.0	0.0	-2.8	0%	-2.8	-2.8	-	—	-	—	0.0	0.0	0.0	0.0	-2.8
Project & Modification Vendor - Procurement	1.48	0.0	0.37	16.32	6.52	15.4	78%	8.89	-0.92	0.42	↓	0.40	↓	19.72	0.0	19.72	19.72	19.72
Project & Modification Vendor - Project Management	0.11	0.02	0.13	6.27	5.31	5.92	85%	0.62	-0.35	0.90	↑	0.85	↑	6.99	0.0	6.99	6.99	6.99
EVM Sub-Total	**3.88**	**6.18**	**0.97**	**82.07**	**47.21**	**112.51**	**118%**	**65.3**	**30.43**	**0.42**	↑	**0.58**	↑	**87.41**	**8.06**	**95.47**	**95.47**	**359.06**
Non-EVM Sub-Total*	**0.35**		**0.0**	**-0.3**		**3.73**	**26%**		**4.03**					**7.41**	**7.13**	**14.54**	**14.54**	**14.54**
Total	**4.23**		**0.97**	**81.77**		**116.23**	**106%**		**34.46**					**94.82**	**15.19**	**110.02**	**110.02**	**373.6**

Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

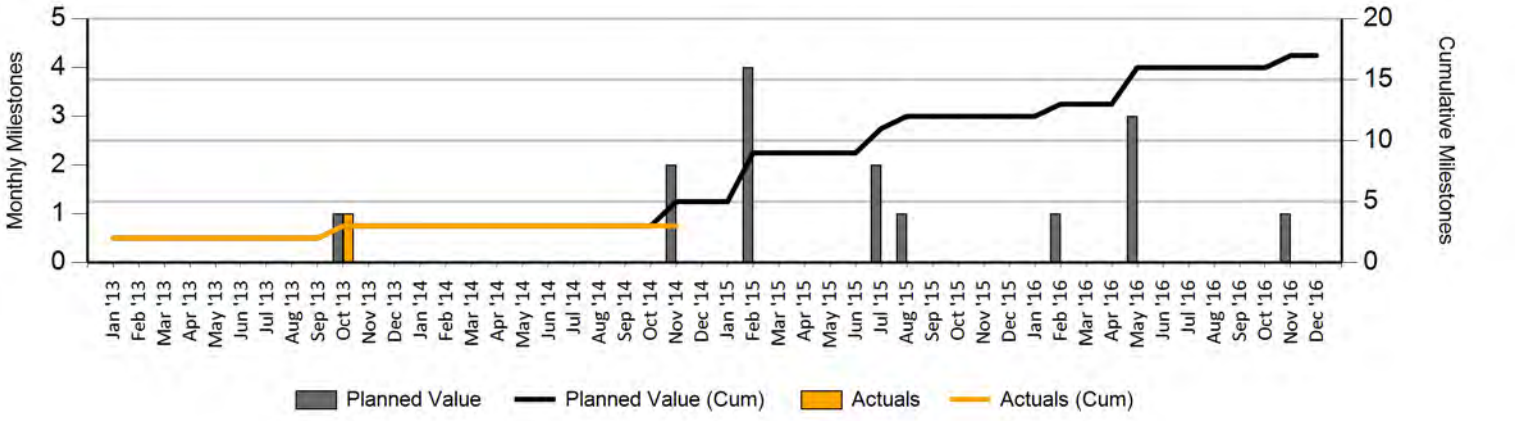
*Non-EVM costs are mainly composed of Interest, Expenses, and Contingency.

Cost Variance Explanation:

CPI = 0.36 is inaccurate due to inaccurate PV. To be corrected in next BCS release in January 2016.

The project is progressing an RFP for the completion phase of the mechanical and electrical work in order to secure pricing for the completion of the project.

Schedule Performance - Tier 3 and 4 Milestones



Nuclear Refurbishment
Bundle: F&IP - D2O Storage Facility
Report Ran On: December 18, 2014

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
31555MS901	EPC Contract Foundation Excavation Complete	3 - ECP	07-Nov-14	21-Jan-15	-75	XX
31555MS230	EPC Contract 75% of all design EC's Accepted by OPG Complete MS PP8	3 - ECP	28-Nov-14	18-Jun-15	-202	XX
ENG-76980	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Non Vapour Recovery)	3 - ECP	02-Feb-15	16-Sep-15	-226	X
31555MS120	EPC Design Documents Approved and Issued (ECP)	3 - ECP	03-Feb-15	17-Sep-15	-226	X
31555MS425	Start of Installation (SOI) DYKE	3 - SOI	18-Feb-15	16-Mar-15	-26	X
31555MS250	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Vapour Recovery)	3 - ECP	26-Feb-15	17-Sep-15	-203	X
31555MS435	Start of Installation (SOI) INSTALL/POSITION TANKS	3 - SOI	30-Jul-15	31-Mar-16	-245	X
31555MS465	Start of Installation (SOI) CONSTRUCT PIPE CHASE	3 - SOI	30-Jul-15	15-Jul-16	-351	X
31555MS455	Start of Installation (SOI) BUILDING PIPING	3 - SOI	19-Aug-15	31-Mar-16	-225	X
31555MS390	Start of Commissioning (CMS)	3 - CMS	08-Feb-16	16-Nov-16	-282	X
31555MS405	Building Systems Completed (AFS)	3 - AFS	19-May-16	09-Mar-17	-294	X
31555MS400	Gate 4 Process Systems Complete Execution Phase Completed (AFS)	3 - AFS	26-May-16	20-Apr-17	-329	X
31555MS030	Project Complete Milestone	4 - PCM	27-May-16	20-Apr-17	-328	X
31555MS410	Gate 5 Project Close Out Phase Completed (PCO)	4 - PCO	28-Nov-16	23-Oct-17	-329	X

Legend:					
√√	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone Threatened
√	Milestone Completed Late	X	Milestone At Risk	XX	Milestone Missed

Milestone list represents a 30 day historical view and a lookahead to 2016-12-01

Schedule Variance Explanation:

SPI = 0.50 is inaccurate due to inaccurate baseline schedule (completion in April 2015). To be corrected in next BCS release in January 2016.

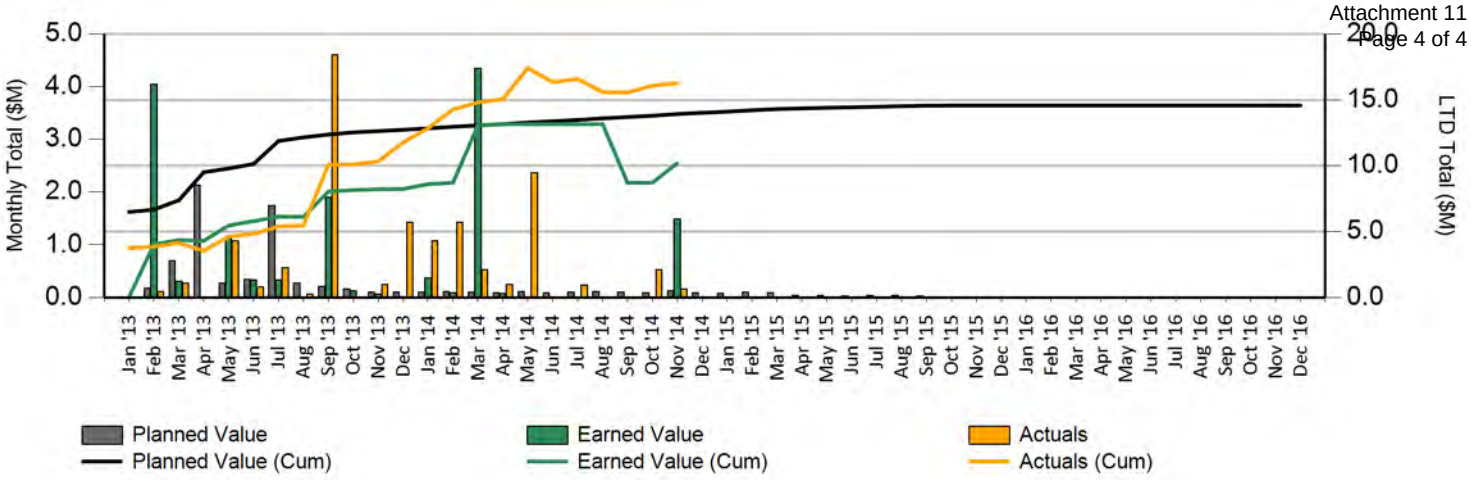
Risk Performance

ID	Title	Risk Description	Current Score	Post Score
12330	16-31555 D2O Storage Project: Completion Date Beyond Start of Refurbishment Start Date	There is a risk that the D2O Storage Project will not be complete prior to the start of DNGS Refurbishment. The current schedule for the base case (i.e., excavation to bedrock) forecasts an AFS date past Feb-2017. This risk is also associated with increased schedule uncertainty during the transition period to implement new contracts per the revised contracting strategy.	25	25
12347	16-31555 D2O Storage Project: Project Cost Escalation Risk	There is a risk that D2O Storage Project costs will coninue to escalate beyond current estimates. This risk is also associated with increased cost uncertainty during the transition period to implement new contracts per the revised contracting strategy.	25	25
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM) will not be ordered in time to support the construction schedule. Delays in awarding revised PO have prevented ordering of nearly $28M in LLMs.	25	16
12396	16-31555 D2O Storage Project: Construction Delays Due to Late Design Completion	There is a risk that the late design completion date will delay construction activities due to the unavailability of design documents required for work planning; design is forecast to be complete no earlier than mid-2015.	20	20

Risk Additional Explanation:

Cost and schedule continue to be top risks for the project. These risks will remain high while the project manages a transition to the new contracting strategy. The new strategy will require new contracts to assume the remaining mechanical and electrical work for the project, and cost escalation is a risk.
Long lead materials risk has increased this month and near term schedule advances also advances need date for material. Specifically, piping and valves for pre-fabrication of spools is of chief concern. Basement process piping is to be lowered into the dyke immediately following dyke completion.

Detail Engineering Earned Value



Detail Engineering Earned Value Variance Explanation:

Nuclear Refurbishment
Bundle: F&IP - D2O Storage Facility
Report Ran On: March 19, 2015

Executive Summary:

Updated March 19, 2015

Cost Performance

- The Project spent $7.4M in February and is now $135M spent LTD.
- Revised BCS for $381M was approved March 6, 2015

RCMT Engineering

- Total of 41 ECs remaining for OPG acceptance (combined scope reduction/rev 0 issuance)
- Burn down curve now submitted and managed weekly for submissions of EC for collabrative review.
- It is critical to manage completion of design by April 30, 2015 to support the work scope of the new general contractor.

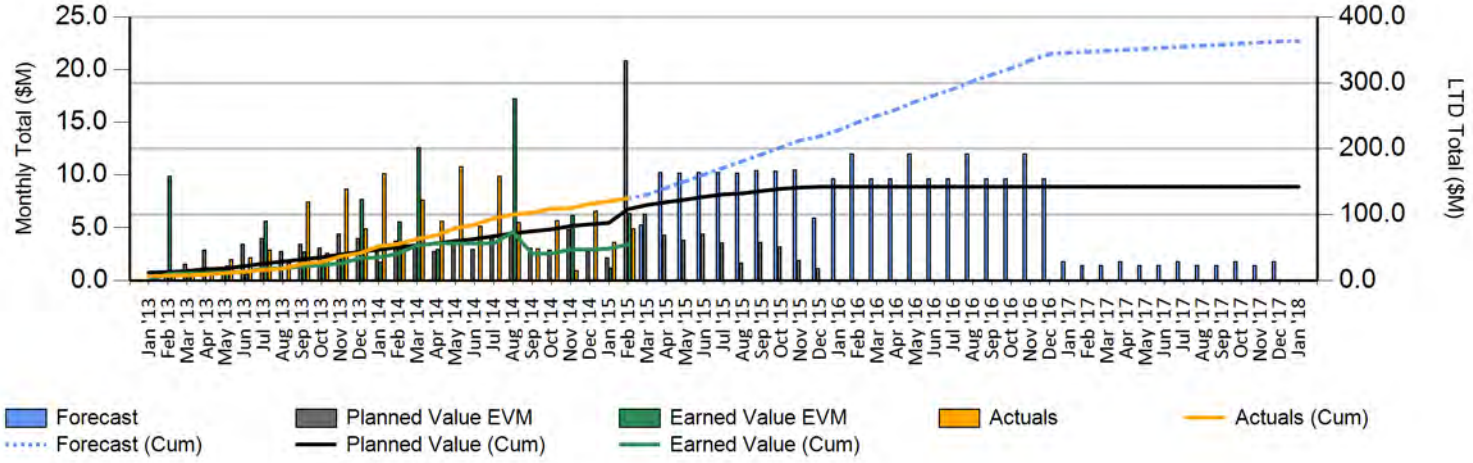
Procurement

- The large new contract evaluation process remains underway. Re-submission of proposals based on clarification process has been completed. Final evaluation for award is underway.
- A PO for RCMT has been issued and is in the process of acceptance.
- To mitigate material delivery risk post dyke complete, the OPG Supply Chain has issued an RFP to procure 600 valves and the 3 non-process tanks.

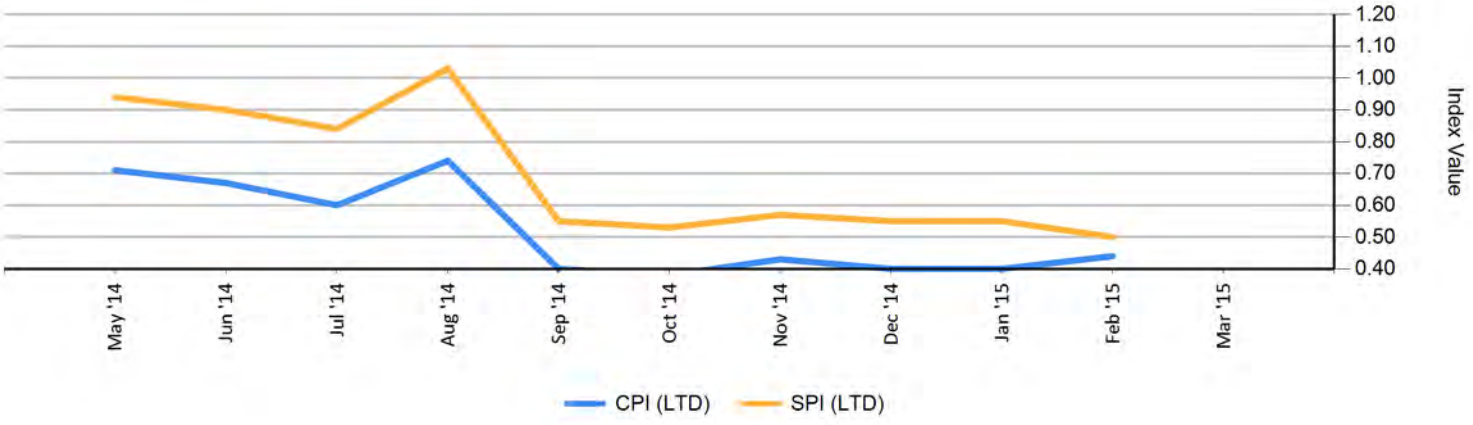
Construction

- Rock anchors have been installed. Residual risk of requirement to install 2 additional anchors due to failures is being managed.
- 221 of 221 rock anchors were stressed and met schedule date of TCD Mar 16 (Reported on track last month). Residual risk for additional rock anchors being managed for this task as well.
- Waterproofing installation has started.
- Embedment installation for active drainage piping currently forecasting beyond baseline schedule.
- Plans remain underway to mobilize Struckform to site in March to start pre-fabricating the formwork.

Cost Performance (EVM)



SPI and CPI Trending (Life to Date EVM)



Nuclear Refurbishment
Bundle: F&IP - D2O Storage Facility
Report Ran On: March 19, 2015

In M dollars	Current Period			Life to Date										At Completion (Life Cycle)				
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	**Cost Variance	Budget Variance	CPI	CPI Trend	SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	Approved Funding	EAC Life Cycle
ES-FOX - Construction	0.55	-0.17	0.41	0.72	0.0	0.41	5%	0.41	-0.3	0	↓	0.00	↓	0.17	8.74	8.9	8.9	8.9
Project & Modification Vendor -							0%	0.0	0.0	-	—	-	—					214.66
Project & Modification Vendor - Close Out	0.0	0.0	0.0	0.0	0.0	0.37	40%	0.37	0.37	-	—	-	—	0.93	0.0	0.93	0.93	0.93
Project & Modification Vendor - Commissioning	0.11	0.0	0.0	0.17	0.0	0.0	0%	0.0	-0.17	-	—	-	—	0.3	0.0	0.3	0.3	0.3
Project & Modification Vendor - Construction	13.91	-10.82	1.91	63.41	15.41	79.18	99%	63.77	15.77	0.19	↓	0.24	↓	44.75	35.15	79.89	79.89	79.89
Project & Modification Vendor - Engineering	4.04	9.03	2.43	18.15	19.24	19.06	78%	-0.18	0.92	1.01	↑	1.06	↑	14.57	9.73	24.3	24.3	24.3
Project & Modification Vendor - Not Assigned	0.0	0.0	-0.37	0.0	0.0	6.07	0%	6.07	6.07	-	—	-	—	0.0	0.0	0.0	0.0	6.07
Project & Modification Vendor - Procurement	0.55	5.75	0.35	18.37	12.27	14.3	72%	2.03	-4.07	0.86	↑	0.67	↑	19.72	0.12	19.84	19.84	19.84
Project & Modification Vendor - Project Management	1.66	2.56	0.21	7.42	7.63	5.47	68%	-2.16	-1.96	1.4	↑	1.03	↑	6.24	1.85	8.09	8.09	8.09
EVM Sub-Total	**20.83**	**6.35**	**4.94**	**108.23**	**54.54**	**124.85**	**88%**	**70.31**	**16.62**	**0.44**	↑	**0.50**	↓	**86.66**	**55.58**	**142.24**	**142.24**	**362.96**
Non-EVM Sub-Total*	**2.37**		**0.0**	**11.16**		**6.58**	**37%**		**-4.58**					**8.16**	**9.61**	**17.77**	**17.77**	**17.77**
Total	**23.19**		**4.94**	**119.39**		**131.43**	**82%**		**12.04**					**94.82**	**65.19**	**160.02**	**160.02**	**380.74**

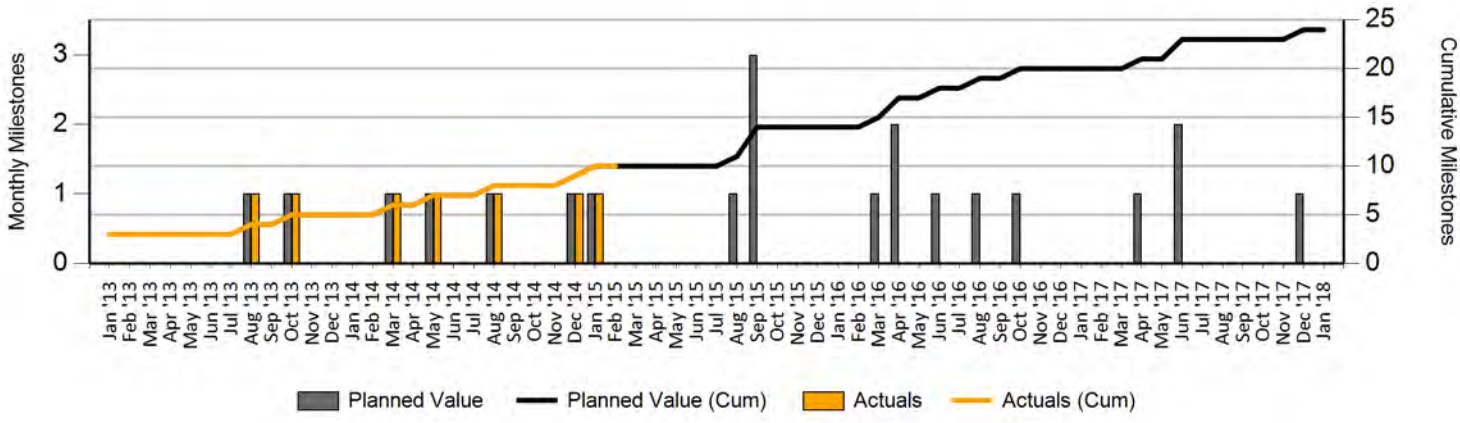
Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

*Non-EVM costs are mainly composed of Interest, Expenses, and Contingency.

Cost Variance Explanation:

PIF in process of being updated to reflect new BCS. Strategy will be to allocate funds where released (i.e. EllisDon PO, RCMT PO), and to leave new contract funds in an "Unreleased account" until required earning rules are set up and PO awarded.

Schedule Performance - Tier 3 and 4 Milestones



Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
NR.CP.IN.01.U0.31555 31555 - Heavy Water Management Building West Annex (Including Phase III) - IIS (471)						
31555MS990	ELEVATION 100 SLAB COMPLETE	3 - SOI		18-Aug-16	0	-
31555MS425	Start of Installation (SOI) DYKE	3 - SOI	15-Jan-15	15-Jan-15 A	0	√√
31555MS455	Start of Installation (SOI) BUILDING PIPING	3 - SOI	19-Aug-15	09-Feb-16	-174	X
31555MS120	EPC Design Documents Approved and Issued (ECP) PHASE I DESIGN ADJUSTED FOR RCMT CONTRACT CLOSURE	3 - ECP	30-Sep-15	30-Apr-15	153	-
31555MS250	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Vapour Recovery)	3 - ECP	30-Sep-15	18-Nov-15	-49	X
ENG-76980	EPC Contract 100% of all design EC's Accepted by OPG Complete MS PP10 (Non Vapour Recovery)	3 - ECP	30-Sep-15	18-Nov-15	-49	X
31555MS435	Start of Installation (SOI) INSTALL/POSITION TANKS	3 - SOI	03-Mar-16	26-Jan-16	37	-
31555MS445	Start of Installation (SOI) BUILDING STRUCTURE	3 - SOI	14-Apr-16	29-Apr-16	-15	X
31555MS475	Start of Installation (SOI) CONSTRUCT/ERECT CAUSEWAY	3 - SOI	14-Apr-16	29-Apr-16	-15	X
31555MS465	Start of Installation (SOI) CONSTRUCT PIPE CHASE	3 - SOI	17-Jun-16	18-Aug-16	-62	X
31555MS390	Start of Commissioning (CMS)	3 - CMS	20-Oct-16	07-Dec-16	-48	X
31555MS405	Building Systems Completed (AFS)	3 - AFS	25-Apr-17	06-Jun-17	-42	X
31555MS030	Project Complete Milestone	4 - PCM	06-Jun-17	18-Jul-17	-42	X
31555MS400	Gate 4 Process Systems Complete Execution Phase Completed (AFS)	3 - AFS	06-Jun-17	18-Jul-17	-42	X
31555MS410	Gate 5 Project Close Out Phase Completed (PCO)	4 - PCO	06-Dec-17	17-Jul-18	-223	X

Legend:	√√	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone Threatened
	√	Milestone Completed Late	X	Milestone At Risk	XX	Milestone Missed

Milestone list represents a 30 day historical view and a lookahead to 2018-01-01

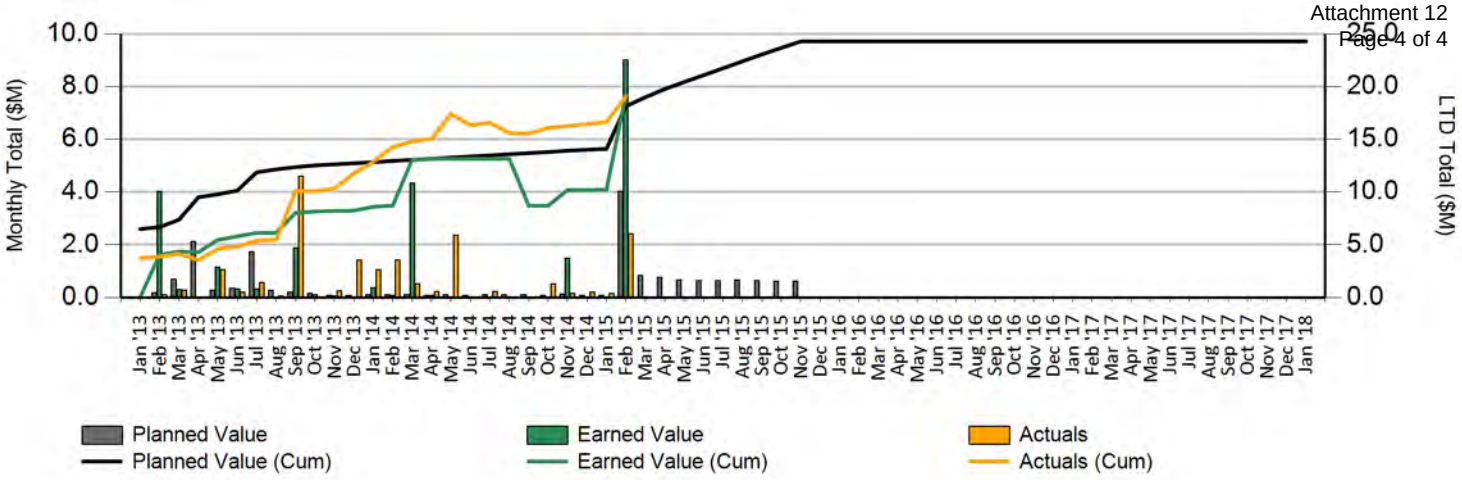
Schedule Variance Explanation:

Risk Performance

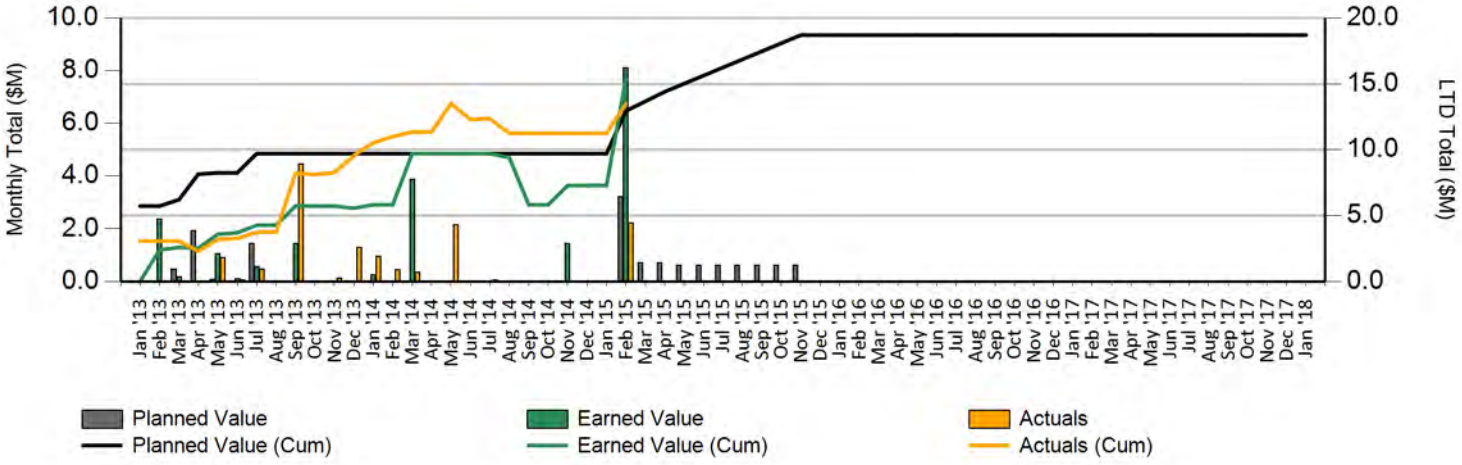
ID	Title	Risk Description	Current Score	Post Score
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM) will not be ordered in time to support the construction schedule. Delays in awarding revised PO have prevented ordering of nearly $28M in LLMs.	25	16
12396	16-31555 D2O Storage Project: Construction Delays Due to Late Design Completion	There is a risk that the late design completion date will delay construction activities due to the unavailability of design documents required for work planning; design is forecast to be complete no earlier than mid-2015.	20	20
12347	16-31555 D2O Storage Project: Project Cost Escalation Risk	There is a risk that D2O Storage Project costs will coninue to escalate beyond current estimates. This risk is also associated with increased cost uncertainty during the transition period to implement new contracts per the revised contracting strategy.	15	12

Risk Additional Explanation:

All Engineering Earned Value



Preliminary and Detail Design Engineering Earned Value



Detail Engineering Earned Value Variance Explanation:

Executive Summary:

Updated April 17, 2015

Cost Performance

- The Project spent $11.1M in March and is now $143M spent LTD.
- Revised BCS for $381M was approved March 6, 2015
- CCF drawing $3,846k contingency was routed for approval April 15, 2015. This aligns forecasted costs for 2015, including items such as:
- RCMT
- AMEC/OSS
- Boyle Excavating
- ES Fox construction support services
- ESPCA/Direct Hires

RCMT Engineering

- Currently 13 Design Packages are forecasting beyond the April 30, 2015 completion date for Rev 0 issuance.
- The main process system EC's, required urgently for the new EPC contractor, remains on track for April 30.
- Mitigation plans are under development.

Procurement

- The large new contract evaluation process remains underway. A Limited Notice to Proceed is targeted for issuance April 17, 2015.
- A PO for RCMT has been awarded and accepted.
- Valve order proposals have been recieved by OPG. Technical evaluation and disposition of exceptions currently in progress. TCD of May 15, 2015 for issuance of POs, with a stretch target for April 30, 2015.

Construction

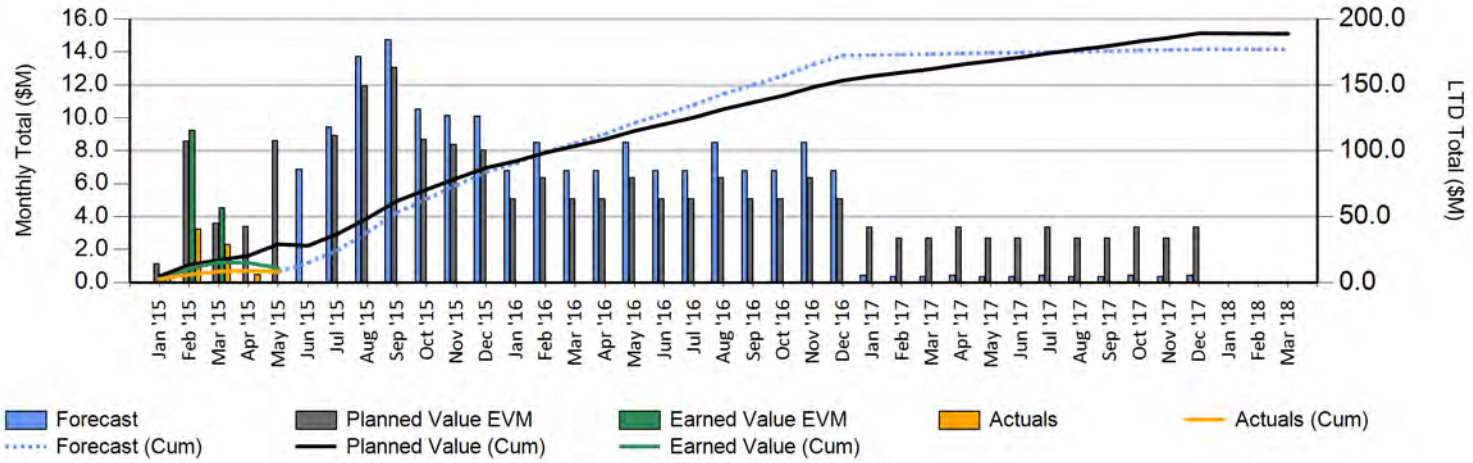
Delays due to water ingress for waterproofing and extended duration for rock anchor installation is challenging the baseline schedule.
Detailed schedule review looking for schedule advancement is currently underway. A recovery plan has been requested from the civil vendor.

- Waterproofing on the south 60% slab is completed April 2 (against baseline of March 10).
- Inspection of Lower Level Rebar 60% completed April 11 (against a baseline of March 17)
- Installation of active drainage piping and grounding started April 11 (against a baseline of March 18)
- Curing of full Raft Slab complete Forecasting finish June 22, 2015
- First Lift Exterior Walls Complete Forecasting finish August 10, 2015

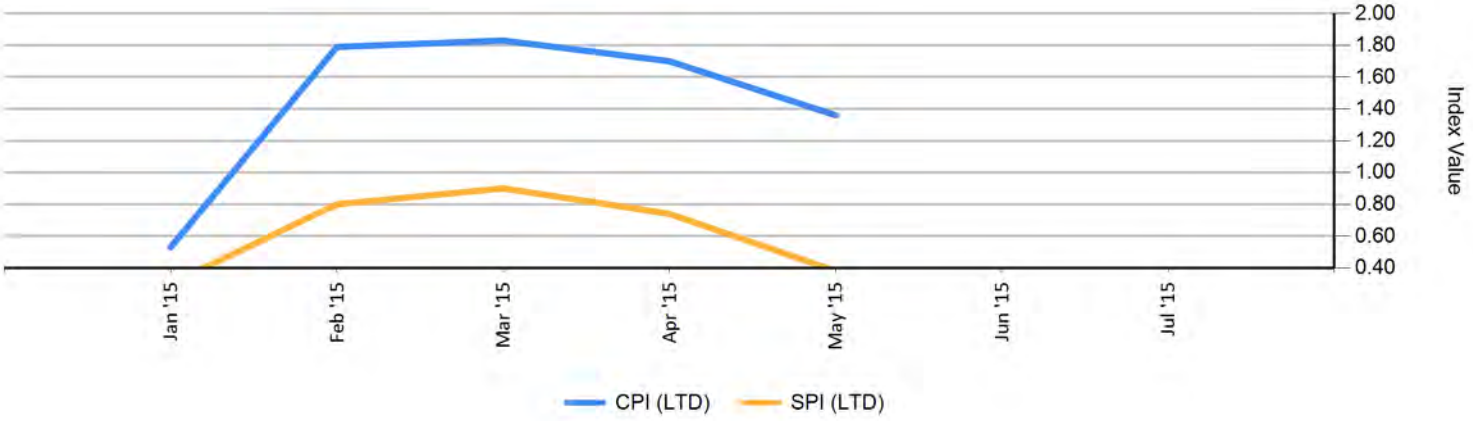
Dyke Construction - 2nd Lift EXTERIOR WALLS Complete forecasting finish 03-Nov-15

- Ready for Tanks aka Dyke Complete - Forecasting January 26, 2016

Cost Performance (EVM)



SPI and CPI Trending (Life to Date EVM)



In M dollars	Current Period			Life to Date										At Completion (Life Cycle)				
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	**Cost Variance	Budget Variance	CPI	CPI Trend	SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	Approved Funding	EAC Life Cycle
Project & Modification Vendor																		
- Project Management	0.06	-1.1	0.46	2.09	4.34	1.61	8%	-2.73	-0.48	2.69	↑	2.07	↑	16.95	2.05	19.0	19.0	19.87
- Engineering	1.34	-2.25	-1.39	6.38	3.36	4.74	19%	1.38	-1.64	0.71	↓	0.53	↓	23.36	1.09	24.45	24.45	23.61
- Procurement	0.69	-1.02	0.18	1.51	1.43	1.61	4%	0.18	0.1	0.89	—	0.95	↑	40.63	3.01	43.63	43.63	43.85
- Construction	6.09	0.29	-0.01	16.51	1.75	0.1	0%	-1.65	-16.41	17.55	↑	0.11	↓	94.2	-0.92	93.28	93.28	85.35
- Commissioning	-0.23	0.07	0.0	0.07	0.07	0.0	0%	-0.07	-0.07	-	—	0.98	↑	0.3	0.14	0.43	0.43	0.37
- Not Assigned	0.0	0.0	0.0	0.0	0.0	0.0	0%	0.0	0.0	-	—	-	—	0.0	0.0	0.0	0.0	0.0
ES-FOX																		
- Construction	0.7	0.0	0.0	2.39	0.0	0.0	0%	0.0	-2.39	-	↓	-	↓	0.0	4.96	4.96	4.96	3.89
EVM Sub-Total	**8.63**	**-4.0**	**-0.75**	**28.96**	**10.95**	**8.07**	**4%**	**-2.89**	**-20.89**	**1.36**	↑	**0.38**	↓	**175.73**	**10.03**	**185.76**	**185.76**	**176.94**
Non-EVM Sub-Total*	**-5.53**		**-1.17**	**113.75**		**137.46**	**70%**		**23.72**					**116.68**	**78.68**	**195.37**	**195.37**	**204.21**
Total	**3.1**		**-1.92**	**142.71**		**145.53**	**38%**		**2.82**					**292.42**	**88.71**	**381.13**	**381.13**	**381.15**

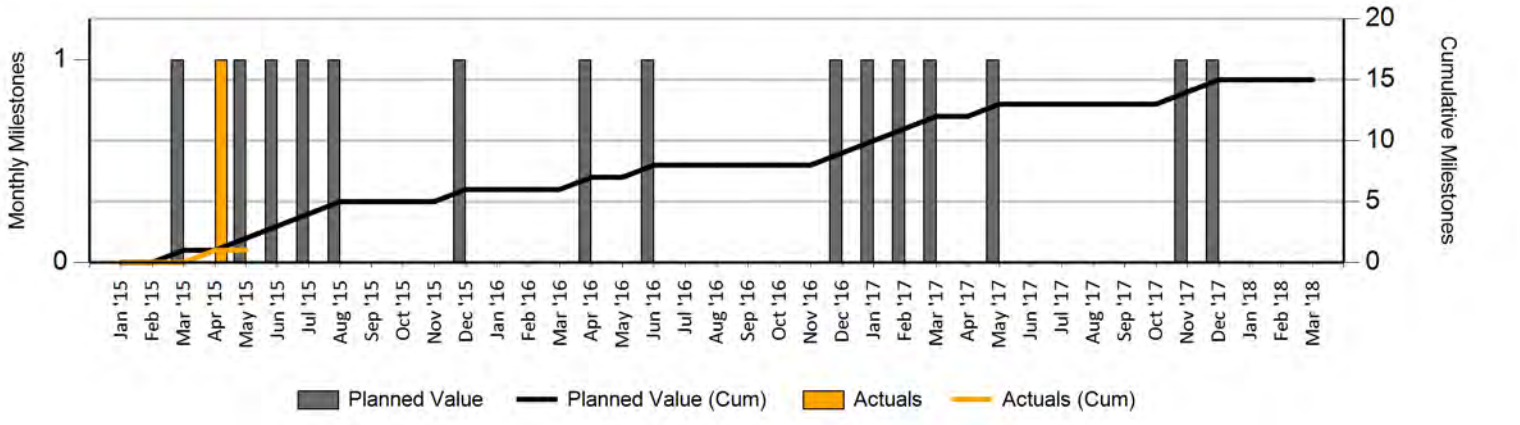
Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

*Non-EVM costs are mainly composed of Interest, Expenses, and Contingency.

Cost Variance Explanation:

Latest PIF has been uploaded to reflect the new BCS release. It consists of released funds (i.e. Ellis Don PO, RCMT PO, etc.), and "unreleased" funds for the new EPC contractor.

Schedule Performance - Tier 3 and 4 Milestones



Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
NR.CP.IN.01.U0.31555 31555 - CP - Heavy Water Management Building West Annex (471)						
31555MS923	Raft Slab First Pour 60% South Side Complete (07Apr15)	3 - PMM		04-Jun-15	0	-
31555MS924	Raft Slab First Pour 40% North Side Complete (13May15)	3 - PMM		06-Jul-15	0	-
31555MS925	First Lift Exterior Walls Complete (08Jul15)	3 - PMM		28-Aug-15	0	-
31555MSRFB	Refurbishment Water (U2) Delivery Target Date (25Feb17)	3 - PMM		25-Feb-17	0	-
31555MS800	Award Contract to New EPC Contractor	3 - SOI	20-Mar-15	05-Jun-15	-77	XX
31555MS804	RCM "Rev 0" Design complete for turnover to new contractor	3 - ECP	29-May-15	30-Apr-15 A	29	√√
CON4460	Dyke Complete	3 - PMM	22-Dec-15	16-Feb-16	-56	X
31555MSTNK	All Tanks Placed in Basement	3 - PMM	21-Apr-16	10-Jun-16	-50	X
31555MSWTR	Capable of Receiving Refurbishment Water (U2)	3 - PMM	30-Jun-16	14-Jul-16	-14	X
31555MS390	Start of Commissioning (CMS)	3 - CMS	12-Dec-16	24-Jan-17	-43	X
31555MS888	BUILDING SHELL COMPLETE	3 - PMM	03-Jan-17	22-Feb-17	-50	X
31555MSCON	Construction Substantially Complete	3 - PMM	10-Mar-17	01-May-17	-52	X
AFS-1000	Final AFS - All Commissioning Complete	3 - PMM	01-May-17	12-Jun-17	-42	X
31555MS410	Gate 5 Project Close Out Phase Completed (PCO)	4 - PCO	01-Nov-17	12-Dec-17	-41	X
31555MS030	Project Complete Milestone	4 - PCM	20-Dec-17	02-Feb-18	-44	X

Legend:					
√√	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone Threatened
√	Milestone Completed Late	X	Milestone At Risk	XX	Milestone Missed

Milestone list represents a 30 day historical view and a lookahead to 2018-03-01

Schedule Variance Explanation:

Milestone date of "Award Contract to new Vendor" shows 15-Apr-15, however is now 05-June-2015. Significant progress with respect to Ts&Cs has been made over the last month as well as review of detailed breakdown of estimates. As a mitigating measure work will commence under a limited notice to proceed, targetted for issuance April 17, 2015.

Additional resources from OSS and Drawing Office have been assigned to the project to assist in meeting the engineering baseline dates to ensure the packages are finalized prior to releasing to the new vendor as planned.

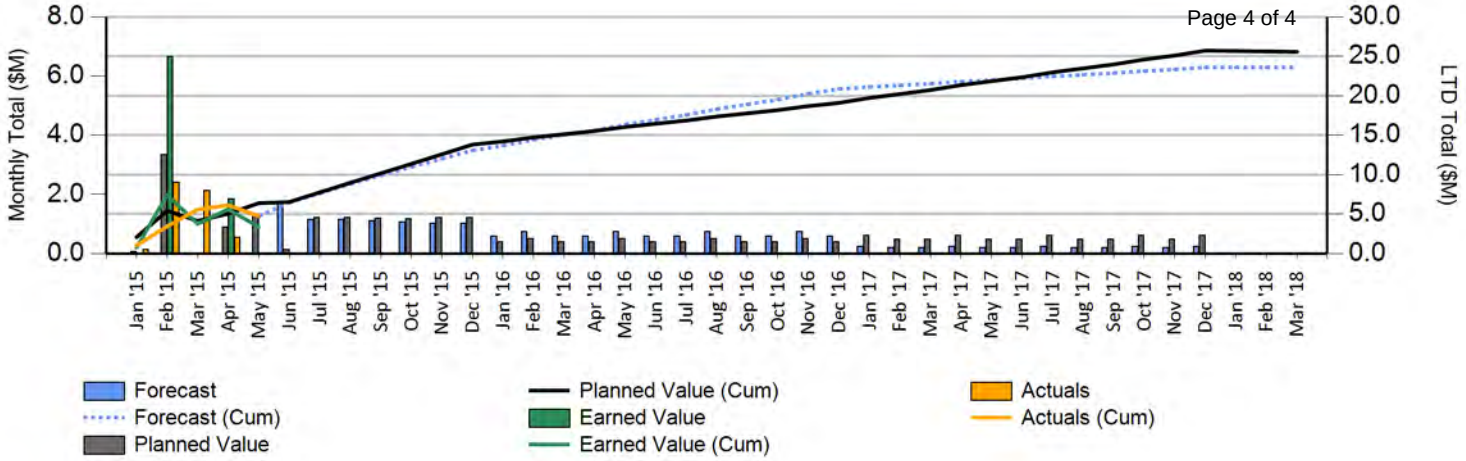
As a result submission of the f majority of design packages within the last 2 weeks of schedule for Rev 0 completion, OPG turn around times for collabrative review, online wiring, and CATID creation has been challenged.

Risk Performance

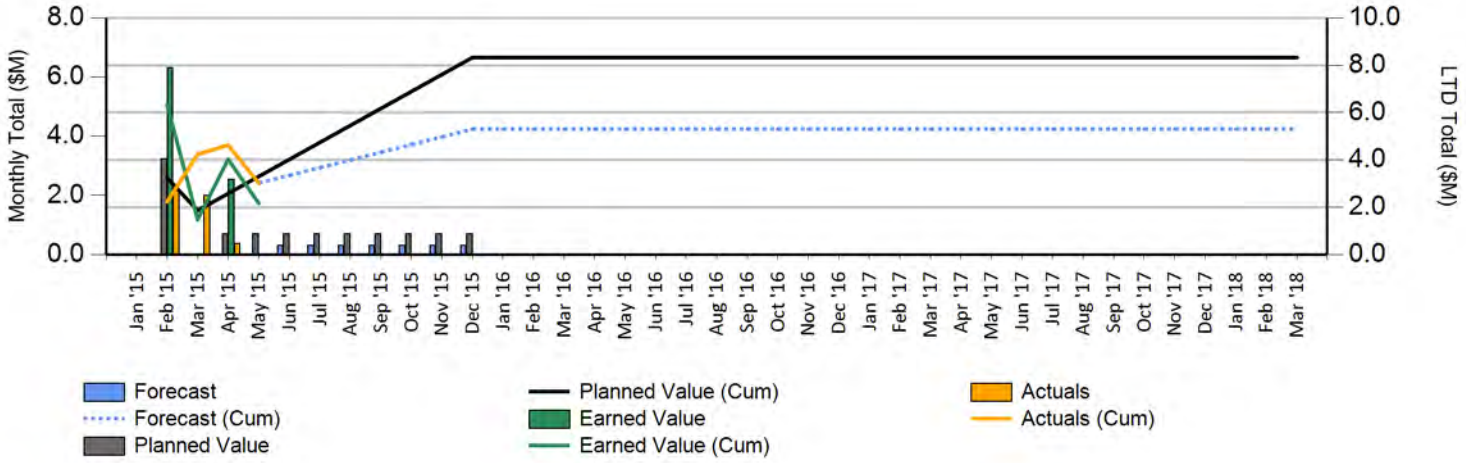
ID	Title	Risk Description	Current Score	Post Score
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM) will not be ordered in time to support the construction schedule. Delays in EPC Vendor PO issuance to material vendors have prevented ordering of nearly $21M in LLMs.	25	16

Risk Additional Explanation:

All Engineering Earned Value



Preliminary and Detail Design Engineering Earned Value



Detail Engineering Earned Value Variance Explanation:

Executive Summary:

Updated September 17, 2015

Cost Performance

- The Project has spent $163M LTD to August month end.

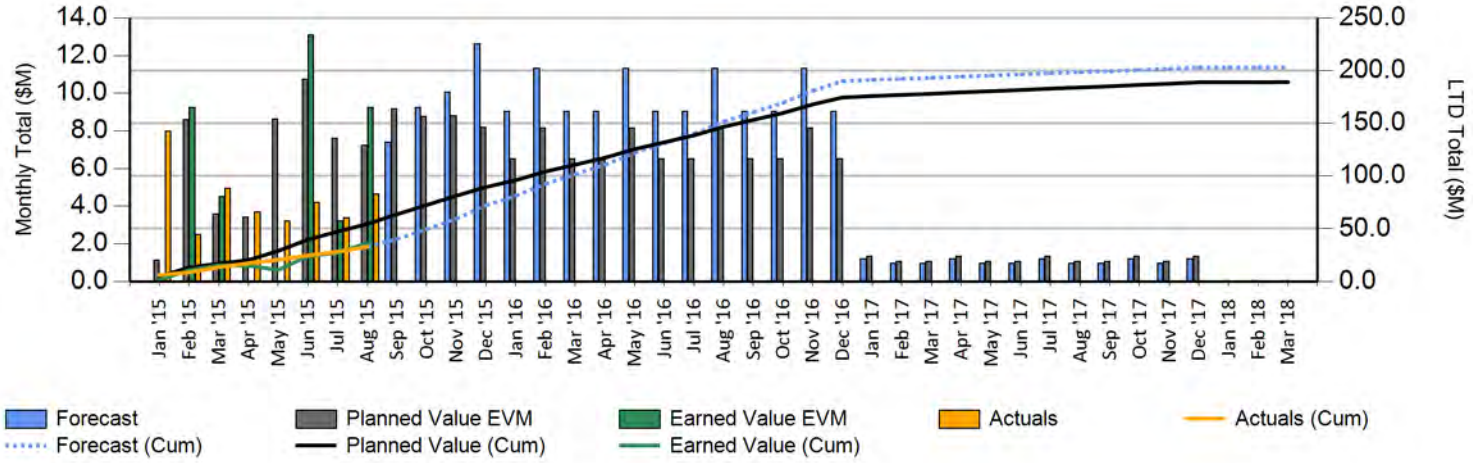
Procurement

- The Purchase Order to Aecon-SLN was issued on August 14, 2015 for the full remaining scope of the D2O storage building.
- ~200 of prioirty 1 valves procured by OPG have been shipped to Aecon, with the remaining valves being shipped in the coming weeks/months.

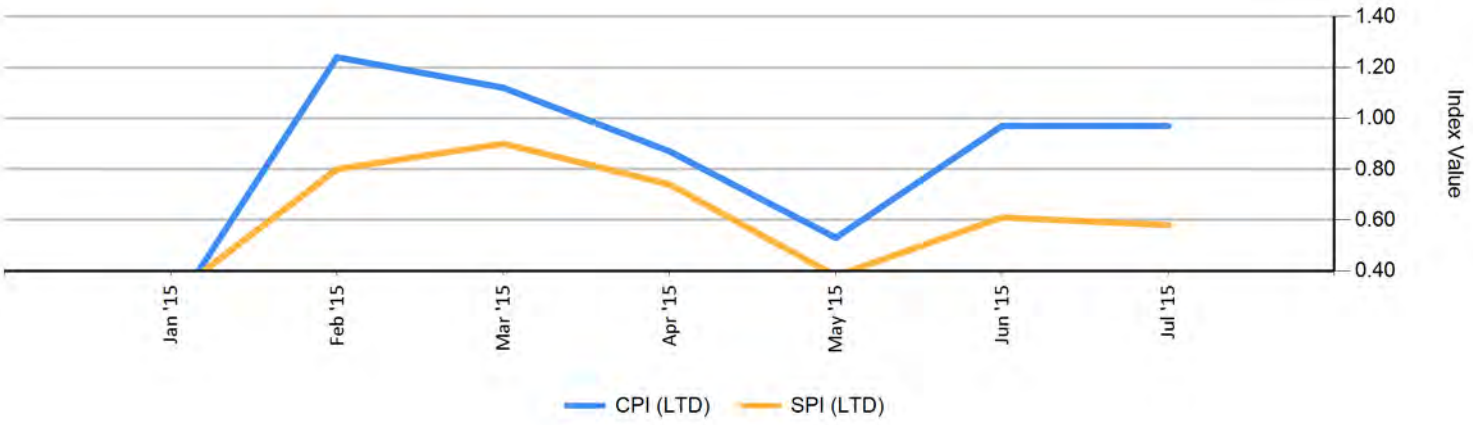
Construction

- First lift exterior and interior walls are complete.
- Second lift south wall pour halted due to form deflection (SCR N-2015-20313). Development of recovery plan in progress.
- Work progressing on second lift SE and SW walls.

Cost Performance (EVM)



SPI and CPI Trending (Life to Date EVM)



In M dollars	Current Period			Life to Date										At Completion (Life Cycle)				
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	**Cost Variance	Budget Variance	CPI	CPI Trend	SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	Approved Funding	EAC Life Cycle
Project & Modification Vendor																		
- Project Management	0.53	-0.25	0.35	2.87	3.95	2.15	30%	-1.8	-0.72	1.83	↑	1.37	↑	5.22	1.88	7.1	7.1	7.17
- Engineering	0.05	2.31	0.02	0.8	2.58	0.37	11%	-2.21	-0.44	7.05	↑	3.21	↑	9.05	-5.81	3.23	3.23	2.83
- Procurement	0.19	0.16	0.13	1.96	1.74	1.99	14%	0.25	0.03	0.87	↑	0.88	↓	2.11	11.94	14.05	14.05	14.14
- Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0%	0.0	0.0	-	—	-	—	0.3	0.08	0.37	0.37	0.37
- Not Assigned	0.0	0.0	2.86	0.0	0.0	19.16	0%	19.16	19.16	-	—	-	—	0.0	0.0	0.0	0.0	19.16
Ellis Don																		
- Construction	1.6	2.07	0.0	19.75	13.27	1.22	5%	-12.05	-18.53	10.87	↑	0.67	↑	22.52	4.15	26.67	26.67	8.63
ES-FOX																		
- Construction	0.65	0.9	0.28	3.13	4.03	0.39	7%	-3.64	-2.73	10.29	↓	1.29	↑	1.58	3.94	5.52	5.52	2.82
Other																		
- Engineering	0.32	1.19	2.32	7.89	5.77	6.22	64%	0.45	-1.68	0.93	↓	0.73	↓	4.46	5.23	9.7	9.7	10.42
- Construction	0.33	0.5	1.11	2.28	2.6	1.31	42%	-1.29	-0.97	1.99	↑	1.14	↑	2.13	0.99	3.12	3.12	3.3
SLNA																		
- Project Management	0.39	0.94	-2.41	1.56	0.94	0.0	0%	-0.94	-1.56	-	—	0.60	↑	11.74	0.0	11.74	11.74	19.56
- Engineering	0.69	0.79	0.0	4.16	0.79	0.0	0%	-0.79	-4.16	-	—	0.19	↑	9.85	0.0	9.85	9.85	5.5
- Procurement	1.88	0.0	0.0	7.52	0.0	0.0	0%	0.0	-7.52	-	—	-	—	37.58	-8.0	29.58	29.58	17.28
- Construction	0.61	0.68	0.0	2.62	0.87	0.0	0%	-0.87	-2.62	-	—	0.33	↑	67.97	0.0	67.97	67.97	91.76
EVM Sub-Total	**7.24**	**9.27**	**4.66**	**54.55**	**36.54**	**32.8**	**17%**	**-3.74**	**-21.74**	**1.11**	↑	**0.67**	↑	**175.73**	**13.17**	**188.9**	**188.9**	**202.94**
Non-EVM Sub-Total*	**2.89**		**2.67**	**136.47**		**130.29**	**68%**		**-6.19**					**116.68**	**75.54**	**192.23**	**192.23**	**178.18**
Total	**10.13**		**7.33**	**191.02**		**163.09**	**43%**		**-27.93**					**292.42**	**88.71**	**381.13**	**381.13**	**381.13**

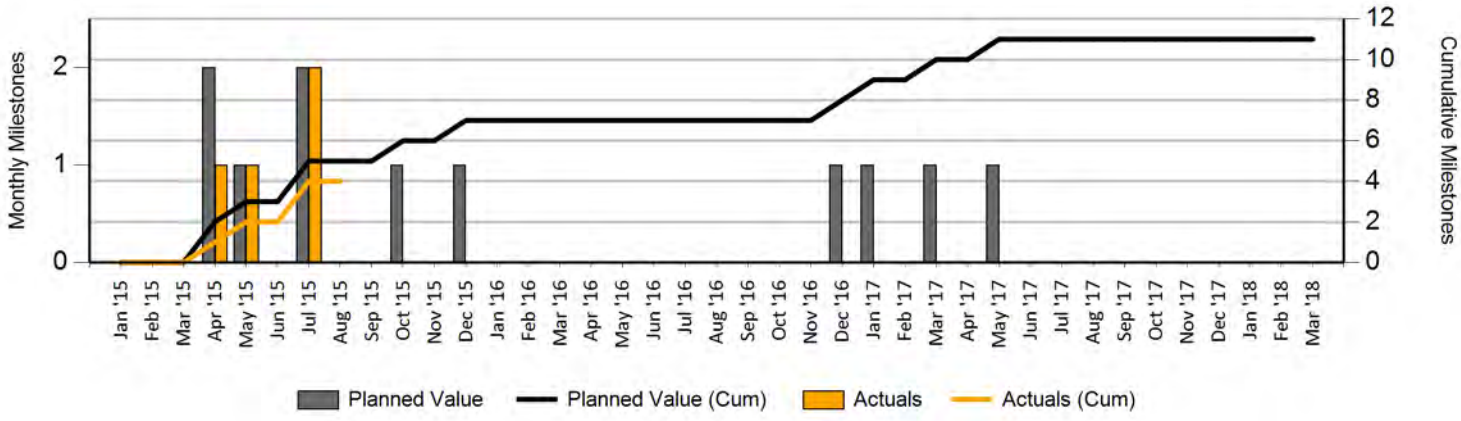
Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

*Non-EVM costs are mainly composed of Interest, Expenses, and Contingency.

Cost Variance Explanation:

- Current LTD spend of $163M to end of August
- YTD spend of $40.2M to end of August
- Forecasted contingency committed/spent is $6.9M, with $26.9M remaining

Schedule Performance - Tier 3 and 4 Milestones



Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
NR.CP.IN.01.UF.31555 31555 - UF - Heavy Water Management Building West Annex (611)						
31555MS410	Gate 5 Project Close Out Phase Completed (PCO) Contract Terminated	4 - PCO		25-May-17	0	-
31555FM194	Raft Slab Second Phase (40%) South (ED PO: 27-May-2015)	3 - PMM	27-May-15	17-Jul-15 A	-51	√
31555FM195	First Lift Exterior Walls Complete (ED PO: 8-Jul-2015)	3 - PMM	08-Jul-15	11-Sep-15	-65	XX
31555SM111	Award Contract to New EPC Contractor	3 - SOI	09-Jul-15	09-Jul-15 A	0	√√
31555FM171	Final AFS - All Commissioning Complete	3 - CMF	15-Oct-15	24-May-16	-222	X
31555FM121	Project Complete Milestone	4 - N/A	23-Dec-15	21-Dec-17	-729	X
31555SM141	Start of Commissioning	3 - N/A	16-Dec-16	07-Jan-16	344	-
31555FM11	Building Shell Complete	3 - N/A	03-Jan-17	10-Sep-15	481	-
31555FM151	Construction Substantially Complete	3 - N/A	10-Mar-17	10-Sep-15	547	-

Legend:					
√√	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone Threatened
√	Milestone Completed Late	X	Milestone At Risk	XX	Milestone Missed

Milestone list represents a 30 day historical view and a lookahead to 2018-03-01

Schedule Variance Explanation:

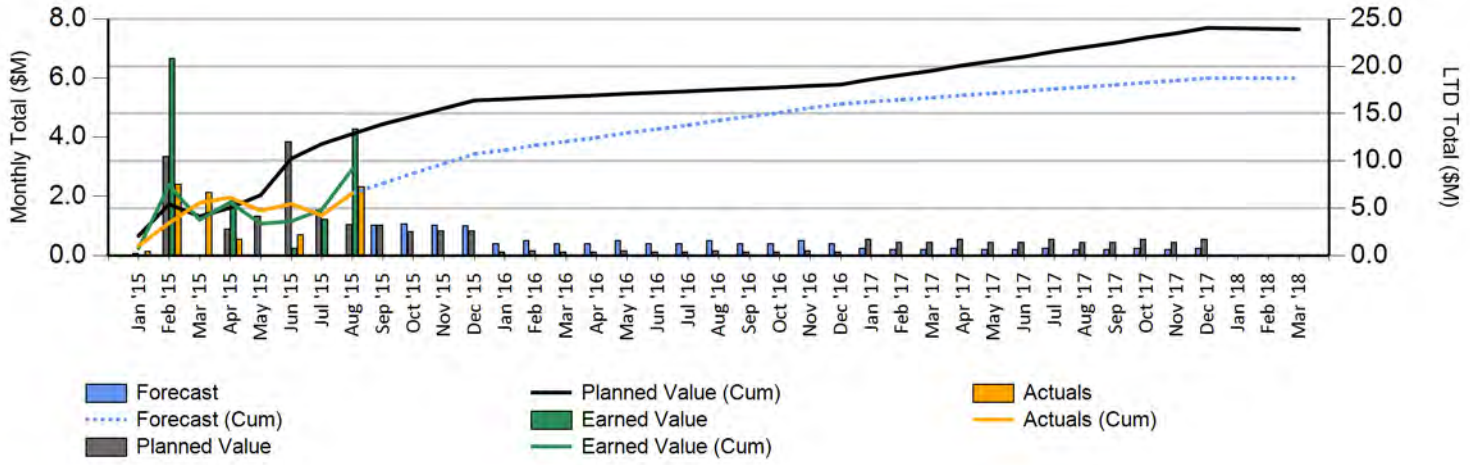
- Ellis Don schedule has been baselined in OPG Production database. Ellis Don completion milestone is forecast as December 29, 2015 and mitigating actions are being reviewed and implemented to recover this to the December 22, 2015 milestone.
- Ongoing efforts to finalize the JV schedule is near completion, which will align the project milestones with the recently approved BCS.

Risk Performance

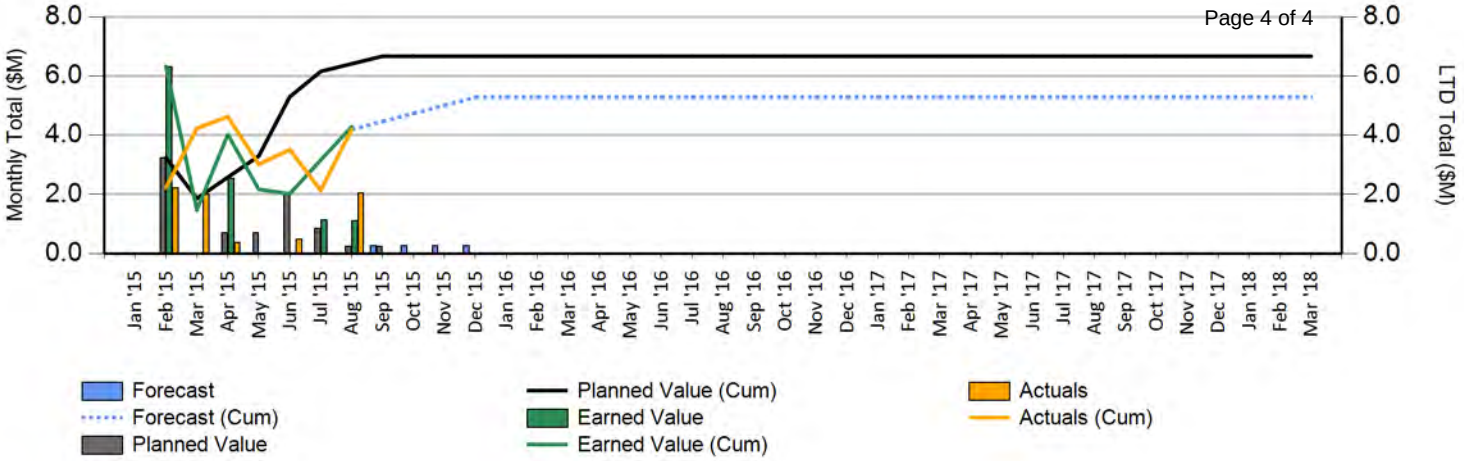
ID	Title	Risk Description	Current Score	Post Score
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM) will not be ordered in time to support the construction schedule. Delays in EPC Vendor PO issuance to material vendors have prevented ordering of nearly $21M in LLMs.	25	16

Risk Additional Explanation:

All Engineering Earned Value



Preliminary and Detail Design Engineering Earned Value



Detail Engineering Earned Value Variance Explanation:

- JV has begun the R00 engineering, and have received the PHT TMOD MDR to commence the engineering efforts.

ONTARIO POWER GENERATION

Quad Chart Report for Nov 2015

F&IP - D2O Storage Facility

Report ID: 105A *Tech Tips*
Report Owner: L. Greenland
Process Owner: D. McAuley
Data Refreshed: 22-Dec-15 10:30 PM

Executive Summary:

Updated Dec. 17, 2015

Cost Performance

- The Project spent $6.8M in November bringing total project spend to $184.4M LTD at November month end
- Costs are on track, with a current CPI of 1.0 once the FIN GEN error is corrected.

Schedule Performance

- Although the seismic dyke recovery plan is on track, the overall project SPI of 0.84 is trending down due to delays in procurement and pre-fabrication activities by JV. JV has prepared recovery plan and review is in progress.

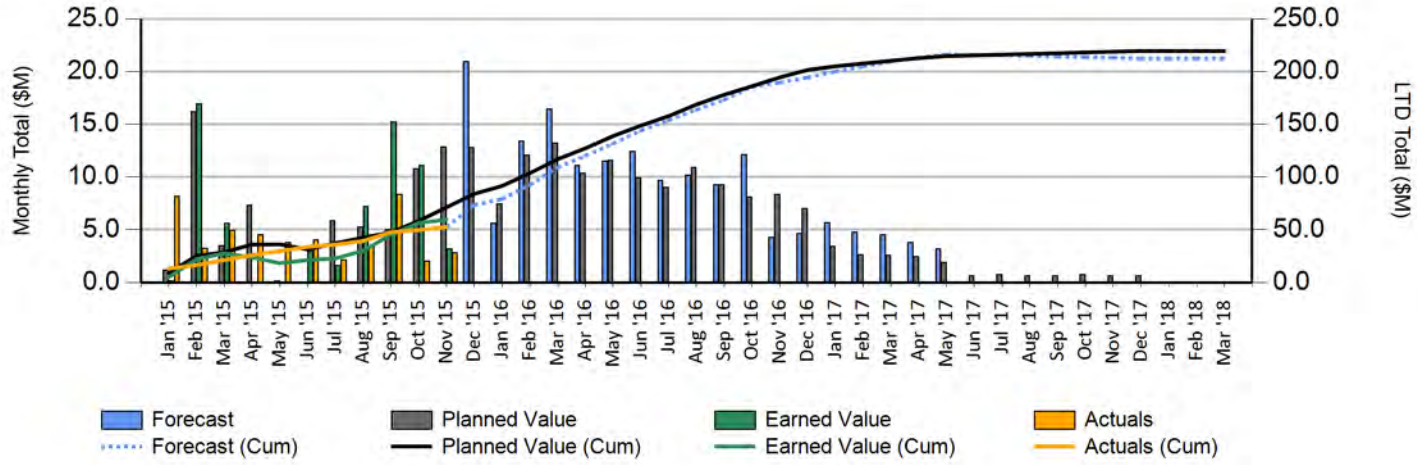
Procurement

- JV continues to advance issuance of Engineered Quotation Requests (EQRs), used to initiate RFPs, ahead of schedule recovery plan resulting in high earned value.
- Although JV recently awarded $3.2M for procurement of material, JV Procurement SPI continues to decline due to procurement delays of bulk materials for pre-fabrication, and subsequent delay on fabrication itself due to lack of materials. Recovery plan has been developed and performance is being tracked.

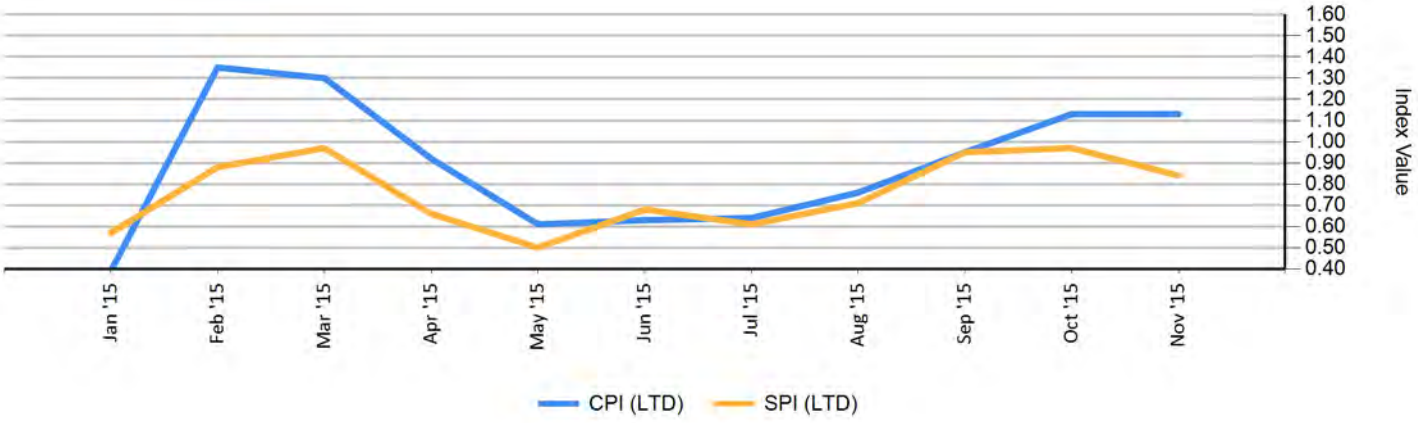
Construction

- Recovery plan for dyke completion is currently on track to complete seismic dyke installation by December 22, 2015.
- Site mobilization by the JV on Nov. 30th was not possible due to delays with pre-fabrication by the JV and remaining work to complete the seismic dyke. A sequenced turnover plan of the basement area was prepared to optimize mobilization and site access while ensuring the remaining civil work could be completed without delay. Site access will be staged over the month of December with full access of 90% of basement beginning Dec. 24th.
- As of today 16 of the 24 process tanks have been delivered to site.
- The 500 ton crane has mobilized to the site as of Dec 17/15, with a target to install one tank the week of December 21/15 in order to gather lessons learned prior to subsequent tank installations in 2016.
- JV on-boarding of required trades continues to support recovery plan.

Cost Performance (EVM)



SPI and CPI Trending (Life to Date EVM)



ONTARIO POWER GENERATION

Quad Chart Report for Nov 2015

F&IP - D2O Storage Facility

Report ID: 105A *Tech Tips*
Report Owner: L. Greenland
Process Owner: D. McAuley
Data Refreshed: 22-Dec-15 10:30 PM

In M dollars	Current Period			Life to Date										At Completion (Life Cycle)				
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	**Cost Variance	Budget Variance	CPI	CPI Trend	SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	Approved Funding	EAC Life Cycle
Project & Modification Vendor	3.95	0.26	0.71	21.31	15.87	10.4	31%	-5.47	-10.91	1.53	↑	0.74	↓	19.28	14.62	33.9	33.9	29.01
- Project Management	0.39	0.13	0.37	3.49	4.5	3.89	54%	-0.62	0.4	1.16	↑	1.29	↓	5.39	1.74	7.13	7.13	7.49
- Engineering	0.08	0.0	0.03	2.93	4.54	3.02	59%	-1.52	0.09	1.50	↓	1.55	↓	10.13	-4.98	5.16	5.16	5.34
- Procurement	3.49	0.13	0.12	14.84	6.78	8.93	42%	2.15	-5.91	0.76	↑	0.46	↓	2.11	19.08	21.19	21.19	21.26
- Construction	0.0	0.0	-0.76	0.05	0.05	1.22	2555%	1.17	1.17	0.04	↑	1.00	—	1.05	-1.0	0.05	0.05	1.22
- Commissioning	0.0	0.0	0.0	0.0	0.0	0.0	0%	0.0	0.0	-	—	-	—	0.3	0.08	0.37	0.37	0.36
- Not Assigned	0.0	0.0	0.95	0.0	0.0	-6.65	0%	-6.65	-6.65	-	—	-	—	0.0	0.0	0.0	0.0	-6.65
Ellis Don	1.96	0.0	0.99	20.26	22.31	21.31	92%	-1.0	1.05	1.05	↑	1.10	↓	14.22	9.02	23.24	23.24	26.16
- Construction	1.96	0.0	0.99	20.26	22.31	21.31	92%	-1.0	1.05	1.05	—	1.10	↓	14.22	9.02	23.24	23.24	26.16
ES-FOX	0.8	0.0	4.49	6.23	3.01	5.96	95%	2.95	-0.27	0.50	↓	0.48	↓	1.58	4.67	6.25	6.25	5.99
- Project Management	0.0	0.0	0.0	0.12	0.12	0.12	100%	0.0	0.0	1.00	—	1.00	—	0.0	0.12	0.12	0.12	0.12
- Construction	0.8	0.0	4.49	6.11	2.89	5.84	95%	2.95	-0.27	0.49	↓	0.47	↓	1.58	4.55	6.13	6.13	5.87
Other	1.04	0.8	-2.82	10.95	9.85	8.83	72%	-1.01	-2.12	1.11	↑	0.90	↓	8.62	3.64	12.26	12.26	11.23
- Project Management	0.0	0.0	0.0	0.25	0.25	0.23	91%	-0.02	-0.02	1.09	↑	1.00	—	0.0	0.25	0.25	0.25	0.23
- Engineering	0.2	0.22	-2.81	4.77	4.79	5.46	110%	0.67	0.69	0.88	↓	1.00	↓	5.35	-0.38	4.97	4.97	5.93
- Construction	0.84	0.58	0.0	5.93	4.81	3.15	45%	-1.66	-2.78	1.53	↑	0.81	↓	2.33	4.7	7.04	7.04	5.07
SLNA	5.15	2.15	-0.56	12.48	8.56	6.09	4%	-2.47	-6.39	1.41	↑	0.69	↓	126.94	16.98	143.93	143.93	139.96
- Project Management	0.89	0.79	0.0	3.67	3.64	3.48	14%	-0.16	-0.19	1.05	↑	0.99	↓	11.74	13.75	25.49	25.49	26.53
- Engineering	0.77	1.01	-0.27	3.4	3.64	2.49	16%	-1.15	-0.91	1.46	↑	1.07	↑	9.85	5.49	15.34	15.34	15.49
- Procurement	3.49	0.19	-0.09	5.41	1.12	0.11	0%	-1.02	-5.3	10.67	↑	0.21	↓	37.58	-1.81	35.77	35.77	30.61
- Construction	0.0	0.16	-0.2	0.0	0.16	0.01	0%	-0.15	0.01	17.47	↑	-	—	67.77	-0.97	66.8	66.8	66.81
- Commissioning							0%	0.0	0.0	-	—	-	—	0.0	0.53	0.53	0.53	0.53
EVM Sub-Total	**12.9**	**3.21**	**2.82**	**71.23**	**59.6**	**52.6**	**24%**	**-7.0**	**-18.63**	**1.13**	↑	**0.84**	↓	**170.63**	**48.94**	**219.58**	**219.58**	**212.35**
Non-EVM Sub-Total*	**1.98**		**4.06**	**126.58**		**131.8**	**82%**		**5.22**					**121.78**	**39.77**	**161.55**	**161.55**	**168.78**
Total	**14.88**		**6.87**	**197.81**		**184.4**	**48%**		**-13.41**					**292.42**	**88.71**	**381.13**	**381.13**	**381.13**

Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

*Non-EVM costs are mainly composed of Interest, Expenses, and Contingency.

Cost Variance Explanation:

- The project is currently forecasting to be under budget for 2015. The forecast is to spend $72.M in 2015, compared to an expected spend of $113.5M in the BCS Approved March 2015. This is attributed to work moving into 2016 per the baseline schedule issued in September 2015 as well as procurement and prefabrication delays.
- A CCF has been prepared to re- baseline cash flows based on the cash flows of the contract awarded to the JV in August 2015
- The project is still forecasting to spend $381.1M including $24M remaining contingency

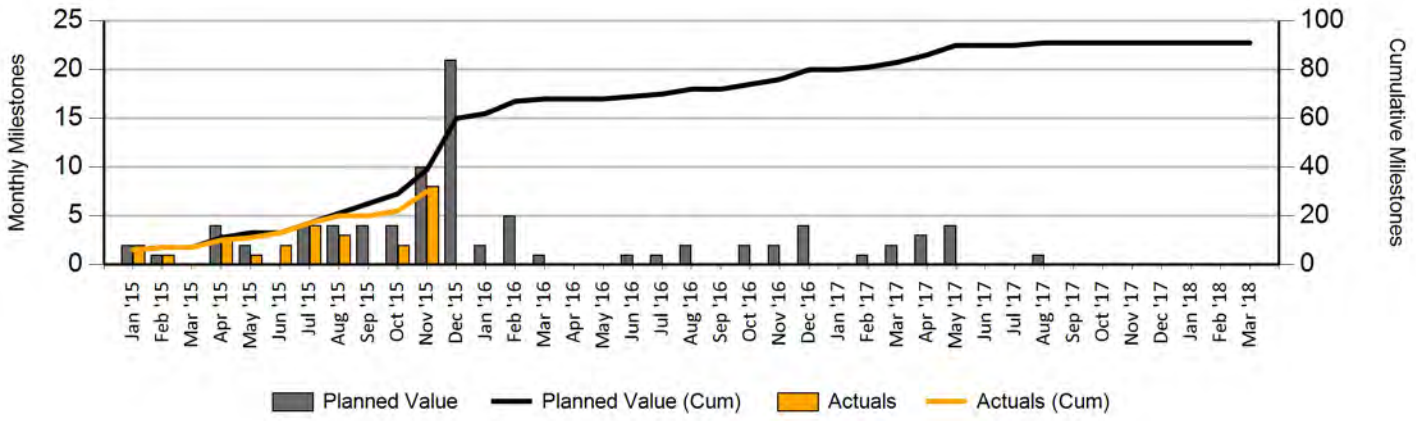
Schedule Performance - Tier 3 and 4 Milestones

ONTARIO POWER GENERATION

Quad Chart Report for Nov 2015

F&IP - D2O Storage Facility

Report ID: 105A *Tech Tips*
Report Owner: L. Greenland
Process Owner: D. McAuley
Data Refreshed: 22-Dec-15 10:30 PM



Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
NR.CP.IN.01.UF.31555.O 31555 - UF - Heavy Water Management Building West Annex - O (920)						
31555MS410	Legacy - Gate 5 Project Close Out Phase Completed (PCO) Contract Terminated	4 - PCO		25-May-17	0	-
31555MS400	Legacy - Gate 4 Process Systems Complete Execution Phase Completed (AFS) Contract Terminated	4 - AFS		09-Aug-17	0	-
31555MS120	Legacy - EPC Design Documents Approved and Issued (ECP) Contract Terminated	3 - ECP	29-May-15	03-Dec-15	-188	XX
31555FM196	First Lift Interior Walls Complete (ED PO: 7-Aug-2015)	3 - N/A	07-Aug-15	26-Nov-15 A	-111	✓
31555FM197	Second Lift Exterior Walls Complete (ED PO: 29-Sep-2015)	3 - N/A	29-Sep-15	19-Nov-15 A	-51	✓
31555FM171	Final AFS - All Commissioning Complete	3 - CMF	15-Oct-15	10-Mar-17	-512	XX
31555FM198	Ready for Tank Installation (ED PO: 22-Dec-2015)	3 - N/A	22-Dec-15	22-Dec-15	0	-
31555SM101	Start of Commissioning (CMS)	3 - CMS	12-Dec-16	03-Dec-15	375	-
NR.CP.IN.01.UF.31555 31555 - UF - Heavy Water Management Building West Annex - (New) (961)						
31555IF500	Receipt Of OPG Supplied-25 Main Process Tanks - 25m3 CL3 - 0-38410-TK8, B100-1, South area, Cleanup	4 - MED		19-Nov-15 A	0	✓✓
31555IF510	Receipt Of OPG Supplied-25 Main Process Tanks - 25m3 CL3 - 0-38410-TK7, B100-1, South area, Cleanup	4 - MED		19-Nov-15 A	0	✓✓
31555IF530	Receipt Of OPG Supplied-25 Main Process Tanks - 25m3 CL3 - 0-38410-TK9, B100-1, South area, Cleanup	4 - MED		19-Nov-15 A	0	✓✓
31555IF520	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK14 , B100-3, North, PHT	4 - MED		27-Nov-15 A	0	✓✓
31555IF550	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK15 , B100-3, North, PHT	4 - MED		30-Nov-15 A	0	✓✓
31555IF590	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK19 , B100-3, North, PHT	4 - MED		30-Nov-15 A	0	✓✓
31555IF560	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK18 , B100-3, North, PHT	4 - MED		03-Dec-15	0	-
31555IF570	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK17 , B100-3, North, PHT	4 - MED		03-Dec-15	0	-
31555IF580	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK20 , B100-2, Center, PHT	4 - MED		03-Dec-15	0	-
31555IF600	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK22 , B100-1, South area, MOD	4 - MED		03-Dec-15	0	-
31555IF610	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK21 , B100-2, Center, PHT	4 - MED		03-Dec-15	0	-
31555IF630	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK23 , B100-1, South area, MOD	4 - MED		03-Dec-15	0	-
31555IF540	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 6 0-38110-TK16 , B100-3, North, PHT	4 - MED		03-Dec-15	0	-
31555IF620	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK24, B100-2, Center, MOD	4 - MED		07-Dec-15	0	-
31555IF640	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK26, B100-2, Center, MOD	4 - MED		07-Dec-15	0	-
31555IF650	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK25, B100-2, Center, MOD	4 - MED		07-Dec-15	0	-
31555IF660	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK28, B100-2, Center, MOD	4 - MED		10-Dec-15	0	-

ONTARIO POWER GENERATION

Quad Chart Report for Nov 2015

F&IP - D2O Storage Facility

Report ID: 105A *Tech Tips*
Report Owner: L. Greenland
Process Owner: D. McAuley
Data Refreshed: 22-Dec-15 10:30 PM

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
31555IF670	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK27, B100-2, Center, MOD	4 - MED		10-Dec-15	0	-
31555IF690	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK29, B100-2, Center, TRF	4 - MED		10-Dec-15	0	-
31555IF680	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK30, B100-2, Center, TRF	4 - MED		15-Dec-15	0	-
31555IF700	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK32 , B100-1, South area, TRF	4 - MED		15-Dec-15	0	-
31555IF710	Receipt Of OPG Supplied-25 Main Process Tanks - 100m3 CL 3 0-38110-TK31 , B100-1, South area, TRF	4 - MED		15-Dec-15	0	-
31555IF720	Receipt Of OPG Supplied-25 Main Process Tanks - 50m3 CL 3 0-38500-TK9, B100-1, South area, Downgraded	4 - MED		17-Dec-15	0	-
31555IF730	Receipt Of OPG Supplied-25 Main Process Tanks - 50m3 CL 3 0-38500-TK8, B100-1, South area, Downgraded	4 - MED		17-Dec-15	0	-
31555IF740	Receipt Of OPG Supplied-25 Main Process Tanks - 25m3 CL 3 0-38500-TK10 , B100 -1, South area, Downgraded	4 - MED		17-Dec-15	0	-
31555M0520	Start Of Installation Of First OPG Supplied Tank	3 - N/A		25-Dec-15	0	-
31555IF160	OPG Supplied Valves at shop 3rd Shipment (Avon-322 Valves)	4 - MED	11-Sep-15	03-Dec-15	-83	XX
31555IF170	OPG Supplied Valves at shop 4th Shipment (Entertech-15 Valves)	4 - MED	21-Sep-15	09-Oct-15 A	-18	✓
31555IF175	OPG Supplied Valves at shop 5th Shipment (Entertech-41Valves)	4 - MED	05-Oct-15	03-Dec-15	-59	XX
31555IF184	OPG Supplied Valves at shop 6th Shipment (Entertech-22 Valves)	4 - MED	14-Oct-15	03-Dec-15	-50	XX
31555IF186	OPG Supplied Valves at shop 7th Shipment (Control Valve-9 Valves)	4 - MED	23-Oct-15	03-Dec-15	-41	XX
31555IF187	OPG Supplied Valves at shop 8th Shipment (Enertech-8 Valves)	4 - MED	16-Nov-15	09-Oct-15 A	38	✓✓
31555M0260	Revise Resources for Steel Subcontractor	4 - SOI	19-Nov-15	03-Dec-15	-14	XX
31555M0250	Revise Resources for HVAC Subcontractor	4 - SOI	24-Nov-15	03-Dec-15	-9	XX
31555M0030	OPG-Dyke Construction Complete (Ready for Tank Installation)	4 - IPC	30-Nov-15	03-Dec-15	-3	XX
31555IF120	Receipt Of OPG Supplied-Class 3/6 Pumps	4 - MED	15-Jan-16	15-Jan-16	0	-
31555IF220	Receive From OPG Vendor Documents Pumps	4 - MED	15-Jan-16	15-Jan-16	0	-
31555IF130	Receipt Of OPG Supplied-3 Auxiliary / Non Storage Tanks	4 - MED	01-Feb-16	01-Feb-16	0	-
31555IF188	OPG Supplied Valves at shop 9th Shipment (Enertech-3 Valves)	4 - MED	01-Feb-16	01-Feb-16	0	-
31555IF200	Receive From OPG Vendor Documents Tanks	4 - MED	01-Feb-16	01-Feb-16	0	-
31555IF210	Receive From OPG Vendor Documents Valves	4 - MED	01-Feb-16	01-Feb-16	0	-
31555M0040	All Tanks Placed In Basement (BSC Milestone)	4 - FOI	09-Feb-16	09-Feb-16	0	-
31555IF110	Receipt Of OPG Supplied-Vapour Recovery Heat Exchangers	4 - MED	15-Mar-16	15-Mar-16	0	-
31555M0050	Capable Of Receiving Refurbishment water Unit 2 - TMOD Staged (BCS Milestone)	3 - FOI	28-Jun-16	27-Jun-16	1	-
31555M0170	Detailed Design Complete	3 - EDD	26-Jul-16	07-Sep-16	-43	X
31555M0060	Commissioning Spares List Identified	4 - DCS	04-Aug-16	23-Aug-16	-19	X
31555M0070	Prefab piping/supports installation in existing HWMB complete	4 - FOI	05-Aug-16	05-Aug-16	0	-
31555IF240	Start Of Outage Segment 1	3 - WNS	17-Oct-16	17-Oct-16	0	-
31555M0200	All Design Updated With Vendor Documents And Issued As New Revision	4 - EDD	24-Oct-16	26-Oct-16	-2	X
31555M0080	Building Piping Installation Complete	4 - FOI	03-Nov-16	07-Nov-16	-4	X
31555M0090	Electrical Installation Complete	4 - FOI	16-Nov-16	26-Oct-16	21	-
31555M0110	Building Shell Complete	4 - CCD	07-Dec-16	07-Dec-16	0	-
31555M0100	Start of Commissioning (BSC Milestone)	3 - CMS	12-Dec-16	14-Dec-16	-2	X
31555M0220	Start of Commissioning - JV	3 - CMS	12-Dec-16	14-Dec-16	-2	X
31555IF250	Start Of Execution Window "PHT Bulk Drain"	3 - WNS	08-Feb-17	08-Feb-17	0	-
31555M0330	Construction Substantially Complete (excluding precommissioning)	4 - AFS	29-Mar-17	06-Feb-17	51	-
31555IF270	PHT And Mod Drain / Dry Complete For Unit 2	3 - IPC	29-Mar-17	29-Mar-17	0	-
31555IF260	End Of Segment #1	3 - WNF	03-Apr-17	03-Apr-17	0	-
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4 - CMF	19-Apr-17	21-Apr-17	-2	X
31555PED20	Project Completion (AFS) - JV	3 - AFS	19-Apr-17	21-Apr-17	-2	X
31555IF280	Start Execution Moderator Drain & Flush	3 - WNS	11-May-17	11-May-17	0	-
31555M0130	Project Close-out Complete	4 - PCO	23-May-17	23-May-17	0	-
31555PED30	Project Close out complete	4 - PCO	23-May-17	23-May-17	0	-

Legend: ✓✓ Milestone Completed Early/On Time | - Milestone On Track | X Milestone At Risk

ONTARIO POWER GENERATION

Quad Chart Report for Nov 2015

F&IP - D2O Storage Facility

Report ID: 105A *Tech Tips*
Report Owner: L. Greenland
Process Owner: D. McAuley
Data Refreshed: 22-Dec-15 10:30 PM

✓	Milestone Completed Late		XX	Milestone Missed

Milestone list represents a 30 day historical view and a lookahead to 2018-03-01

Schedule Variance Explanation:

- Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work
- EllisDon continues to execute recovery schedule, targeting December 22, 2015 for basement dyke completion

Risk Performance

ID	Title	Risk Description	Current Score	Post Score
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM) will not be ordered in time to support the construction schedule.	12	12
13953	16-31555 Risk of delayed mobilization to site due to spool piece fabrication delays	The JV is currently behind in their prefabrication of spools and supports, increasing risk to November 30, 2015 readiness. Spool pieces are under wayin Dec2015 and now scheduled according to a recovery schedule.	6	1
12277	16-31555 D2O Storage Project: Risk of Damage to Storage Tank	There is a risk that one or more of the heavy water storage tanks will be damaged prior to being placed in service.	5	5
13532	16-31555 D2O Storage Project: Transition between engineering vendors	There is a risk that the transition between the two engineering vendors may result in additional costs and schedule due to the state of the Revision 0 design packages. In addition, field support from the new vendor on the previous vendors design may result in additional design changes due to different designers interpretation of codes/standards. This field support could cause construction delays. Also any latent design errors will have to be revised by the new engineering vendor.	3	3

Risk Additional Explanation:

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Executive Summary:

Updated March 18, 2016

Cost Performance

- The Project spent $9.04M in February bringing total project spend to $208.0M LTD at February month end.
- Costs are moderately on track, with a current CPI of 0.97. Of concern is the JV CPI of 0.91, which represents a majority of the remaining planned value for this project.

Schedule Performance

- Overall schedule performance is "poor" with an overall SPI of 0.85. This is mainly driven by pipe pre-fabrication and installation significantly off plan to the baseline.
- JV SPI currently reporting 0.58 due to the issues with bulk material procurement, which is a bottle neck for the fabrication and installation process.
- A recovery schedule was put in place on January 14, 2016, and the JV is falling behind this recovery plan with an SPI of 0.88. This is mainly due to material delivery to site and receipting as well as pre-fabrication progress.

Procurement

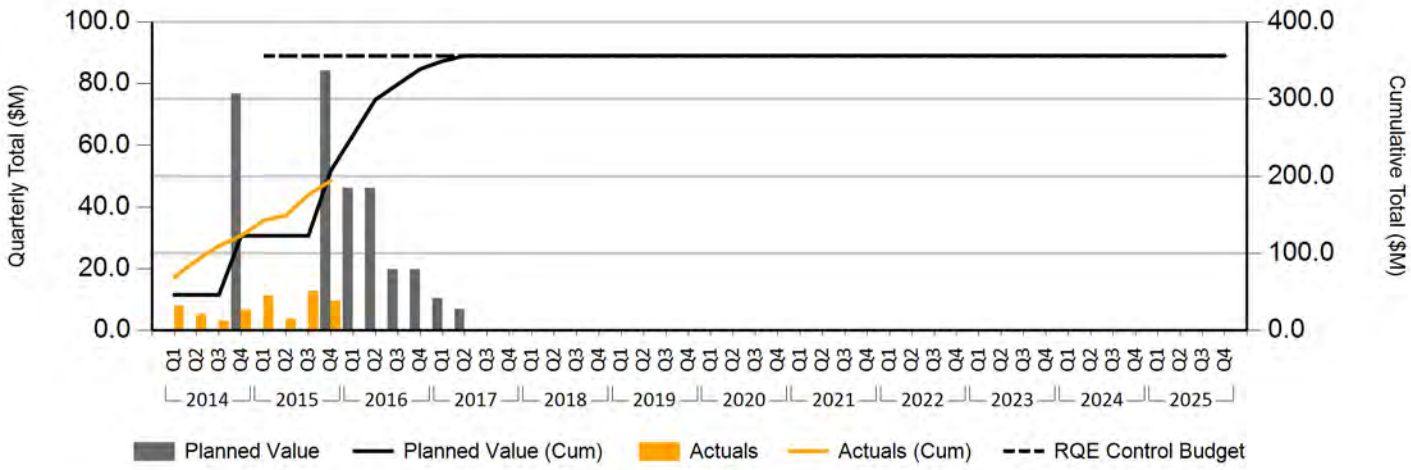
- JV bulk material procurement to support pre-fabrication is falling behind recovery plan to allocate material to the fabrication floor for welding.
- 17 of 25 POs have been issued for engineering procurement.

Construction

- 11 tanks have been installed
- All of the angles on the perimeter wall for process piping have been installed.
- The temporary dome is fully installed and in use which will provide shelter from the winter weather.

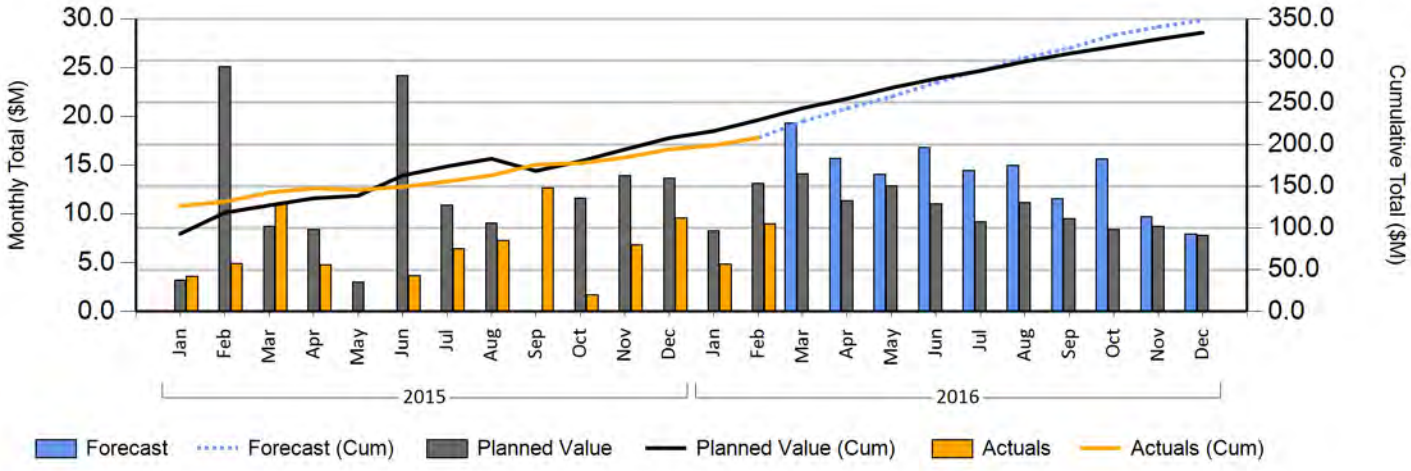
RQE Life Cycle Funding

RQE Life Cycle Original Budget	RQE Life Cycle Control Budget	Life to Date Actual	Released Control Budget
$356.23M	$356.23M	$194.04M	$356.5M



*Cost information in the above graph and table relating to RQE includes Interest and Escalation. Contingency is not included.

Released Cost



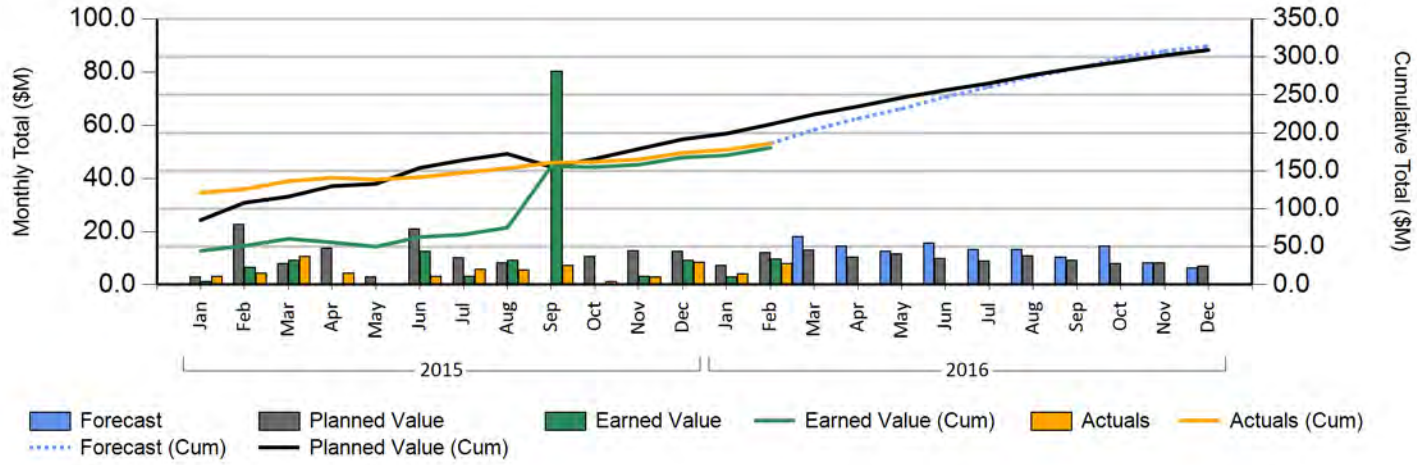
ONTARIO POWER GENERATION

Project Report for Feb 2016

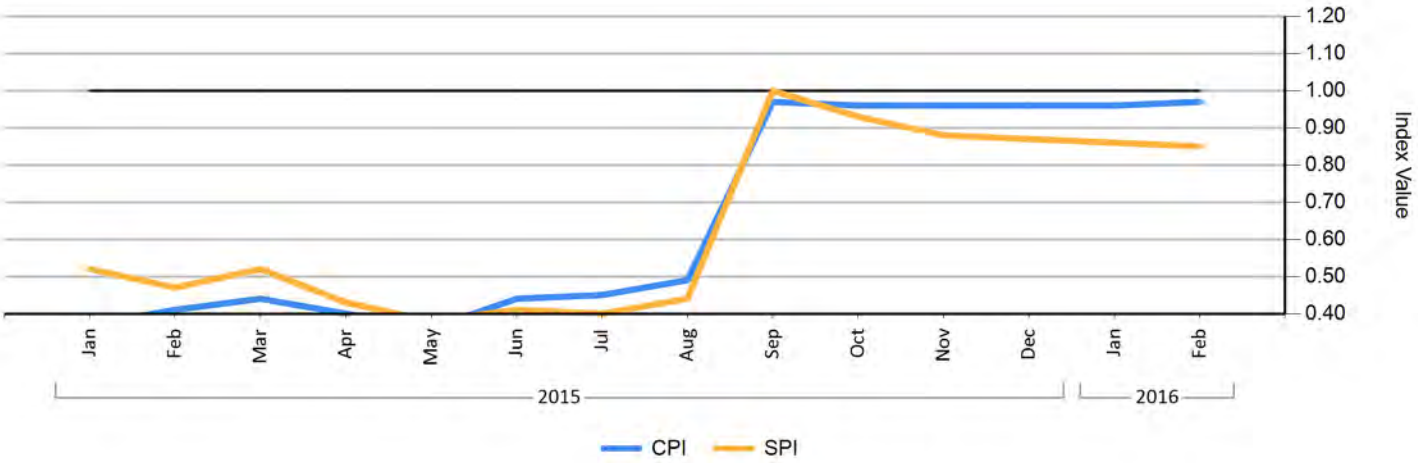
F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Released Earned Value (EVM) Cost



SPI and CPI Trending (Life to Date EVM)



In M dollars	Current Period			Life to Date										At Completion (Gate)			
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	Cost Variance	Budget Variance	*CPI	CPI Trend	*SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	EAC for Released
Project & Modification Vendor	0.53	0.24	0.57	15.5	15.51	8.82	37%	-6.69	-6.68	1.76	↓	1.00	↓	15.23	8.62	23.85	34.83
- Cost Management							0%	0.0	0.0	-	—	-	—	0.0	0.0	0.0	9.33
- Project Management	0.22	0.09	0.36	3.66	4.22	4.3	66%	0.07	0.64	0.98	↓	1.15	↓	5.22	1.29	6.51	7.03
- Engineering	0.02	0.0	0.02	1.0	2.48	0.51	16%	-1.97	-0.5	4.89	↓	2.47	↓	9.05	-5.95	3.1	2.71
- Procurement	0.26	0.13	0.17	10.8	8.77	4.0	29%	-4.77	-6.8	2.19	↓	0.81	↓	0.67	13.2	13.87	15.03
- Commissioning	0.02	0.02	0.0	0.04	0.04	0.0	0%	-0.04	-0.04	-	—	0.99	↑	0.3	0.08	0.37	0.71
- Not Assigned	0.0	0.0	0.03	0.0	0.0	0.02	0%	0.02	0.02	-	—	-	—	0.0	0.0	0.0	0.02
Ellis Don	0.19	-1.16	0.66	27.74	26.43	31.43	105%	3.6	3.59	0.88	↓	1.00	↓	24.32	5.54	29.86	32.61
- Cost Management	0.0		0.01	1.3		1.4	108%	0.0	0.0	-	—	-	—	0.0	1.3	1.3	1.4
- Construction	0.19	-1.16	0.65	26.44	26.43	30.03	105%	3.6	3.59	0.88	↓	1.00	↓	23.02	5.54	28.56	31.21
- Close Out	0.0		0.0	0.0		0.0	0%	0.0	0.0	-	—	-	—	1.3	-1.3	0.0	0.0

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

In M dollars	Current Period			Life to Date										At Completion (Gate)			
Project	Planned Value	Earned Value	Actuals	Planned Value	Earned Value	Actuals	% Spent	Cost Variance	Budget Variance	*CPI	CPI Trend	*SPI	SPI Trend	Original Budget	Directed Changes	Control Budget	EAC for Released
ES-FOX	-0.01	0.0	0.5	6.29	4.08	7.02	112%	2.94	0.72	0.58	↓	0.65	—	1.58	4.67	6.25	7.77
- Project Management	0.0	0.0	0.0	0.12	0.12	0.12	100%	0.0	0.0	1.00	—	1.00	—	0.0	0.12	0.12	0.12
- Construction	-0.01	0.0	0.5	6.17	3.96	6.9	113%	2.94	0.72	0.57	↓	0.64	—	1.58	4.55	6.13	7.65
Other	0.04	0.04	0.29	12.62	11.08	10.31	79%	-0.78	-2.31	1.08	↓	0.88	—	8.18	4.79	12.98	13.48
- Project Management	0.0	0.0	0.0	1.12	1.12	1.43	127%	0.31	0.31	0.78	↓	1.00	—	0.75	0.37	1.12	2.11
- Engineering	0.0	0.0	0.1	4.47	4.47	4.96	111%	0.49	0.49	0.90	↓	1.00	—	4.46	0.01	4.47	7.17
- Construction	0.04	0.04	0.19	6.65	5.49	3.54	51%	-1.95	-3.11	1.55	↓	0.83	↑	2.33	4.68	7.01	3.83
- Close Out	0.0	0.0	0.0	0.37	0.0	0.37	100%	0.37	0.0	-	—	-	—	0.63	-0.26	0.37	0.37
SLNA	11.36	10.66	5.83	38.32	22.47	23.88	16%	1.38	-14.46	0.94	↑	0.59	↑	149.38	-3.18	146.19	146.72
- Cost Management	0.0		0.02	0.0		0.03	1%	0.0	0.0	-	—	-	—	0.0	2.27	2.27	2.29
- Project Management	0.94	0.97	1.57	6.62	6.71	14.07	55%	7.36	7.45	0.48	↑	1.01	—	11.74	13.75	25.49	33.0
- Engineering	0.88	1.11	1.12	5.95	5.65	4.42	29%	-1.23	-1.53	1.28	↓	0.95	↑	9.85	5.49	15.34	13.69
- Procurement	2.07	4.64	0.29	10.35	6.03	0.61	2%	-5.42	-9.74	9.90	↑	0.58	↑	37.58	-1.81	35.77	27.87
- Construction	7.47	3.93	2.83	15.39	4.09	4.75	7%	0.66	-10.64	0.86	↑	0.27	↑	90.2	-23.41	66.8	69.33
- Commissioning							0%	0.0	0.0	-	—	-	—	0.0	0.53	0.53	0.53
Legacy	1.08	0.0	1.19	128.72	100.71	126.54	92%	5.24	-6.08	0.95	—	0.90	—	93.74	43.64	137.37	145.75
Total	**13.2**	**9.78**	**9.04**	**229.19**	**180.28**	**208.0**	**58%**	**5.69**	**-25.22**	**0.97**	↑	**0.85**	↓	**292.42**	**64.08**	**356.5**	**381.15**

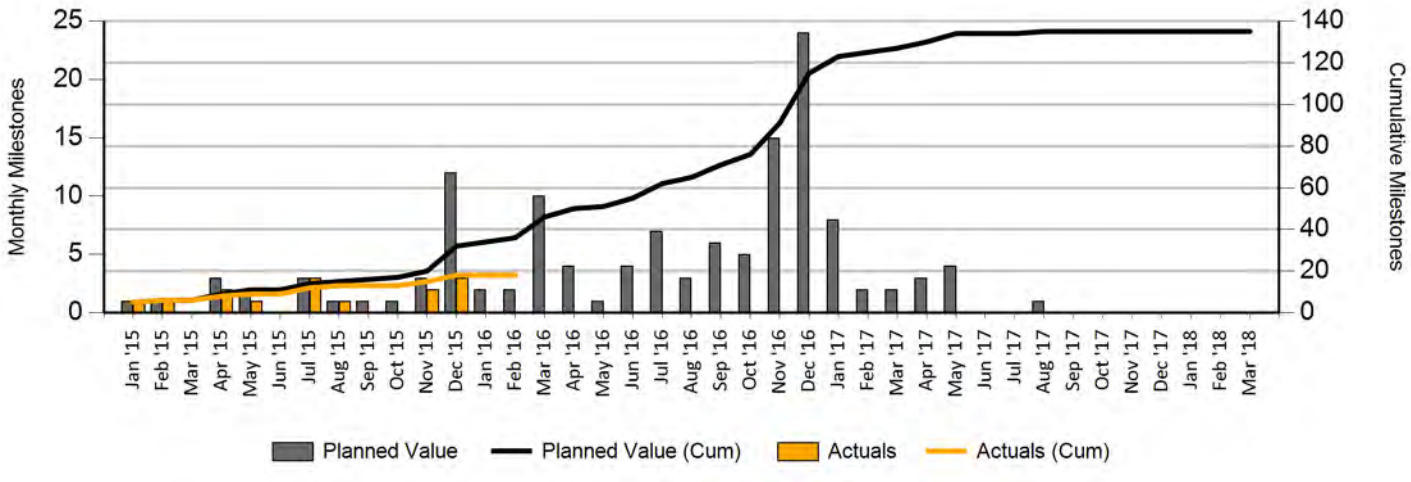
Legend:	Poor	Moderate	Good	Excellent	Good	Moderate
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09

Cost Variance Explanation:

- The JV has provided a new Project Controls Plan to align with the recently uploaded recovery schedule. This will modify the earning rules. This plan is currently under review by the OPG team

- Current CPI of the project is 0.97, and 0.91 for the JV. This is a significant increase from last month's JV CPI (0..65) which is due to the placement of 6 additional tanks in the dyke.

Schedule Performance - Tier 3 and 4 Milestones



ONTARIO POWER GENERATION

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
NR.CP.IN.01.UF.31555.O 31555 - UF - Heavy Water Management Building West Annex Project -- BLM (920)						
31555MS410	Legacy - Gate 5 Project Close Out Phase Completed (PCO) Contract Terminated	4 - PCO		25-May-17	0	-
31555MS400	Legacy - Gate 4 Process Systems Complete Execution Phase Completed (AFS) Contract Terminated	4 - AFS		09-Aug-17	0	-
31555MS120	Legacy - EPC Design Documents Approved and Issued (ECP) Contract Terminated	3 - ECP	29-May-15	11-Mar-16	-287	XX
31555FM171	Final AFS - All Commissioning Complete	3 - CMF	15-Oct-15	16-Jun-17	-610	XX
31555SM101	Start of Commissioning (CMS)	3 - CMS	12-Dec-16	31-Jan-17	-50	X
NR.CP.IN.01.UF.31555 31555 - UF - Heavy Water Management Building West Annex Project -- SNC (961)						
A71216	T-19 Schedule the Task on IPG - Objectives met - Storage Tank level indicators HWMB Control Room Tie-Ins	4 - PTI		13-Jun-16	0	-
A71716	T-19 Schedule the Task on IPG - Objectives met - Termination of D2O power cables to Municipal SwitchGear 53	4 - PTI		13-Jun-16	0	-
A71516	T-19 Schedule the Task on IPG - Objectives met - EL.100 Telephone and LAN - Tie in to HWMB	4 - PTI		06-Jul-16	0	-
A71116	T-19 Schedule the Task on IPG - Objectives met - Storage Tank/equip control systems HWMB Control Room Tie-Ins	4 - PTI		08-Jul-16	0	-
A71416	T-19 Schedule the Task on IPG - Objectives met - EL.100 PA system installation - tie in to HWMB	4 - PTI		08-Jul-16	0	-
A71016	T-19 Schedule the Task on IPG - Objectives met - EL.107 Beetles System Tie-In with existing building CDF	4 - PTI		18-Jul-16	0	-
A70916	T-19 Schedule the Task on IPG - Objectives met - Fire and Smoke Detection System Tie-Ins with HWMB	4 - PTI		21-Jul-16	0	-
A71316	T-19 Schedule the Task on IPG - Objectives met - FAAGM and FAATM Tie-Ins	4 - PTI		19-Aug-16	0	-
A71256	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Storage Tank level indicators HWMB Control Room Tie-Ins	4 - PCM		05-Sep-16	0	-
A71756	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Termination of D2O power cables to Municipal SwitchGear 53	4 - PCM		05-Sep-16	0	-
A71616	T-19 Schedule the Task on IPG - Objectives met - DCU4 - Cable routing, C.INST. and terminations of complete system	4 - PTI		12-Sep-16	0	-
A71556	T-9 Pre T-8 Logic Schedule Issued - Objectives met - EL.100 Telephone and LAN - Tie in to HWMB	4 - PCM		28-Sep-16	0	-
A71156	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Storage Tank/equip control systems HWMB Control Room Tie-Ins	4 - PCM		30-Sep-16	0	-
A71456	T-9 Pre T-8 Logic Schedule Issued - Objectives met - EL.100 PA system installation - tie in to HWMB	4 - PCM		30-Sep-16	0	-
A71056	T-9 Pre T-8 Logic Schedule Issued - Objectives met - EL.107 Beetles System Tie-In with existing building CDF	4 - PCM		10-Oct-16	0	-
A70956	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Fire and Smoke Detection System Tie-Ins with HWMB	4 - PCM		13-Oct-16	0	-
A71356	T-9 Pre T-8 Logic Schedule Issued - Objectives met - FAAGM and FAATM Tie-Ins	4 - PCM		11-Nov-16	0	-
A71656	T-9 Pre T-8 Logic Schedule Issued - Objectives met - DCU4 - Cable routing, C.INST. and terminations of complete system	4 - PCM		05-Dec-16	0	-
31555M0260	Revise Resources for Steel Subcontractor	3 - SOI	18-Nov-15	11-Mar-16	-114	XX
31555M0250	Revise Resources for HVAC Subcontractor	3 - SOI	23-Nov-15	11-Mar-16	-109	XX
A15180	T-19 Schedule the Task on IPG - Objectives met - Reconfiguration Of the D2O Cleanup System	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15280	T-19 Schedule the Task on IPG - Objectives met - Tie In To D2O Cleanup System	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15380	T-19 Schedule the Task on IPG - Objectives met - Tie In To Moderator D2O Supply	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15480	T-19 Schedule the Task on IPG - Objectives met - Tie In To PHT D2O Supply/Transfer System	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15580	T-19 Schedule the Task on IPG - Objectives met - Tie In To Upgrader System	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15680	T-19 Schedule the Task on IPG - Objectives met - Tie In To Domestic Water System	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15780	T-19 Schedule the Task on IPG - Objectives met - Tie In To Demineralised Water	4 - PTI	09-Dec-15	19-May-16	-162	XX
A16280	T-19 Schedule the Task on IPG - Objectives met - Relocation Of Elec/IC Lines In Loading Bay	4 - PTI	09-Dec-15	19-May-16	-162	XX
A15880	T-19 Schedule the Task on IPG - Objectives met - Tie In And Transfer Sewage System	4 - PTI	09-Dec-15	29-Jun-16	-203	XX
A15980	T-19 Schedule the Task on IPG - Objectives met - Tie in To Fire Water Protection	4 - PTI	09-Dec-15	06-Jul-16	-210	XX

ONTARIO POWER GENERATION

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
A16180	T-19 Schedule the Task on IPG - Objectives met - Relocation Of Mech Lines In Loading Bay	4 - PTI	27-Jan-16	19-May-16	-113	XX
31555M0140	Tanks Installed	4 - FOI	28-Jan-16	05-Apr-16	-68	XX
A16080	T-19 Schedule the Task on IPG - Objectives met - Tie in To Breathing Air	4 - PTI	02-Feb-16	19-May-16	-107	XX
31555M0040	All Tanks Placed In Basement (BSC Milestone)	4 - FOI	09-Feb-16	31-Mar-16	-51	XX
A15220	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Reconfiguration Of the D2O Cleanup System	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15320	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To D2O Cleanup System	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15420	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To Moderator D2O Supply	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15520	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To PHT D2O Supply/Transfer System	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15620	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To Upgrader System	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15720	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To Domestic Water System	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15820	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In To Demineralised Water	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A16320	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Relocation Of Elec/IC Lines In Loading Bay	4 - PCM	02-Mar-16	11-Aug-16	-162	XX
A15920	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In And Transfer Sewage System	4 - PCM	02-Mar-16	21-Sep-16	-203	XX
A16020	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie in To Fire Water Protection	4 - PCM	02-Mar-16	28-Sep-16	-210	XX
31555M0290	100 EL Slab Poured	4 - FOI	08-Apr-16	15-Jun-16	-68	X
A16220	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Relocation Of Mech Lines In Loading Bay	4 - PCM	20-Apr-16	11-Aug-16	-113	X
31555M0300	Start Pipe Chase	3 - SOI	26-Apr-16	06-Jun-16	-41	X
A16120	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie in To Breathing Air	4 - PCM	26-Apr-16	11-Aug-16	-107	X
31555M0310	Start steel erection work on West Annex Bldg - EL 100	3 - SOI	19-May-16	25-Jul-16	-67	X
31555M0050	Capable Of Receiving Refurbishment water Unit 2 - TMOD Staged (BCS Milestone)	4 - FOI	27-Jun-16	28-Jun-16	-1	X
31555M0150	All Piping and Pumps Installed in Basement	4 - FOI	27-Jun-16	14-Oct-16	-109	X
31555M0160	Building Structural Steel Complete	4 - FOI	11-Jul-16	05-Sep-16	-56	X
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3 - SOI	12-Jul-16	06-Sep-16	-56	X
31555M0070	Prefab piping/supports installation in existing HWMB complete	4 - FOI	04-Aug-16	29-Aug-16	-25	X
31555M0180	All Tie In Completed	4 - FOI	04-Aug-16	02-Nov-16	-90	X
A30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	3 - CMS	20-Oct-16	08-Dec-16	-49	X
31555M0190	Pipe Chase/ Causeway Civil Complete	4 - FOI	24-Oct-16	20-Oct-16	4	-
31555M0210	All Piping Prefab Complete	4 - FOI	26-Oct-16	26-Oct-16	0	-
31555M0080	Building Piping Installation Complete	4 - FOI	02-Nov-16	03-Nov-16	-1	X
31555M0090	Electrical Installation Complete	4 - FOI	16-Nov-16	14-Dec-16	-28	X
A30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	3 - CMS	26-Nov-16	10-Dec-16	-14	X
A30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	3 - CMS	29-Nov-16	05-Jan-17	-37	X
A30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distribution system	3 - CMS	29-Nov-16	24-Jan-17	-56	X
A30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	3 - CMS	30-Nov-16	29-Nov-16	1	-
A30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive), CDF rack	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30895	Release For Commissioning-EC#120494-I&C-#77 Ventilation System I&C	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	3 - CMS	30-Nov-16	03-Dec-16	-3	X
A30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	3 - CMS	30-Nov-16	03-Dec-16	-3	X

ONTARIO POWER GENERATION

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
A30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	3 - CMS	30-Nov-16	07-Dec-16	-7	X
A30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	3 - CMS	01-Dec-16	23-Jan-17	-53	X
A31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Domestic Water	3 - CMS	02-Dec-16	10-Dec-16	-8	X
A30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery Sump	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	3 - CMS	05-Dec-16	06-Dec-16	-1	X
A30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	3 - CMS	06-Dec-16	03-Dec-16	3	-
A30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	3 - CMS	08-Dec-16	03-Dec-16	5	-
A1635	Release For Commissioning-Hydrotest / Leakage Test Pipelines	3 - CMS	09-Dec-16	07-Dec-16	2	-
A30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	3 - CMS	10-Dec-16	07-Dec-16	3	-
A30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	3 - CMS	10-Dec-16	12-Dec-16	-2	X
A30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	3 - CMS	12-Dec-16	03-Dec-16	9	-
31555M0100	Start of Commissioning (BSC Milestone)	3 - CMS	12-Dec-16	12-Dec-16	0	-
31555M0220	Start of Commissioning - JV	3 - CMS	12-Dec-16	12-Dec-16	0	-
A31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	3 - CMS	12-Dec-16	12-Dec-16	0	-
A31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	3 - CMS	13-Dec-16	22-Dec-16	-9	X
A30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	3 - CMS	22-Dec-16	05-Jan-17	-14	X
A30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	3 - CMS	24-Dec-16	15-Dec-16	9	-
31555M0230	All Electrical on 108 el installed	4 - FOI	28-Dec-16	01-Dec-16	27	-
A30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	3 - CMS	03-Jan-17	22-Dec-16	12	-
A30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	3 - CMS	07-Jan-17	07-Jan-17	0	-
A31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	3 - CMS	09-Jan-17	14-Jan-17	-5	X
A30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	3 - CMS	16-Jan-17	07-Dec-16	40	-
A1645	Release For Commissioning-Flushing / Cleaning of Pipelines	3 - CMS	18-Jan-17	16-Jan-17	2	-
A1615	Release For Commissioning-Electrical Testing	3 - CMS	24-Jan-17	03-Feb-17	-10	X
A30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	3 - CMS	25-Jan-17	07-Jan-17	18	-
A31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	3 - CMS	25-Jan-17	04-Feb-17	-10	X
A1665	Release For Commissioning-Mechanical Equipment Start-up	3 - CMS	15-Feb-17	06-Mar-17	-19	X
A30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	3 - CMS	15-Feb-17	25-Mar-17	-38	X
A1655	Release For Commissioning-Fire Detection (Alarm) System Testing	3 - CMS	07-Mar-17	16-Mar-17	-9	X
31555M0330	Construction Substantially Complete (excluding precommissioning)	3 - AFS	21-Mar-17	10-Mar-17	11	-
A1625	Release For Commissioning-HVAC Start-up	3 - CMS	04-Apr-17	25-Mar-17	10	-
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4 - CMF	19-Apr-17	19-Apr-17	0	-
31555PED20	Project Completion (AFS) - JV	3 - AFS	19-Apr-17	19-Apr-17	0	-

ONTARIO POWER GENERATION

Project Report for Feb 2016

F&IP - D2O Storage Facility

Report ID: 0105A *Tech Tips*
Report Owner: L. Greenland
Project Manager: A. Colella
Data Refreshed: 02-Mar-16

Activity ID	Activity Name	Tier	Baseline Date	Current Date	Variance (Days)	Status
31555M0130	Project Close-out Complete	4 - PCO	23-May-17	23-May-17	0	-
31555M0240	Final Completion / Project Closeout	4 - PCO	23-May-17	23-May-17	0	-
31555PED30	Project Close out complete	4 - PCO	23-May-17	23-May-17	0	-

Legend:

✓✓	Milestone Completed Early/On Time	-	Milestone On Track	X	Milestone At Risk
✓	Milestone Completed Late			XX	Milestone Missed

Milestone list represents a 30 day historical view and a 60 day look ahead or any AFS Milestones in 2016.

Schedule Variance Explanation:

- Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work. Also the ability to get materials to the field have held up adding a second shift to recovery schedule. Recovery plan has been uploaded to the system on January 14, 2016

- Current SPI of the project is 0.85, and 0.58 for the JV. Based on the new recovery schedule, the JV SPI is 0.88.

Risk Performance

ID	Title	Risk Description	Current Score	Post Score
12334	16-31555 D2O Storage Project: Construction Delays Due to LLM Ordering Delays	There is a risk that long lead materials (LLM)/Bulk materials will not be ordered/delivered in time to support the construction schedule.	12	12
14177	16-31555 - 11 New Design EC's Completion Date	The 11 new DEC's for JV to complete have a completion date (per the latest recovery schedule) of late 2016, threatening the installation and commissioning milestones.	12	6
14179	16-31555 - Commissioning Requirements/Schedule	Need to identify commissioning team lead, and develop commissioning strategy, including light vs. heavy water commissioning.	9	2
13953	16-31555 Risk of delayed mobilization to site due to spool piece fabrication delays	The JV is currently behind in their prefabrication of spools and supports, increasing schedule risk per the recovery schedule. Spool pieces are currently being fabricated and installed, and not in alignment with the recovery schedule.	6	4

Risk Additional Explanation:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Executive Summary:

Updated July 15, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality
N-2016-17063 - Job-box inadvertently tipped over
N-2016-15855 - Steel wedge dislodged from beam pocket and fell 30' to basement floor in safe work area
N-2016-14771 - Worker drilled through empty conduit

Accomplishments/Issues
- Start of Q-deck and rebar installation to support the 100el floor slab pour (critical path)
- All basement wall spools installed
- All mechanical equipment lowered into basement (pre-requisite to Q-deck install)

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.80. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.52 due to delays in steel fabrication.
- A recovery schedule was put in place on January 14, 2016, and the JV is falling behind this recovery plan with an SPI of 0.72. OPG has reviewed the latest JV schedule and revised logic ties together with JV. Revised schedule uploaded into P6 on June 10, 2016
- Current AFS date is on plan for May 1, 2017.

Cost
- The Project spent $10.7M in June against a plan of $12.1M bringing total project spend to $250.4M LTD at June month end.
- Current EAC remains in alignment with BCS released value of $381.1M.

Cost Summary:

Life to Date costs are $250.4M against a control budget of $298.3M, with an overall CPI of 0.96. Forecasted EAC is $381.1M.

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Current date for pouring the 100el floor slab is July 30, 2016.

Resource Summary:

Risk Summary:

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Structural Steel is currently critical path to support pouring of the 100el floor slab.

ONTARIO POWER GENERATION

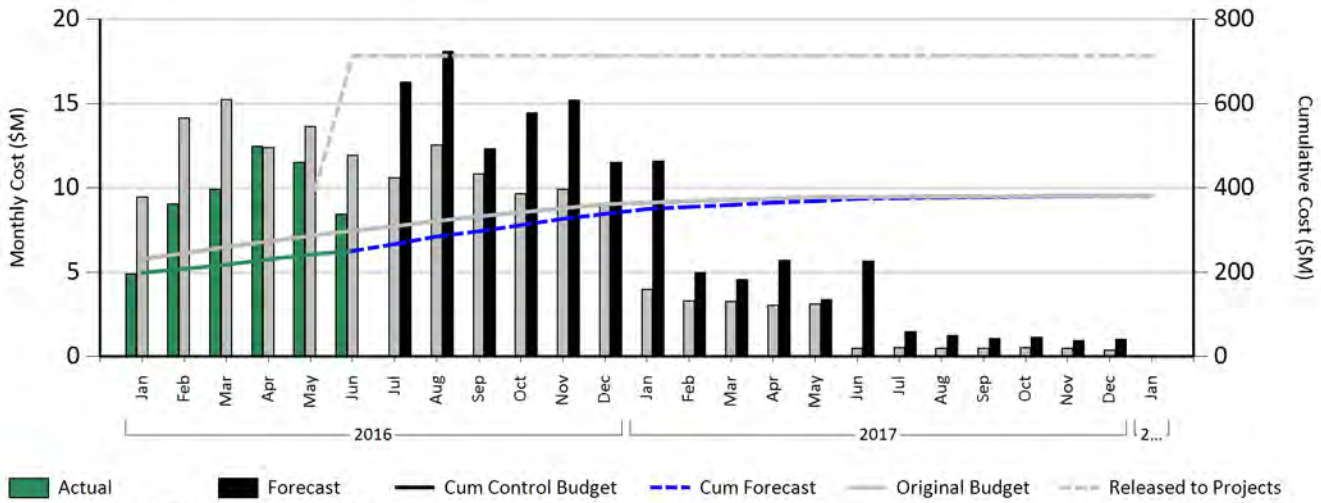
Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

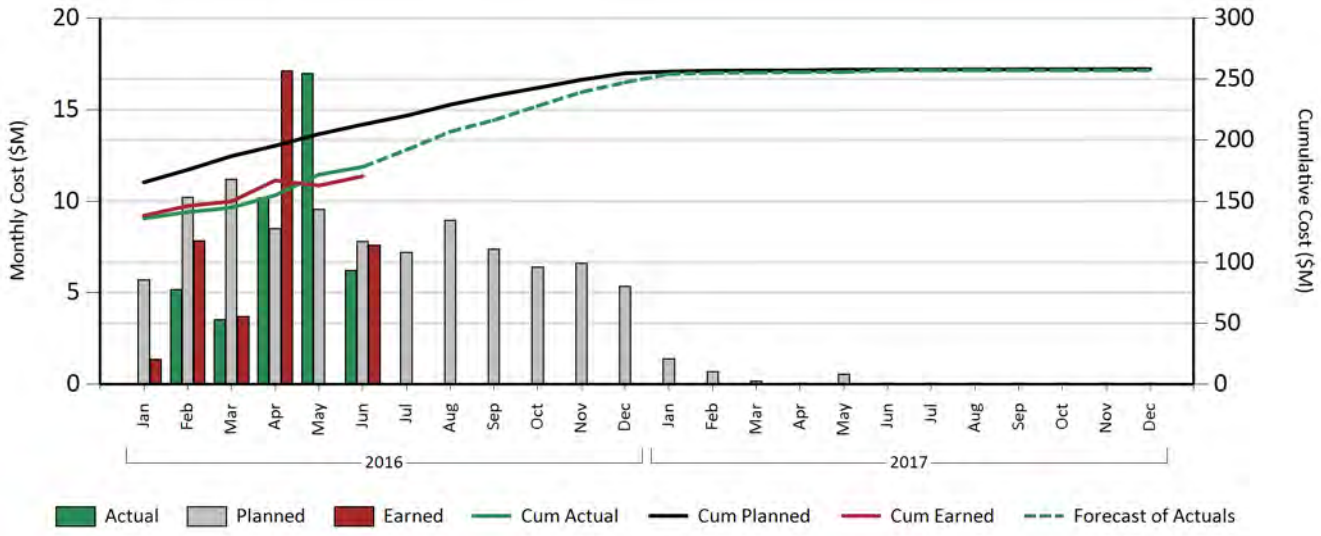
Filters Applied:
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Project: 31555 - D2O Storage Facility-UFCP, 00000 - NA
Bundle: All
Vendor: All

(1) 24 MONTH VIEW - COST PERFORMANCE *($ MILLIONS)*



Life-To-Date	
Original Budget	298,332
Control Budget	298,332
Actual	250,388
Variance-to-Control Budget	(47,945)
% of Control Budget Spent	84%
Funding Released to Projects	356,496

(2) 24 MONTH VIEW - EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	212,891
Earned Value	170,536
Actual	178,141
Cost Performance Index	0.96
Schedule Performance Index	0.80

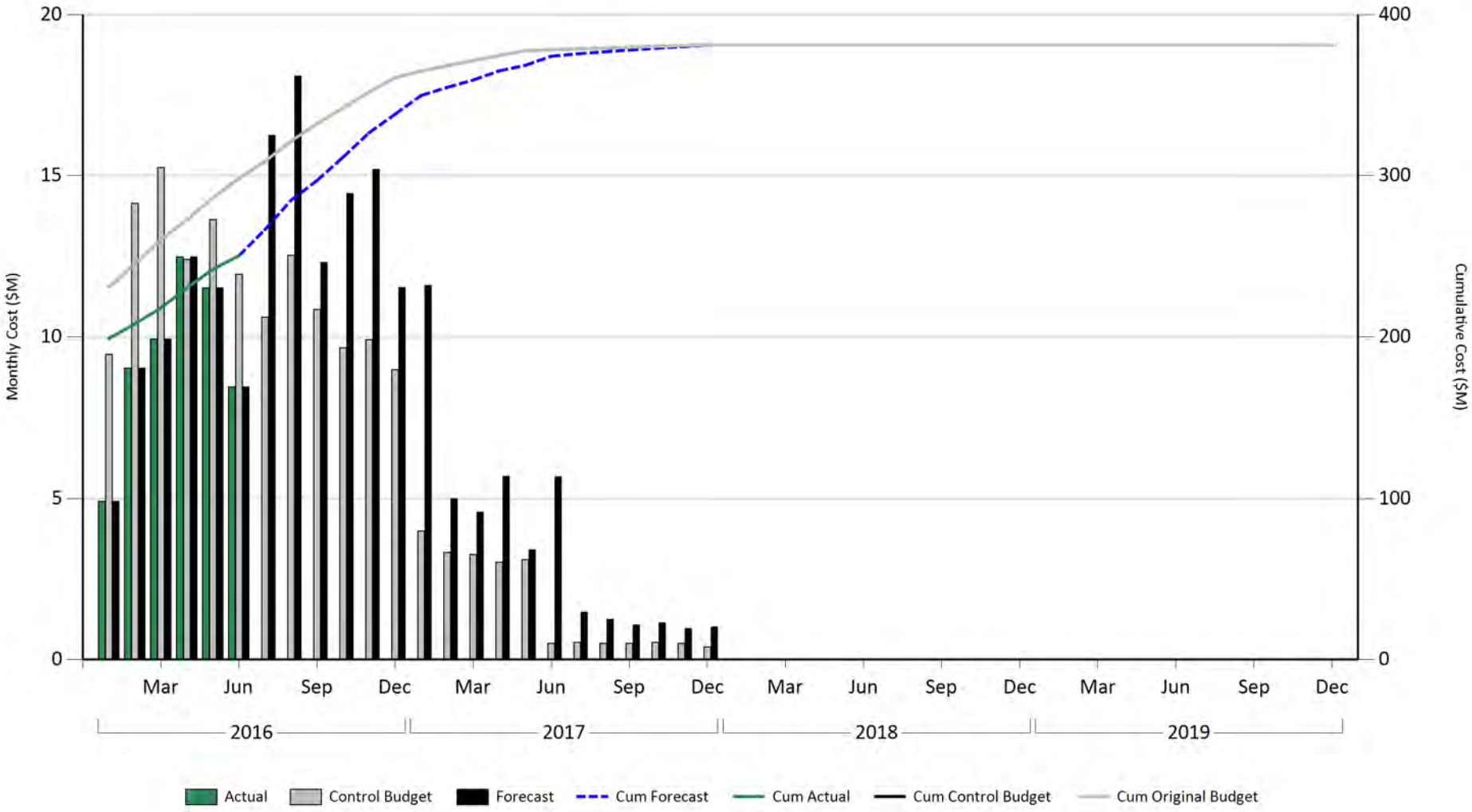
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

(3) COST CURVE *($ MILLIONS) - Units: U2, U0, UD, US, UF*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget
381,174	381,174	250,388	66%	130,742	381,129	(44)

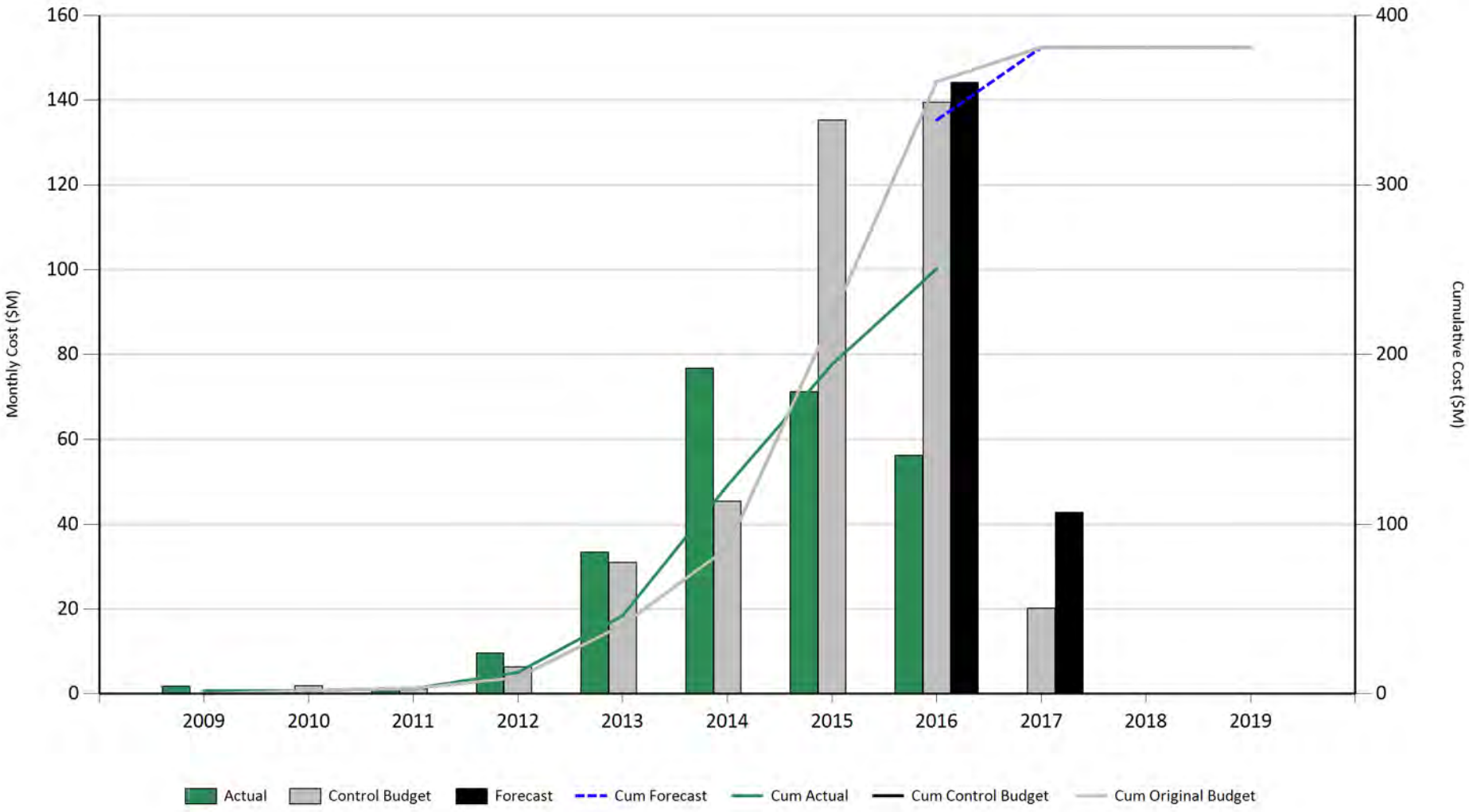
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

(4) LIFE CYCLE COST *($ MILLIONS)*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget
381,174	381,174	250,388	66%	130,742	381,129	(44)

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Filters Applied:
Report Type: Vendor Overview
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Project: 31555 - D2O Storage Facility-UFCP, 00000 - NA
Include Interest: Yes
Bundle: All
Vendor: All

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	11,948	8,444	(3,504)	71%
Life-to-Date	298,332	250,388	(47,945)	84%

	CPI		SPI	
2016-Jun Life-To-Date	0.96		0.80	
2016-May Life-To-Date				

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	381,174	381,129	(44)
Life Cycle Contingency	0	0	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
	0 - Other	24,947	0	24,947	1,039	0	(1,039)	-	-	16,216	0	(16,216)	-	-	8,703	-	8,703	(16,244)	-
	1 - Project Management	6,545	0	6,545	197	225	28	3.03	2.72	4,491	5,120	629	1.51	1.22	2,653	0.27	7,773	1,228	-
	3 - Engineering	3,118	0	3,118	37	93	57	-	-	1,132	830	(302)	-	-	2,696	-	3,526	408	-
	4 - Procurement	13,940	0	13,940	232	269	37	6.68	9.04	11,815	3,418	(8,397)	47.03	0.93	3,535	0.11	6,953	(6,987)	-
	6 - Commissioning	378	0	378	17	0	(17)	-	-	110	0	(110)	-	-	819	1.00	819	441	-
1	**Project & Modification Vendor**	**48,928**	**0**	**48,928**	**1,522**	**587**	**(935)**	**5.44**	**5.80**	**33,763**	**9,368**	**(24,396)**	**7.02**	**0.96**	**18,406**	**0.16**	**27,774**	**(21,154)**	**-**
	0 - Other	1,306	0	1,306	0	0	0	-	-	1,306	1,401	94	-	-	0	-	1,401	94	-
	5 - Construction	28,198	0	28,198	152	0	(152)	-	1.54	27,211	28,746	1,535	0.98	1.00	1,075	1.88	29,821	1,623	-
2	**P&M Ellis Don**	**29,504**	**0**	**29,504**	**152**	**0**	**(152)**	**-**	**1.54**	**28,517**	**30,147**	**1,629**	**0.98**	**1.00**	**1,075**	**1.88**	**31,221**	**1,717**	**-**
	1 - Project Management	121	0	121	0	0	0	-	-	121	120	(1)	-	-	0	-	120	(1)	-
	5 - Construction	6,157	0	6,157	(4)	54	59	-0.08	1.00	6,186	7,077	892	0.01	0.01	850	-15.73	7,927	1,770	-
3	**PMV.ESFOX**	**6,278**	**0**	**6,278**	**(4)**	**54**	**59**	**-0.08**	**1.00**	**6,306**	**7,197**	**891**	**0.01**	**0.01**	**850**	**-15.73**	**8,047**	**1,769**	**-**
	0 - Other	21,849	0	21,849	771	1,080	310	-	-	18,375	14,119	(4,256)	-	-	11,544	-	25,663	3,815	-
	1 - Project Management	3,529	0	3,529	0	0	0	-	-	3,522	5,877	2,355	1.00	1.00	8	-	5,885	2,356	-
	3 - Engineering	18,535	0	18,535	137	0	(137)	-	-	16,876	17,205	329	1.15	1.00	900	-	18,105	(430)	-
	4 - Procurement	20,263	0	20,263	0	240	240	-	-	20,263	28,359	8,095	0.68	1.00	0	-	28,359	8,095	-
	5 - Construction	76,631	0	76,631	2	(2,296)	(2,298)	0.00	1.00	76,619	69,846	(6,772)	1.12	1.00	0	0.00	69,846	(6,785)	-
4	**P&M Legacy**	**140,807**	**0**	**140,807**	**910**	**(976)**	**(1,886)**	**0.00**	**1.00**	**135,655**	**135,405**	**(250)**	**1.01**	**1.00**	**12,453**	**0.00**	**147,858**	**7,051**	**-**
	1 - Project Management	876	0	876	0	97	97	-	-	876	1,723	847	-	-	495	-	2,217	1,342	-
	3 - Engineering	4,490	0	4,490	0	206	206	-	-	4,490	5,401	910	-	-	3,165	-16.64	8,565	4,075	-
	5 - Construction	7,549	0	7,549	34	95	61	-	1.00	6,827	4,465	(2,362)	1.87	0.54	784	0.74	5,249	(2,301)	-
	9 - Closeout	375	0	375	0	0	0	-	-	375	374	(2)	1.00	1.00	0	-	374	(2)	-
5	**P&M Other Vendors**	**13,291**	**0**	**13,291**	**34**	**398**	**364**	**0.52**	**1.00**	**12,569**	**11,962**	**(607)**	**0.32**	**0.25**	**4,443**	**2.70**	**16,405**	**3,114**	**-**
	0 - Other	2,282	0	2,282	0	0	0	-	-	0	250	250	-	-	1,883	-	2,133	(149)	-
	1 - Project Management	20,870	0	20,870	1,039	615	(424)	-	-	10,935	10,372	(563)	-	-	12,340	-	22,712	1,841	-
	3 - Engineering	15,438	0	15,438	1,019	(255)	(1,273)	-2.62	1.64	9,900	6,958	(2,942)	1.64	0.77	7,422	0.44	14,380	(1,058)	-
	4 - Procurement	36,000	0	36,000	2,393	(70)	(2,463)	-26.53	0.77	22,463	7,725	(14,738)	1.41	0.49	26,922	0.89	34,647	(1,353)	-
	5 - Construction	67,245	0	67,245	4,884	3,288	(1,597)	1.21	0.82	38,224	16,545	(21,679)	1.09	0.47	44,421	0.97	60,966	(6,279)	-
	6 - Commissioning	531	0	531	0	0	0	-	-	0	0	0	-	-	527	-	527	(4)	-
	U - Unallocated Cost	0	0	0	0	4,803	4,803	-	-	0	14,460	14,460	-	-	0	-	14,460	14,460	-
6	**P&M SNC/AECON JV**	**142,366**	**0**	**142,366**	**9,335**	**8,381**	**(954)**	**0.76**	**0.82**	**81,522**	**56,309**	**(25,213)**	**0.78**	**0.49**	**93,515**	**1.14**	**149,824**	**7,458**	**-**

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
	Nuclear Refurbishment Program	**381,174**	**0**	**381,174**	**11,948**	**8,444**	**(3,504)**	**1.22**	**0.97**	**298,332**	**250,388**	**(47,945)**	**0.96**	**0.80**	**130,742**	**1.09**	**381,129**	**(44)**	**-**

Note: - CPI and SPI are calculated on Deliverable Based work packages only.
- All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

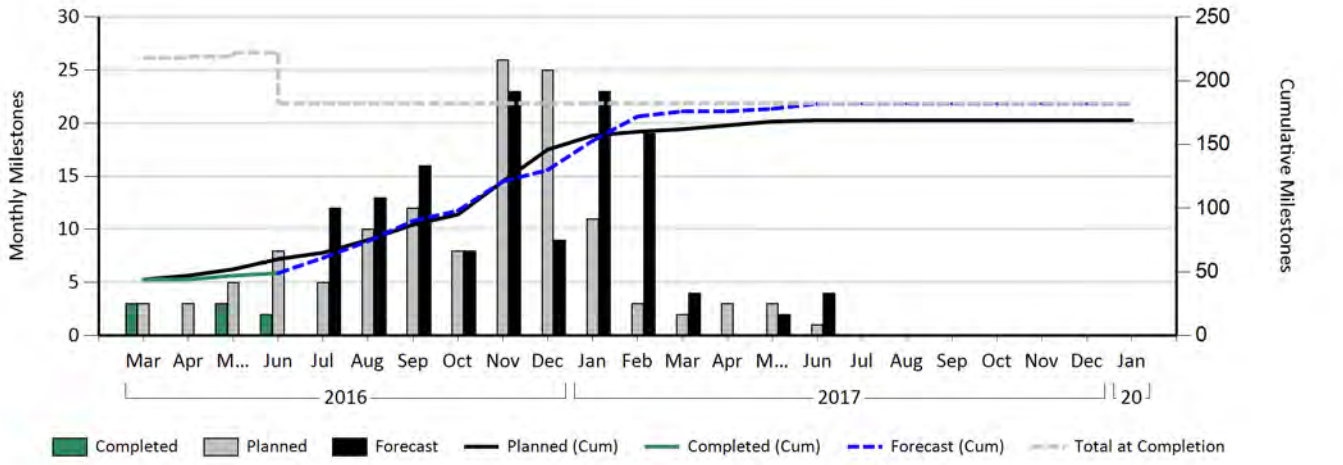
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Status: Active
Table: 120 Day Window
Project: 31555 - UF - SNC Heavy Water Management Building West Annex Project, 00000 - NA
Bundle: All
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**122**
LTD Planned Completion	42
Milestones Planned to Date Completed	18 | 43%
Variance Ahead / (Behind)	(24)
Milestones Completed on Time	8 | 19%
Milestones Forecasting Late	84 | 81%
# of Milestones Completed | Remaining	18 | 104
Milestones with No Baseline	**60**
# of Milestones Completed | Remaining	31 | 29
Total # of Milestones	**182**
# of Milestones Completed | Remaining	49 | 133



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
31555IF750	Start of Commissioning Planning & Energization Strategy	5	MED		30-Jun-16	0	-27	XX
31555M0340	Q Deck Installed	4	FOI		13-Jul-16	0	0	-
A47530	Manufacturing Equipment/Material Completed 100% and Delivered to Site -45 Volt DC Instrument Power Supply	5	MED		08-Aug-16	0	31	-
A47610	Manufacturing Equipment/Material Completed 100% and Delivered to Site - D2O Liquid Recovery Pump Control	5	MED		18-Aug-16	0	34	-
A47100	Manufacturing Equipment/Material Completed 100% and Delivered to Site -Sampling Cabinet	5	MED		19-Aug-16	0	27	-
A47690	Manufacturing Equip/Material Completed 100% and Delivered to Site-Instrument Transfer System (Rosemount)	5	MED		26-Aug-16	0	-10	-
A71016	T-19 Schedule the Task on IPG - Objectives met - EL.107 Beetles System Tie-In with existing building CDF	4	PTI		07-Sep-16	0	-27	-
A71116	T-19 Schedule the Task on IPG - Objectives met - Storage Tank/equip control systems HWMB Control Room Tie-Ins	4	PTI		07-Sep-16	0	-27	-
A71216	T-19 Schedule the Task on IPG - Objectives met - Storage Tank level indicators HWMB Control Room Tie-Ins	4	PTI		07-Sep-16	0	-27	-
A71316	T-19 Schedule the Task on IPG - Objectives met - FAAGM and FAATM Tie-Ins	4	PTI		07-Sep-16	0	-19	-
A71416	T-19 Schedule the Task on IPG - Objectives met - EL.100 PA system installation - tie in to HWMB	4	PTI		07-Sep-16	0	-27	-
A71516	T-19 Schedule the Task on IPG - Objectives met - EL.100 Telephone and LAN - Tie in to HWMB	4	PTI		07-Sep-16	0	-27	-
A71716	T-19 Schedule the Task on IPG - Objectives met - Termination of D2O power cables to Municipal SwitchGear 53	4	PTI		07-Sep-16	0	-27	-
A70916	T-19 Schedule the Task on IPG - Objectives met - Fire and Smoke Detection System Tie-Ins with HWMB	4	PTI		07-Sep-16	0	-14	-
A71616	T-19 Schedule the Task on IPG - Objectives met - DCU4 - Cable routing, C.INST. and terminations of complete system	4	PTI		12-Sep-16	0	0	-

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A47180	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Active / Inactive Drainage Pumps for	5	MED		26-Sep-16	0	-42	-
31555IF184	OPG Supplied Valves at shop 6th Shipment (Entertech-22 Valves)	5	MED	14-Oct-15	30-Jun-16	-260	-27	XX
31555IF186	OPG Supplied Valves at shop 7th Shipment (Control Valve-9 Valves)	5	MED	23-Oct-15	30-Jun-16	-251	-8	XX
31555M0260	Revise Resources for Steel Subcontractor	5	SOI	18-Nov-15	30-Jun-16	-225	-22	XX
31555M0250	Revise Resources for HVAC Subcontractor	5	SOI	23-Nov-15	30-Jun-16	-220	-22	XX
A15880	T-19 Schedule the Task on IPG - Objectives met - Tie In And Transfer Sewage System	4	PTI	09-Dec-15	07-Sep-16	-273	-27	XX
31555IF188	OPG Supplied Valves at shop 9th Shipment (Enertech-3 Valves)	5	MED	01-Feb-16	30-Jun-16	-150	-27	XX
31555IF210	Receive From OPG Vendor Documents Valves	5	MED	01-Feb-16	30-Jun-16	-150	-8	XX
31555M0280	All Equipment Lowered to Basement	5	MED	09-Feb-16	21-Jul-16	-163	-45	XX
A16320	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Relocation Of Elec/IC Lines In Loading Bay	4	PCM	02-Mar-16	12-Oct-16	-224	-16	XX
A15920	T-9 Pre T-8 Logic Schedule Issued - Objectives met - Tie In And Transfer Sewage System	4	PCM	02-Mar-16	30-Nov-16	-273	-27	XX
A23920	Manufacturing Equipment/Material Completed 100% in Storage -Hand & Foot Monitors,Whole Body Monitor	5	MED	08-Mar-16	10-Jun-16 A	-94	48	✓
31555M0290	100 EL Slab Poured	4	FOI	08-Apr-16	30-Jul-16	-113	7	XX
31555M0300	Start Pipe Chase	3	SOI	26-Apr-16	30-Jun-16	-65	35	XX
A27390	Manufacturing Equipment/Material Completed 100% -Weight Scale 0-63891-WS1/WS2/WS3/WS4	5	MED	27-Apr-16	20-Jul-16	-84	42	XX
A27310	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vaccum Tank	5	MED	04-May-16	29-Jul-16	-86	26	XX
A30680	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Leak Detection System Panel 0-73870-	5	MED	12-May-16	25-Aug-16	-105	6	XX
31555M0310	Start steel erection work on West Annex Bldg - EL 100	3	SOI	19-May-16	10-Aug-16	-83	26	XX
A30600	Manufacturing Equipment/Material Completed 100% - Fire And Smoke Detection Panel 0-73870-FC1/FC2	5	MED	25-May-16	13-Sep-16	-111	20	XX
A23560	Manufacturing Equipment/Material Completed 100% and Delivered to Site -Instrumentation Air / Service Air	5	MED	06-Jun-16	03-Nov-16	-150	-1	XX
A27470	Manufacturing Equipment/Material Completed 100% - vertical Flooded heat Excanger	5	MED	08-Jun-16	24-Aug-16	-77	22	XX
A23680	Manufacturing Equipment/Material Completed 100% and Delivered to Site -Munter Drier	5	MED	10-Jun-16	18-Jul-16	-38	64	XX
A23980	Manufacturing Equipment/Material Completed 100% and Delivered to Site- Tritium Air Monitors	5	MED	17-Jun-16	12-Aug-16	-56	47	XX
A27790	Manufacturing Equipment/Material Completed 100% and Delivered to Site -Filter Unit 0-73690-FR21/FR22	5	MED	21-Jun-16	23-Sep-16	-94	-25	XX
A27710	Manufacturing Equipment/Material Completed 100% - Building Stack	5	MED	23-Jun-16	16-Jun-16 A	7	169	✓✓
31555M0050	Capable Of Receiving Refurbishment water Unit 2 - TMOD Staged (BCS Milestone)	4	FOI	27-Jun-16	02-Nov-16	-128	-89	XX
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	21-Nov-16	-147	22	XX
31555M0160	Building Structural Steel Complete	4	FOI	11-Jul-16	01-Nov-16	-113	-14	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	02-Nov-16	-113	-15	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	27-Oct-16	-94	18	X
A23320	Manufacturing Equipment/Material Completed 100% and Delivered to Site -Switchgear 13KV & 600V	5	MED	28-Jul-16	15-Sep-16	-49	0	X
31555M0060	Commissioning Spares List Identified	3	DCS	04-Aug-16	22-Nov-16	-110	-27	X
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	30-Aug-16	-26	44	X
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	13-Jan-17	-162	-36	X
A27550	Manufacturing Equipment/Material Completed 100% - Heating And Ventilation Unit 0-73690-HVU5	5	MED	23-Aug-16	05-Dec-16	-104	9	X
A28030	Manufacturing Equipment/Material Completed 100% - Fluid Cooler 0-73870-FC1/FC2	5	MED	24-Aug-16	07-Oct-16	-44	-3	X

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A23740	Manufacturing Equipment/Material Completed 100% and Delivered to Site-HVAC Control	5	MED	08-Sep-16	05-Oct-16	-27	9	X
A23260	Manufacturing Equipment/Material Completed 100% & Delivered to Site -Back-up Power Diesel Gen-set	5	MED	08-Sep-16	17-Oct-16	-39	-3	X
A24040	Manufacturing Equipment/Material Completed 100% and Delivered to Site- Gamma Monitors	5	MED	11-Oct-16	07-Sep-16	34	69	-
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	08-Aug-16	79	120	-
A30895	Release For Commissioning-EC#120494-I&C-#77 Ventilation System I&C	4	CMS	30-Nov-16	26-Aug-16	96	138	-
A23620	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Stack Monitor	5	MED	15-Feb-17	01-Sep-16	167	40	-
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	20-Feb-17	29	42	-
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	08-May-17	-19	4	X

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

Filters Applied:

Bundles: AISC Projects Executed during NR, BoP, Cyclical, Defueling, F&IP (Campus Plan), Fuel Handling, Functional, Islanding, Not Available, P&M AISC Projects, RF&R, RSF, SDLU, SGs, SIOs, Special Projs, TGs

Sub Bundles: All Sub Bundles Included

Vendors: All Vendors Included

Projects: 31555

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

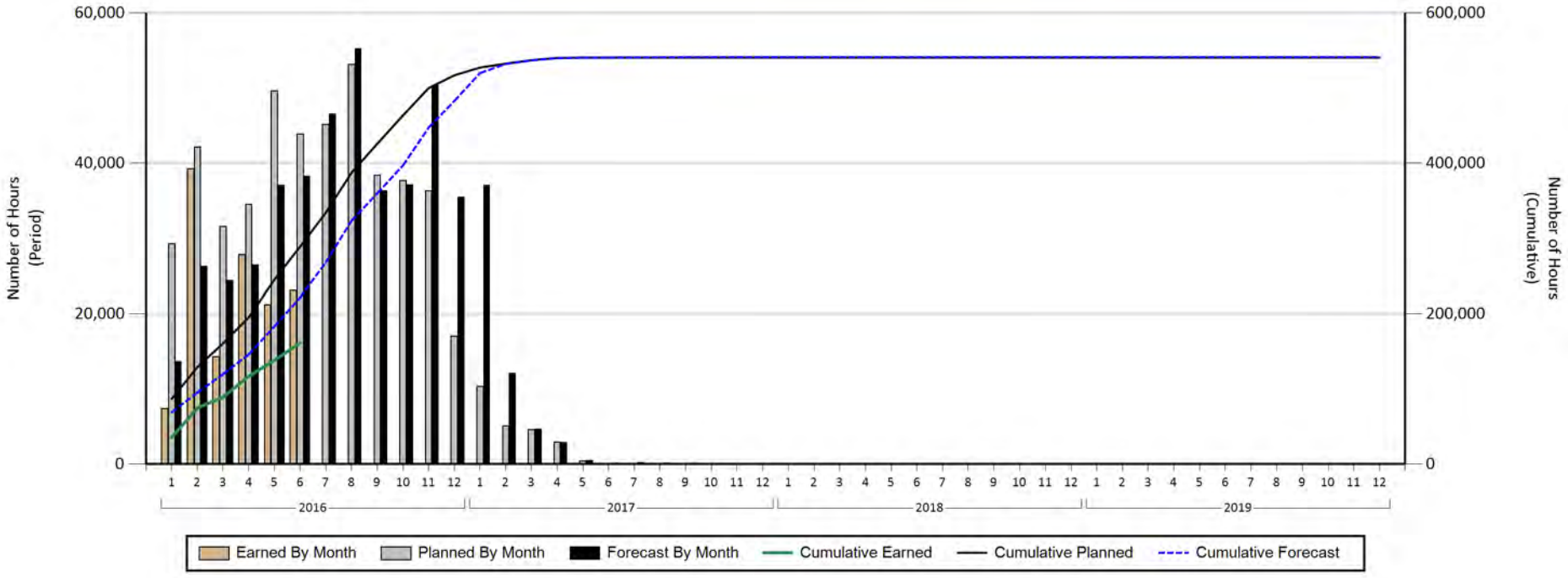
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	0	0
I	Inspections	0	0
E	Engineering	0	0
P	Procurement	0	0
C	Construction	0	0
C	Commissioning	0	0
C	Closeout	0	0
	Others	540,661	541,257
	Total	540,661	541,257

	Planned %	Earned %	Variance
Cumulative Progress	**53.5%**	**29.9%**	**-23.6%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	43,889	23,126	-20,763	**0.53**	N/A
Cumulative	289,084	161,545	-127,539	**0.56**	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2016

ID	Title	Risk Description	Current Score	Post Score
14287	16-31555 - Building Structural Steel Delivery Dates	Event: Changes to the 100el slab thickness Cause: Design changes to an accepted EC Impact: Late fabrication and delivery of structural steel	25	8
14177	16-31555 - 11 New Design EC's Completion Date	Event: Late start of new EPC Vendor Cause: Amount of design work to complete including equipment vendor information. Impact: Late procurement/installation/commissioning activities The 11 new DEC's for JV to complete have a completion date (per the latest recovery schedule) of late 2016, threatening the installation and commissioning milestones.	20	15
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor Cause: Insufficient QA resources to support CWP/ITP/Materials. Impact: Expedited construction schedule with many activities progressing in parallel.	20	15
12334	16-31555 D2O Storage Project: Construction Delays Due to Material Ordering Delays	Event: Late placement of purchase orders or long lead times of materials/equipment Cause: Lack of procurement resources Impact: There is a risk that long lead materials (LLM)/Bulk materials will not be ordered/delivered in time to support the construction schedule.	16	16

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

Executive Summary:

Updated October 14, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-23195 - Fuel Smell (soil) in Pipe Chase Excavation; work resumed after investigation
N-2016-24121 - Rebar Dowels Bent without Engineering Approval

Accomplishments/Issues
- Sequence 9 structural steel installation complete
- Mud slab for pipe chase poured
- Installation of duct work commenced
- EAC at risk due to recent change notice provided
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.58 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on January 14, 2016, and the JV is falling behind this recovery plan with an SPI of 0.88, although this SPI has slightly increased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV. Revised schedule uploaded into P6 on June 10, 2016
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $14.01M in September against a plan of $11.85M bringing total project spend to $296.7M LTD at September month end. This increase over planned spend was due to more JV engineered material accruals than anticipated.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Cost Summary:

Life to Date costs are $296.7M against a control budget of $340.9M, with an overall CPI of 0.93. Forecasted EAC is $381.1M.

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Resource Summary:

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

Risk Summary:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

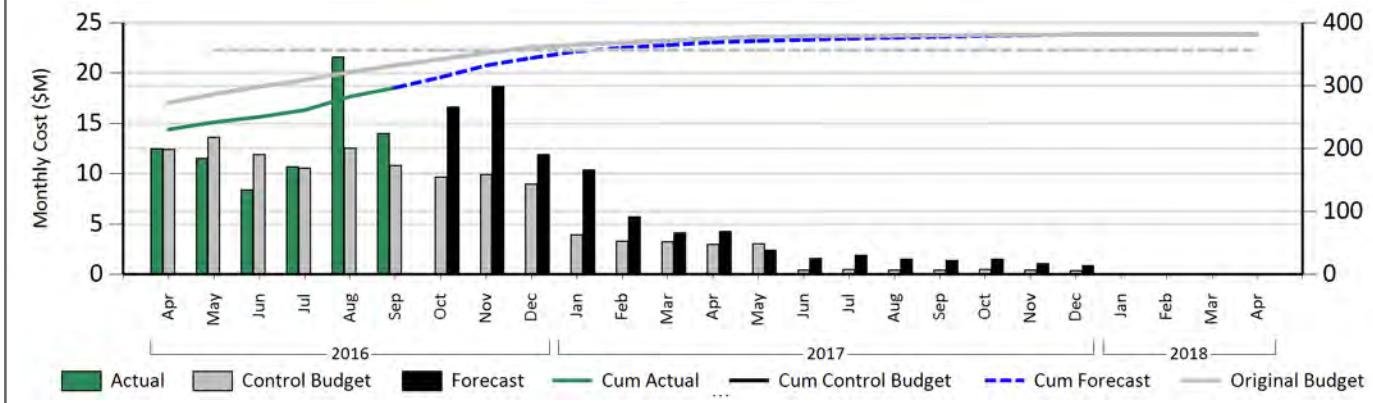
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

Filters Applied:
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Project: 31555 - D2O Storage Facility-UFCP
Bundle: All
Vendor: All

100%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*

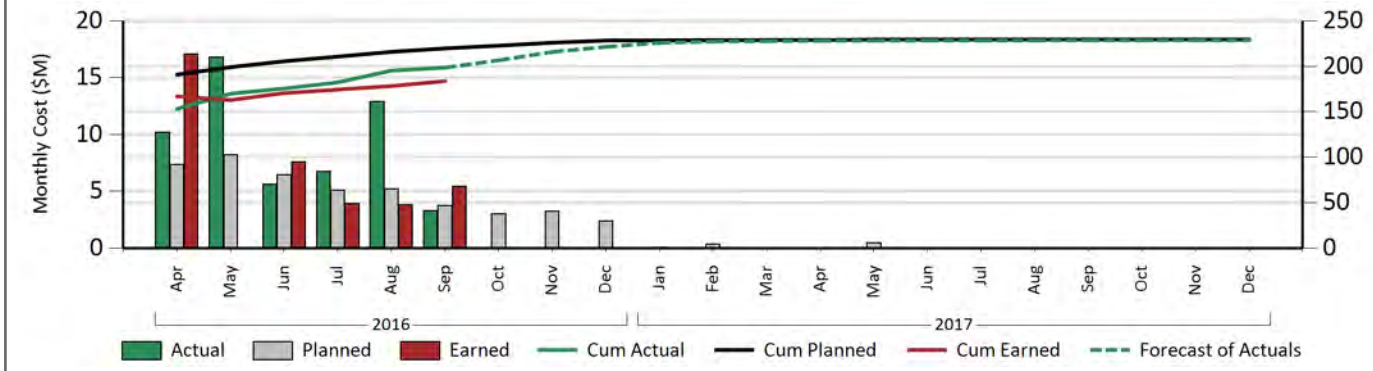


Life-To-Date	
Original Budget	332,347
Control Budget	332,347
Actual	296,748
Variance-to-Control Budget	(35,598)
% of Control Budget Spent	89%
Funding Released to Projects	356,496

=

66%

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*

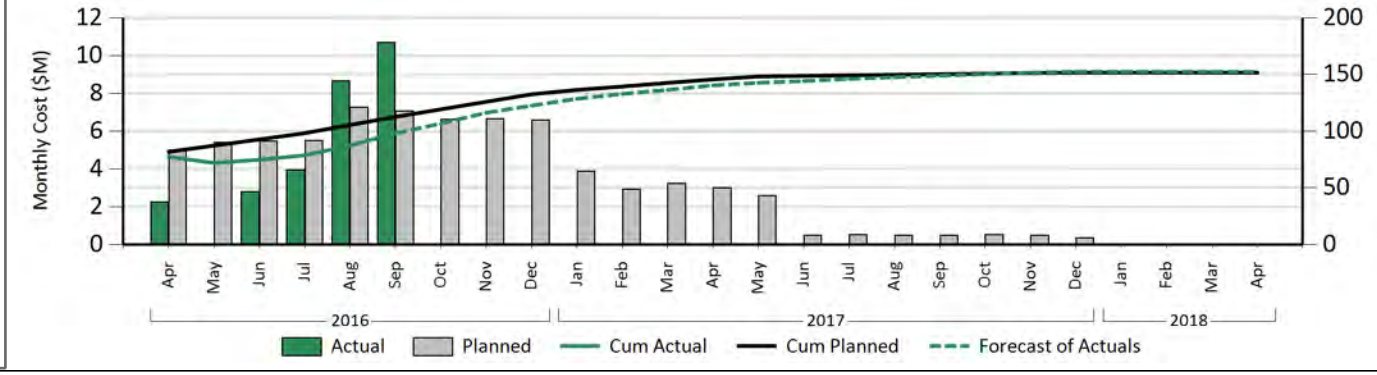


Life-To-Date	
Planned Value	219,723
Earned Value	183,771
Actual	198,587
Variance-to-Planned Value	(21,136)
Cost Performance Index	0.93
Schedule Performance Index	0.84

+

34%

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	112,623
Actual	98,161
Variance-to-Planned Value	(14,462)

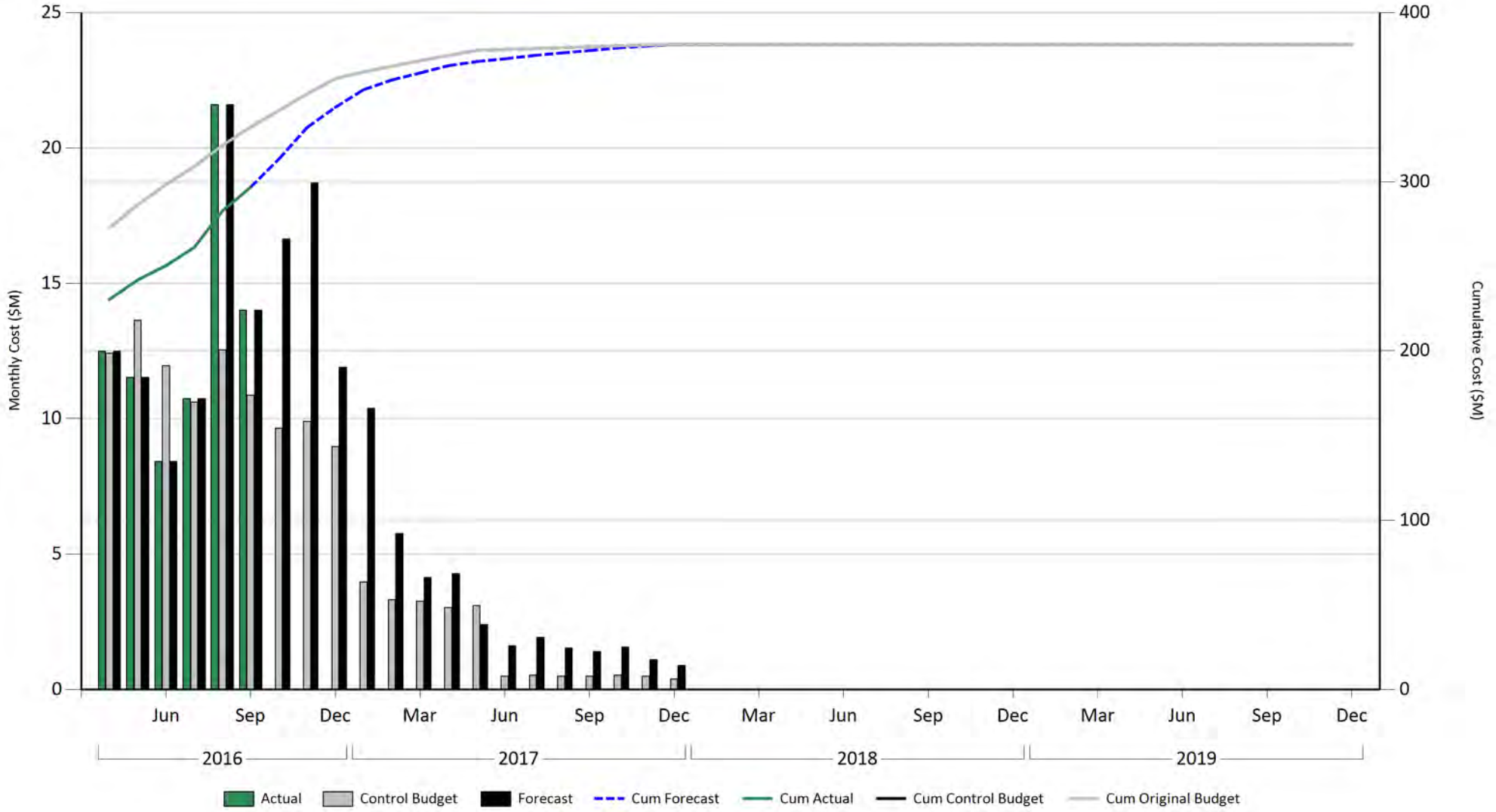
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

COST CURVE *($ MILLIONS) - Units: U2, U0, UD, US, UF*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget At Completion
381,174	381,174	296,748	78%	84,381	381,129	(44)

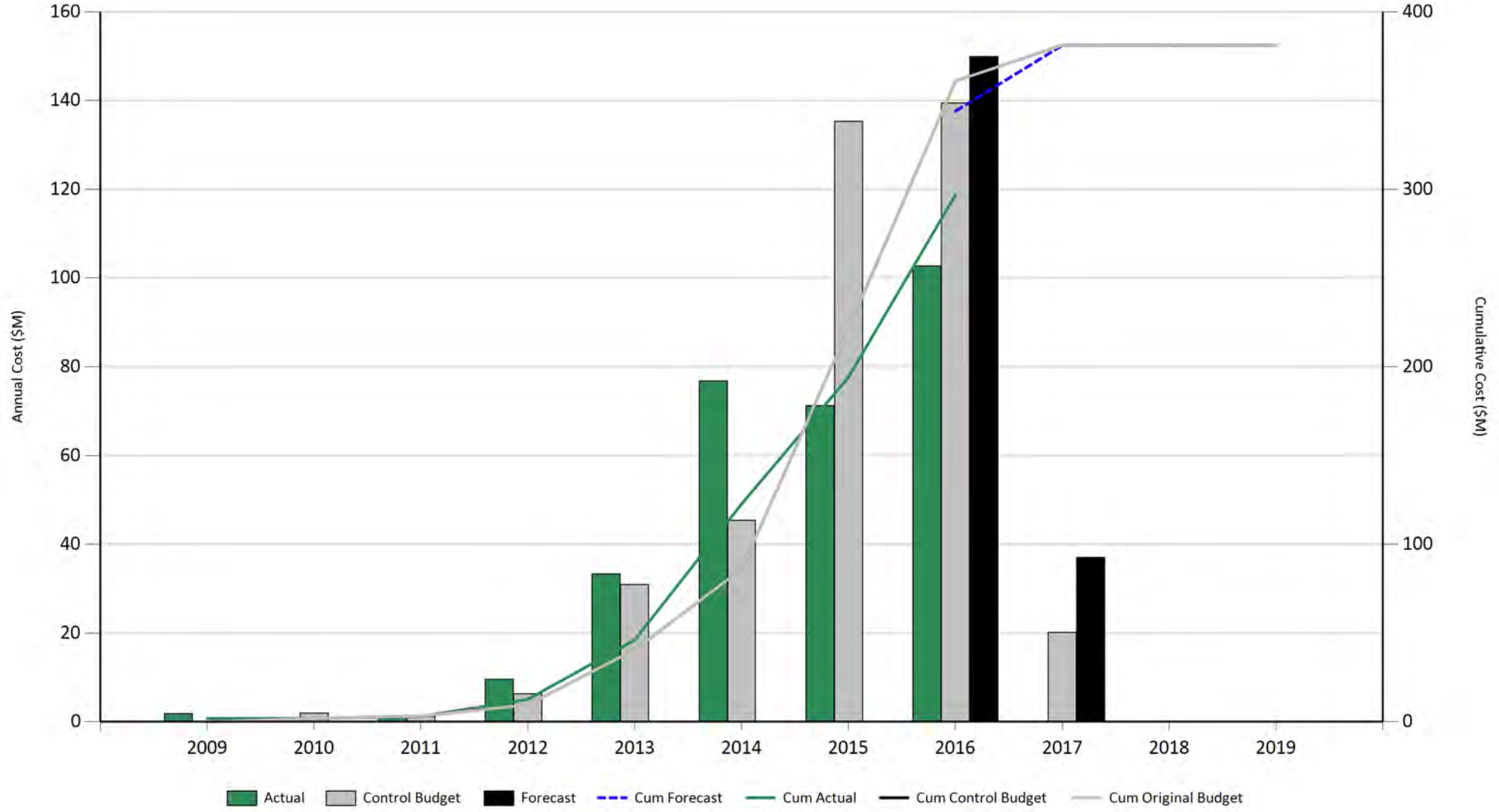
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

LIFE CYCLE COST *($ MILLIONS)*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget At Completion
381,174	381,174	296,748	78%	84,381	381,129	(44)

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

Filters Applied:
Report Type: Vendor Overview
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Project: 31555 - D2O Storage Facility-UFCP
Include Interest: Yes
Bundle: All
Vendor: All
Only Show Deliverable Values: No

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	10,860	14,017	3,157	129%
Life-to-Date	332,347	296,748	(35,598)	89%

	CPI	SPI
2016-Sep Life-To-Date	0.93	0.84
2016-Aug Life-To-Date	1.03	0.83

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	381,174	381,129	(44)
Life Cycle Contingency	0	0	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
	0 - Other	44,927	0	44,927	1,370	1,229	(141)	-	-	36,832	17,103	(19,728)	-	-	13,962	-	31,065	(13,862)	(2,212)
	1 - Project Management	6,562	0	6,562	198	231	33	-	-	5,116	7,506	2,390	1.18	1.03	2,071	0.45	9,577	3,015	34
	3 - Engineering	2,830	0	2,830	9	115	105	-	-	899	900	1	-	-	3,055	-	3,955	1,125	(7)
	4 - Procurement	13,940	0	13,940	191	139	(52)	-	-	12,504	3,818	(8,686)	39.69	0.90	1,403	0.11	5,222	(8,718)	4
	6 - Commissioning	378	0	378	17	14	(3)	-	-	165	43	(122)	-	-	630	1.13	673	295	(49)
1	**Project & Modification Vendor**	**68,636**	**0**	**68,636**	**1,785**	**1,727**	**(58)**	**-**	**-**	**55,516**	**29,370**	**(26,146)**	**5.40**	**0.91**	**21,121**	**0.16**	**50,492**	**(18,145)**	**(2,230)**
	0 - Other	1,306	0	1,306	0	0	0	-	-	1,306	1,401	94	-	-	0	-	1,401	94	0
	5 - Construction	28,198	0	28,198	152	0	(152)	-	1.16	27,704	28,862	1,157	1.00	1.00	0	1.23	28,862	664	0
2	**P&M Ellis Don**	**29,504**	**0**	**29,504**	**152**	**0**	**(152)**	**-**	**1.16**	**29,011**	**30,262**	**1,252**	**1.00**	**1.00**	**0**	**1.23**	**30,262**	**758**	**0**
	1 - Project Management	121	0	121	0	0	0	-	-	121	120	(1)	-	-	0	-	120	(1)	0
	5 - Construction	6,157	0	6,157	(4)	(215)	(211)	0.02	1.00	6,171	7,081	910	0.00	0.00	250	-20.78	7,331	1,174	(340)
3	**PMV.ESFOX**	**6,278**	**0**	**6,278**	**(4)**	**(215)**	**(211)**	**0.02**	**1.00**	**6,292**	**7,201**	**910**	**0.00**	**0.00**	**250**	**-20.78**	**7,451**	**1,174**	**(340)**
	0 - Other	1,869	0	1,869	0	0	0	-	-	1,869	0	(1,869)	-	-	0	-	0	(1,869)	0
	1 - Project Management	3,513	0	3,513	0	0	0	-	-	3,513	5,868	2,355	1.00	1.00	0	-	5,868	2,355	0
	3 - Engineering	17,417	0	17,417	137	0	(137)	-	-	16,167	18,282	2,114	0.93	1.00	0	-	18,282	865	0
	4 - Procurement	15,710	0	15,710	0	0	0	-	-	15,710	23,936	8,225	0.61	1.00	1,028	-	24,964	9,253	140
	5 - Construction	76,602	0	76,602	0	7	7	0.00	1.00	76,602	69,808	(6,794)	1.12	1.00	0	0.00	69,808	(6,794)	7
	9 - Closeout	375	0	375	0	0	0	-	-	375	374	(2)	1.00	1.00	0	-	374	(2)	0
4	**P&M Legacy**	**115,486**	**0**	**115,486**	**137**	**7**	**(130)**	**0.00**	**1.00**	**114,237**	**118,267**	**4,030**	**0.99**	**1.00**	**1,028**	**0.00**	**119,295**	**3,809**	**146**
	1 - Project Management	1,128	0	1,128	0	(44)	(44)	-	-	1,128	2,066	938	-	-	360	-	2,426	1,298	(89)
	3 - Engineering	5,897	0	5,897	0	(234)	(234)	-	-	5,897	5,271	(626)	0.29	0.24	3,655	4.13	8,926	3,029	(334)
	4 - Procurement	4,553	0	4,553	0	41	41	-	-	4,553	4,495	(58)	1.01	1.00	0	-	4,495	(58)	41
	5 - Construction	7,578	0	7,578	36	164	129	-	1.00	6,959	4,792	(2,167)	2.00	0.56	617	0.70	5,409	(2,169)	132
5	**P&M Other Vendors**	**19,156**	**0**	**19,156**	**36**	**(72)**	**(108)**	**0.97**	**1.00**	**18,537**	**16,623**	**(1,913)**	**0.75**	**0.57**	**4,632**	**1.67**	**21,255**	**2,100**	**(250)**
	0 - Other	2,282	0	2,282	0	608	608	-	-	0	858	858	-	-	1,215	-	2,073	(209)	354
	1 - Project Management	20,618	0	20,618	953	3,498	2,545	-	-	13,563	17,204	3,641	-	-	7,994	-	25,198	4,580	2,430
	3 - Engineering	15,438	0	15,438	765	3,167	2,401	0.59	-	12,156	15,801	3,645	0.87	0.96	2,370	-0.45	18,171	2,734	2,781
	4 - Procurement	36,000	0	36,000	2,455	17,192	14,736	0.14	1.05	29,794	26,872	(2,923)	0.65	0.61	16,136	2.28	43,008	7,008	14,420
	5 - Construction	67,245	0	67,245	4,581	9,302	4,720	0.33	2.16	53,242	33,465	(19,777)	0.83	0.63	29,254	1.43	62,719	(4,526)	3,965
	6 - Commissioning	531	0	531	0	0	0	-	-	0	0	0	-	-	380	-	380	(150)	(80)
	U - Unallocated Cost	0	0	0	0	(21,196)	(21,196)	-	-	0	824	824	-	-	0	-	824	824	(21,196)

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
6	**P&M SNC/AECON JV**	**142,114**	**0**	**142,114**	**8,755**	**12,571**	**3,815**	**1.60**	**1.55**	**108,755**	**95,024**	**(13,731)**	**0.74**	**0.63**	**57,350**	**1.85**	**152,374**	**10,260**	**2,674**
	Nuclear Refurbishment Program	**381,174**	**0**	**381,174**	**10,860**	**14,017**	**3,157**	**1.66**	**1.46**	**332,347**	**296,748**	**(35,598)**	**0.93**	**0.84**	**84,381**	**1.48**	**381,129**	**(44)**	**0**

Note: - CPI and SPI are calculated on Deliverable Based work packages only.
- All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

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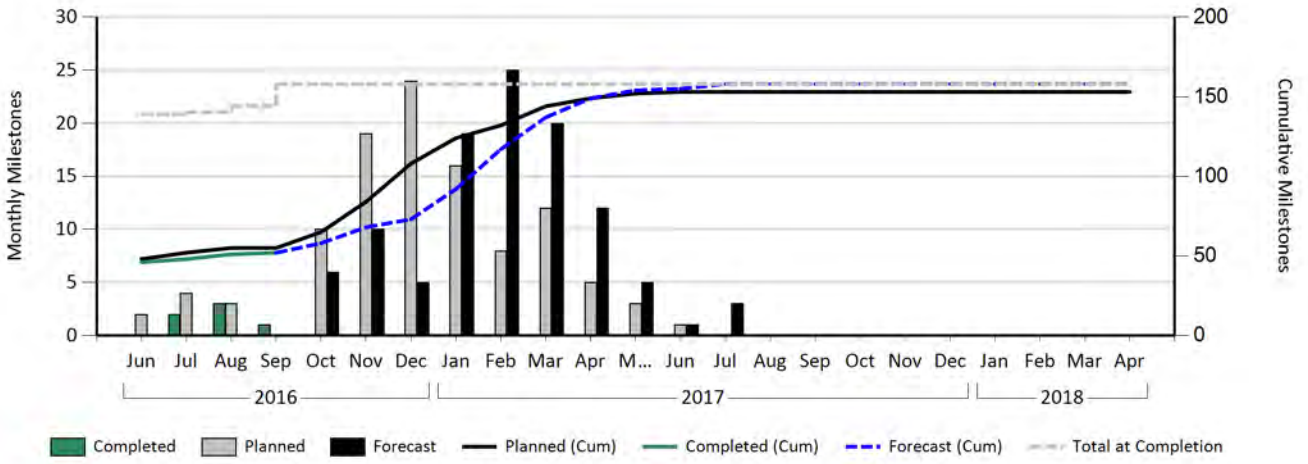
Period Ending: September 2016

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Status: Active
Table: 120 Day Window
Project: 31555 - UF - SNC Heavy Water Management Building West Annex Project
Bundle: All
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**95**
LTD Planned Completion	27
Milestones Planned to Date Completed	19 | 70%
Variance Ahead / (Behind)	(8)
Milestones Completed on Time	6 | 22%
Milestones Forecasting Late	69 | 91%
# of Milestones Completed | Remaining	19 | 76
Milestones with No Baseline	**63**
# of Milestones Completed | Remaining	33 | 30
Total # of Milestones	**158**
# of Milestones Completed | Remaining	52 | 106



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
A611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		30-Sep-16	0	159	-
A47020	Manufacturing Equipment/Material Completed 100% - Portal Monitors	5	MED		30-Sep-16	0	-1	-
31555IM010	Pipe Chase Micropiles complete	4	FOI		03-Oct-16	0	-10	-
31555IM020	Pipe Chase Walls poured	4	FOI		17-Oct-16	0	-5	-
31555IM030	Pipe Chase Pipe Spools all installed	4	FOI		31-Oct-16	0	-4	-
A881230	Release For Commissioning-EC#120421-PHT	4	CMS		16-Nov-16	0	-6	-
31555IF210	Receive From OPG Vendor Documents Valves		MED	01-Feb-16	30-Sep-16	-242	-28	XX
31555M0310	Start steel erection work on West Annex Bldg - EL 100	3	SOI	19-May-16	06-Sep-16 A	-110	-4	✓
31555M0050	Capable Of Receiving Refurbishment water Unit 2 - TMOD Staged (BCS Milestone)	4	FOI	27-Jun-16	16-Nov-16	-142	-6	XX
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	18-Jan-17	-205	-2	XX
31555M0160	Building Structural Steel Complete	4	FOI	11-Jul-16	09-Dec-16	-151	0	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	20-Dec-16	-161	-8	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	04-Jan-17	-163	-49	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	28-Oct-16	-85	-18	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	06-Apr-17	-245	-28	XX

Legend:
✓✓ Completed Early/On Time
✓ Completed Late
\- On Track
X At Risk
XX Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
31555IF240	Start of Outage Segment 1 (31555U2SG1S)	3	WNS	17-Oct-16	17-Oct-16	0	0	-
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	17-Nov-16	-30	-17	X
A30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS	20-Oct-16	27-Feb-17	-130	-6	X
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	29-Nov-16	-36	-32	X
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	04-Jan-17	-72	-49	X
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	07-Dec-16	-42	-28	X
A27950	Manufacturing Equipment/Material Completed 100% and Delivered to Site -A/C Unit 0-73870-ACU9 To ACU13	5	MED	31-Oct-16	04-Nov-16	-4	-22	X
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	07-Feb-17	-97	0	X
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	17-Apr-17	-152	-20	X
A23440	Manufacturing Equipment/Material Completed 100% and Delivered to Site - MCC	5	MED	18-Nov-16	30-Nov-16	-12	0	X
A30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS	26-Nov-16	05-May-17	-160	-38	X
A30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power	4	CMS	29-Nov-16	01-Mar-17	-92	-12	X
A30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS	29-Nov-16	08-May-17	-160	-7	X
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	06-Dec-16	-7	-7	X
31555M0700	Corporate Scorecard - Refurbishment Campus Plan - D2O Heavy Water Storage Facility Ready to Receive U2 PHT	2	CCD	30-Nov-16	30-Nov-16	0	0	-
A30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS	30-Nov-16	02-Feb-17	-64	-12	X
A30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS	30-Nov-16	02-Feb-17	-64	-3	X
A30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS	30-Nov-16	04-Feb-17	-66	-15	X
A30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS	30-Nov-16	01-Mar-17	-91	14	X
A30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS	30-Nov-16	04-Apr-17	-125	-7	X
A30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS	30-Nov-16	05-Apr-17	-126	14	X
A30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS	30-Nov-16	25-Apr-17	-146	-28	X
A30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS	30-Nov-16	25-Apr-17	-146	-28	X
A30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS	01-Dec-16	20-Apr-17	-140	-9	X
A23800	Manufacturing Equipment/Material Completed 100% -Chiller	5	MED	02-Dec-16	07-Dec-16	-5	0	X
A31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage,	4	CMS	02-Dec-16	27-Jan-17	-56	-83	X
A30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS	05-Dec-16	12-Jan-17	-38	23	X
A30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS	05-Dec-16	20-Jan-17	-46	-3	X
A30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS	05-Dec-16	21-Jan-17	-47	-2	X
A30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS	05-Dec-16	01-Feb-17	-58	0	X
A30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS	05-Dec-16	09-Feb-17	-66	-3	X
A31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS	05-Dec-16	22-Feb-17	-79	-2	X
A31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery	4	CMS	05-Dec-16	20-Mar-17	-105	-2	X
A23380	Manufacturing Equipment/Material Completed 100% and Delivered to Site - UPS (Delivery 35 days)	5	MED	06-Dec-16	31-Oct-16	36	0	-
A30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS	06-Dec-16	08-Mar-17	-92	-18	X
31555M0110	Building Shell Complete		CCD	07-Dec-16	07-Feb-17	-62	14	X

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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Process Owner: Multiple
Period Ending: September 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS	08-Dec-16	25-Apr-17	-138	-28	X
A30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS	10-Dec-16	27-Feb-17	-79	-17	X
A30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS	10-Dec-16	25-Apr-17	-136	-28	X
31555M0220	Start of Commissioning - JV	4	CMS	12-Dec-16	03-Jan-17	-22	0	X
31555M0100	Start of Commissioning (BSC Milestone)	4	CMS	12-Dec-16	03-Jan-17	-22	0	X
A30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS	12-Dec-16	27-Jan-17	-46	14	X
A31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS	12-Dec-16	01-Mar-17	-79	-12	X
A31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS	13-Dec-16	08-Feb-17	-57	-8	X
A30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS	22-Dec-16	02-Mar-17	-70	-13	X
A30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS	24-Dec-16	22-Feb-17	-60	-12	X
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	02-Jan-17	-5	14	X
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	21-Mar-17	0	9	-
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	29-May-17	-40	0	X

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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Error: Subreport could not be shown.

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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Process Owner: Multiple
Period Ending: September 2016

ID	Title	Risk Description	Current Score	Post Score
14287	16-31555 - Building Structural Steel Delivery Dates	Event: Changes to the 100el slab thickness Cause: Design changes to an accepted EC Impact: Late fabrication and delivery of structural steel	25	8
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor and continued construction delays Cause: Insufficient QA resources to support CWP/ITP/Materials. Impact: Expedited construction schedule with many activities progressing in parallel.	20	15
14177	16-31555 - 11 New Design EC's Completion Date	Event: Late start of new EPC Vendor Cause: Amount of design work to complete including equipment vendor information. Impact: Late procurement/installation/commissioning activities The 11 new DEC's for JV to complete have a completion date (per the latest recovery schedule) of late 2016, threatening the installation and commissioning milestones.	20	15
12334	16-31555 D2O Storage Project: Construction Delays Due to Material Ordering Delays	Event: Late placement of purchase orders or long lead times of materials/equipment Cause: Lack of procurement resources Impact: There is a risk that long lead materials (LLM)/Bulk materials will not be ordered/delivered in time to support the construction schedule.	16	16

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

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Period Ending: December 2016

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

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Process Owner: Multiple
Period Ending: December 2016

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

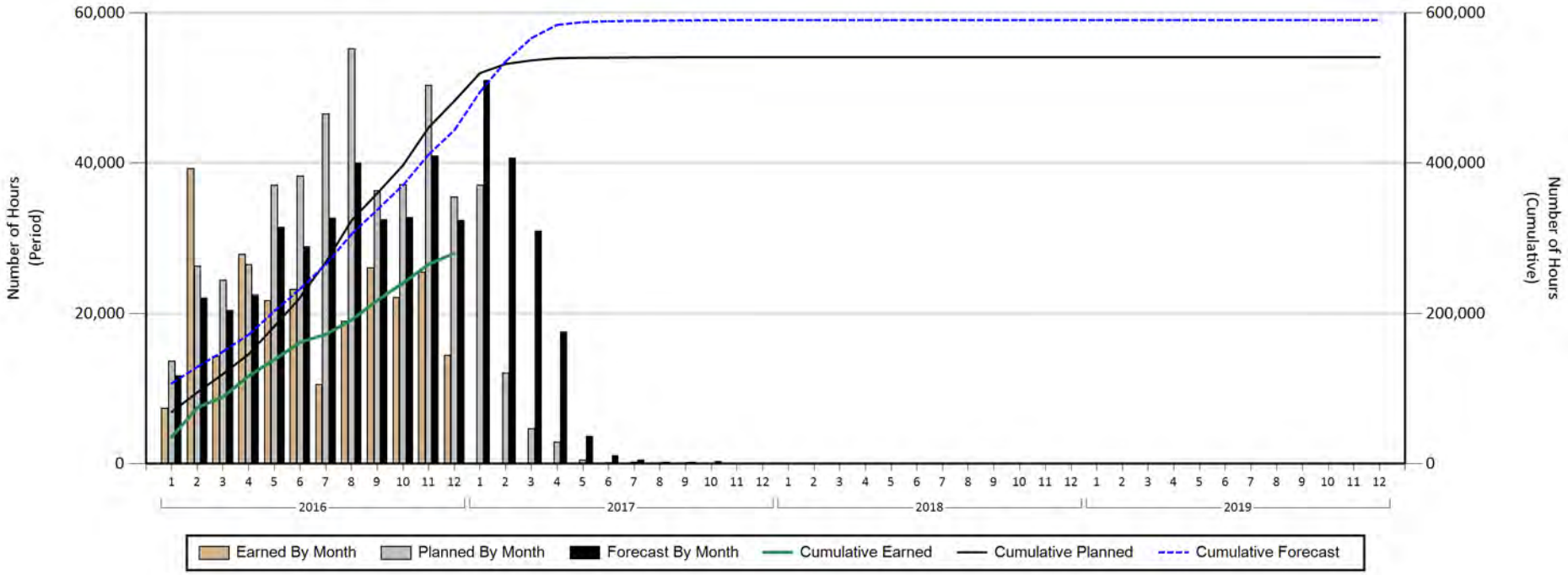
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,243	422,248
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,157	590,563

	Planned %	Earned %	Variance
Cumulative Progress	**89.2%**	**51.7%**	**-37.5%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	35,492	14,473	-21,019	**0.41**	N/A
Cumulative	482,879	279,802	-203,077	**0.58**	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

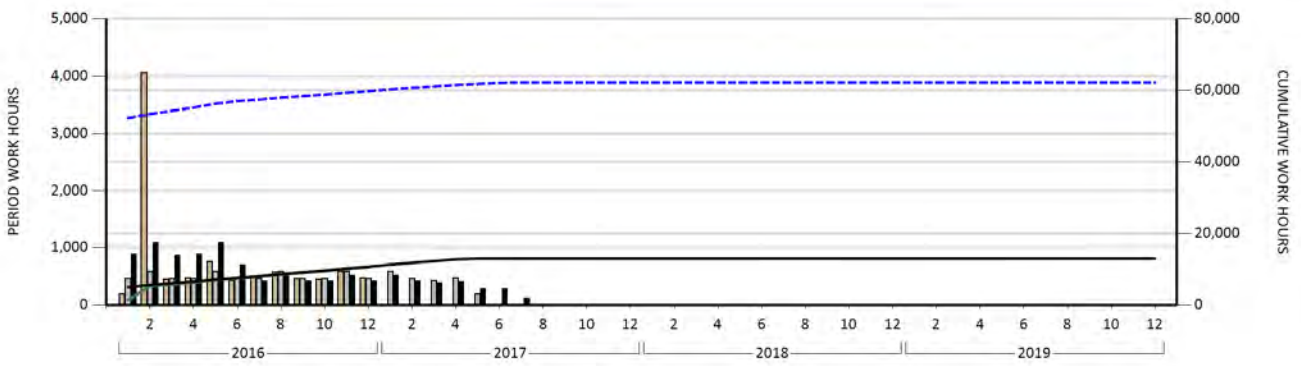
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**423**	**59,776**	**62,242**
Baseline Hours	473	10,752	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	486	10,680	
Actual	N/A	N/A	
Variance (Earned From Baseline)	13	(72)	
SPI on Baseline	1.03	0.99	

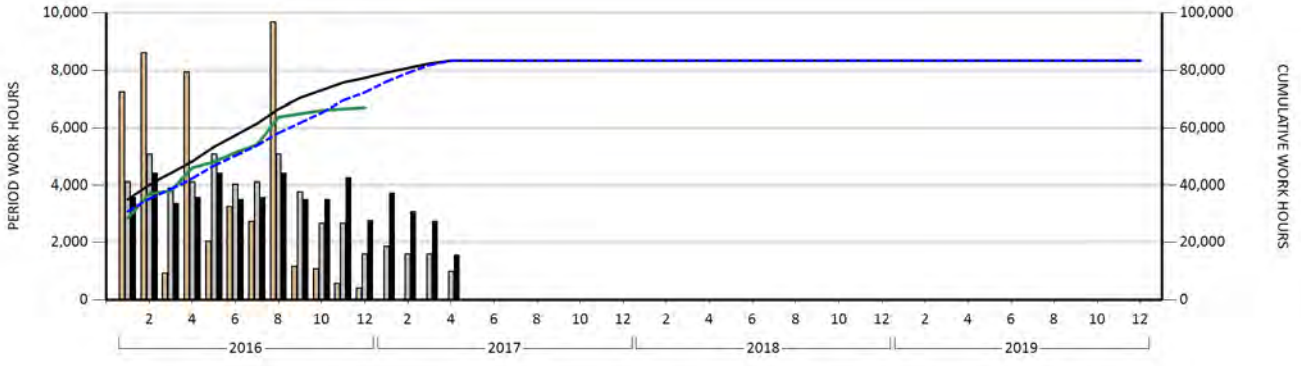
	Planned %	Earned %	Variance
Cumulative Progress	**83.1%**	**82.5%**	**-0.6%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**2,767**	**72,327**	**83,447**
Baseline Hours	1,602	77,387	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	417	67,065	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(1,185)	(10,322)	
SPI on Baseline	0.26	0.87	

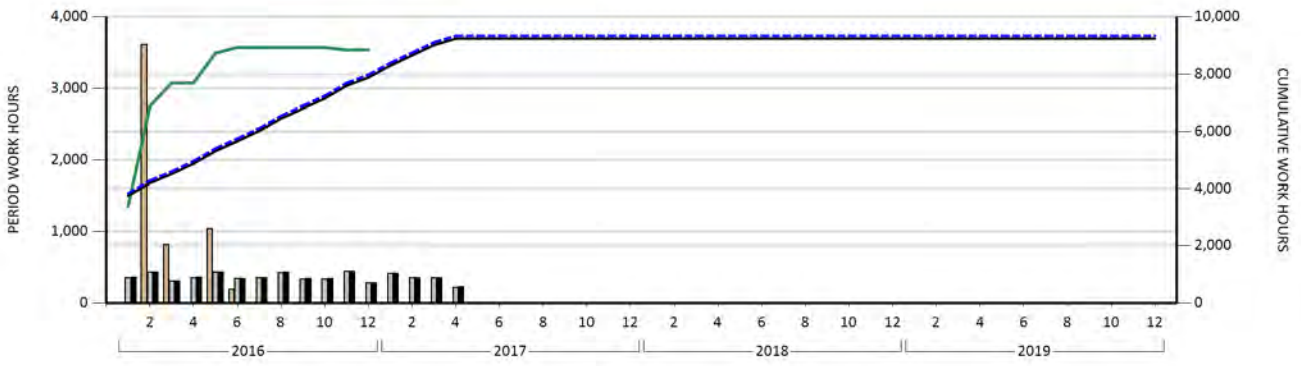
	Planned %	Earned %	Variance
Cumulative Progress	**92.7%**	**80.4%**	**-12.3%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**286**	**7,983**	**9,357**
Baseline Hours	286	7,886	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	8	8,863	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(278)	977	
SPI on Baseline	0.03	1.12	

	Planned %	Earned %	Variance
Cumulative Progress	**85.2%**	**95.7%**	**10.5%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

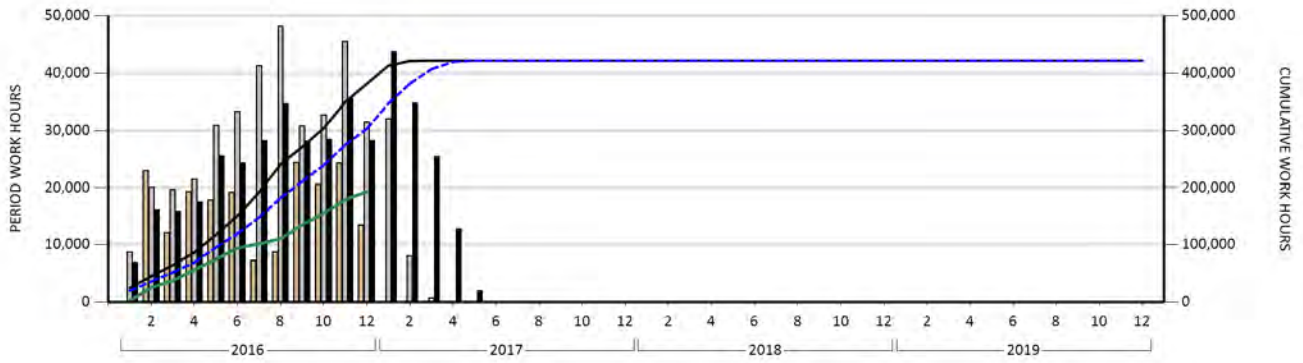
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**28,329**	**303,138**	**422,248**
Baseline Hours	31,520	381,307	422,243
Forecast (Recovery)	N/A	N/A	
Earned Hours	13,562	193,195	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(17,957)	(188,112)	
SPI on Baseline	0.43	0.51	

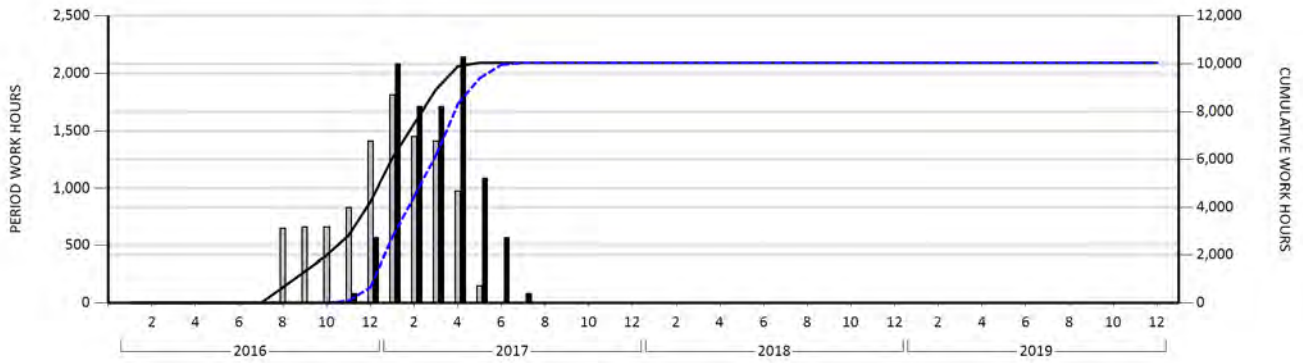
	Planned %	Earned %	Variance
Cumulative Progress	**90.3%**	**45.8%**	**-44.5%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**568**	**654**	**10,053**
Baseline Hours	1,413	4,235	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(1,413)	(4,235)	
SPI on Baseline	-	-	

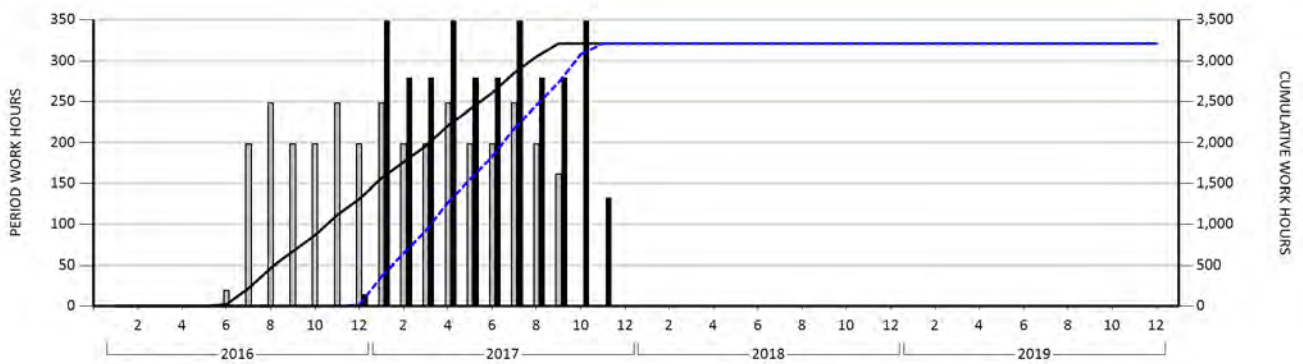
	Planned %	Earned %	Variance
Cumulative Progress	**42.1%**	**0.0%**	**-42.1%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**14**	**14**	**3,216**
Baseline Hours	199	1,313	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(199)	(1,313)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**40.8%**	**0.0%**	**-40.8%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

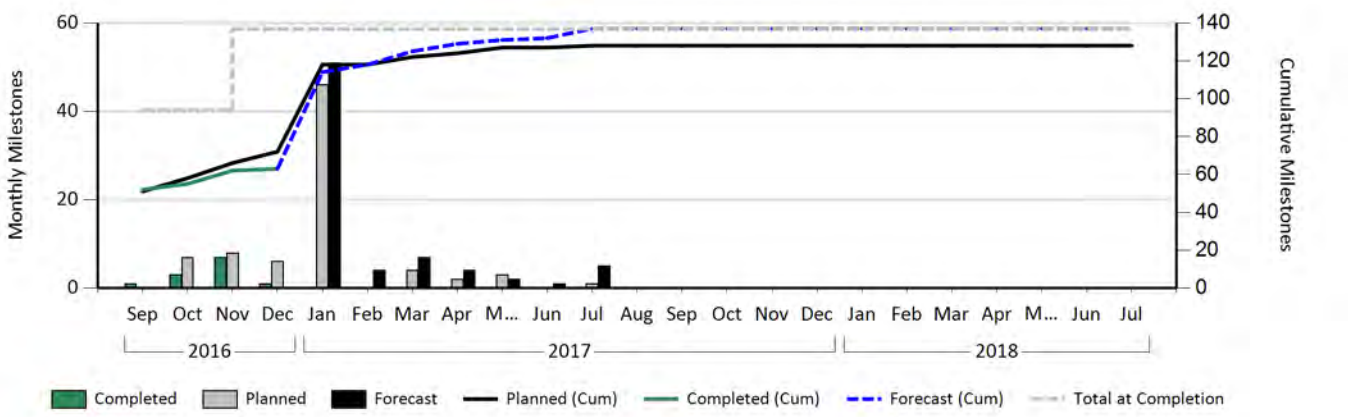
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	44
Milestones Planned to Date Completed	26 | 59%
Variance Ahead / (Behind)	(18)
Milestones Completed on Time	10 | 23%
Milestones Forecasting Late	26 | 100%
# of Milestones Completed | Remaining	26 | 26
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	37 | 48
Total # of Milestones	**137**
# of Milestones Completed | Remaining	63 | 74



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
A881230	Release For Commissioning-EC#120421-PHT	4	CMS		30-Nov-16 A	0	0	✓✓
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		03-Jan-17	0	-32	-
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		03-Jan-17	0	-32	-
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		03-Jan-17	0	-32	-
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		03-Jan-17	0	-32	-
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		03-Jan-17	0	-32	-
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		03-Jan-17	0	-32	-
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		03-Jan-17	0	-32	-
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		03-Jan-17	0	-32	-
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		03-Jan-17	0	-32	-
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		03-Jan-17	0	-32	-
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		03-Jan-17	0	-32	-
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		03-Jan-17	0	-32	-
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		03-Jan-17	0	-32	-
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		03-Jan-17	0	-32	-
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		03-Jan-17	0	-32	-
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		03-Jan-17	0	-32	-
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		03-Jan-17	0	-32	-
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		03-Jan-17	0	-32	-

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		03-Jan-17	0	-32	-
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		03-Jan-17	0	-32	-
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		03-Jan-17	0	-32	-
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		03-Jan-17	0	-32	-
AA1618	CCD-HVAC Start-up		CCD		03-Jan-17	0	-32	-
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		03-Jan-17	0	-32	-
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		03-Jan-17	0	-32	-
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		03-Jan-17	0	-32	-
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		03-Jan-17	0	-32	-
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		03-Jan-17	0	-32	-
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		03-Jan-17	0	-32	-
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		03-Jan-17	0	-32	-
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		03-Jan-17	0	-32	-
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		03-Jan-17	0	-32	-
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		03-Jan-17	0	-32	-
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		03-Jan-17	0	-32	-
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		03-Jan-17	0	-32	-
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		03-Jan-17	0	-32	-
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		03-Jan-17	0	-32	-
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		03-Jan-17	0	-32	-
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		03-Jan-17	0	-32	-
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		03-Jan-17	0	-32	-
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		03-Jan-17	0	-32	-
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		03-Jan-17	0	-32	-
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		03-Jan-17	0	-32	-
31555IM030	Pipe Chase Pipe Spools all installed	4	FOI		03-Jan-17	0	-32	-
31555SM101	Start of Commissioning (CMS)	3	CMS		02-Mar-17	0	-30	-
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		15-Mar-17	0	14	-
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		15-Mar-17	0	14	-
31555IF210	Receive From OPG Vendor Documents Valves		MED	01-Feb-16	30-Dec-16	-333	-28	XX
31555M0050	Capable Of Receiving Refurbishment water Unit 2 - TMOD Staged (BCS Milestone)	4	FOI	27-Jun-16	30-Nov-16 A	-156	0	✓
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	08-Mar-17	-254	-13	XX
31555M0160	Building Structural Steel Complete	4	FOI	11-Jul-16	30-Nov-16 A	-142	0	✓
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	17-Jan-17	-189	-25	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	07-Mar-17	-225	2	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	13-Apr-17	-252	-79	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	01-May-17	-270	-27	XX
31555IF240	Start of Outage Segment 1 (31555U2SG1S)	3	WNS	17-Oct-16	30-Dec-16	-74	-28	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	09-Jan-17	-83	0	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	25-Jan-17	-93	-21	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	07-Mar-17	-134	2	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	09-Jan-17	-75	-26	XX
A27950	Manufacturing Equipment/Material Completed 100% and Delivered to Site -A/C Unit 0-73870-ACU9 To ACU13	5	MED	31-Oct-16	05-Dec-16 A	-35	9	✓
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	06-Mar-17	-124	0	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	27-Apr-17	-162	-17	XX
A23440	Manufacturing Equipment/Material Completed 100% and Delivered to Site - MCC	5	MED	18-Nov-16	02-Jan-17	-45	23	XX
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	03-Feb-17	-66	-7	XX
31555M0700	Corporate Scorecard - Refurbishment Campus Plan - D2O Heavy Water Storage Facility Ready to Receive U2 PHT W	2	CCD	30-Nov-16	30-Nov-16 A	0	0	✓✓
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	03-Feb-17	-63	0	XX
A23380	Manufacturing Equipment/Material Completed 100% and Delivered to Site - UPS (Delivery 35 days)	5	MED	06-Dec-16	26-Oct-16 A	41	0	✓✓
31555M0110	Building Shell Complete		CCD	07-Dec-16	01-Mar-17	-84	5	XX
31555M0220	Start of Commissioning - JV	4	CMS	12-Dec-16	29-Nov-16 A	13	51	✓✓
31555M0100	Start of Commissioning (BSC Milestone)	4	CMS	12-Dec-16	29-Nov-16 A	13	51	✓✓
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	07-Feb-17	-41	-7	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	16-May-17	-125	-32	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	23-May-17	-132	-39	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	27-Apr-17	-37	-8	X
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	07-Jun-17	-49	-8	X

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

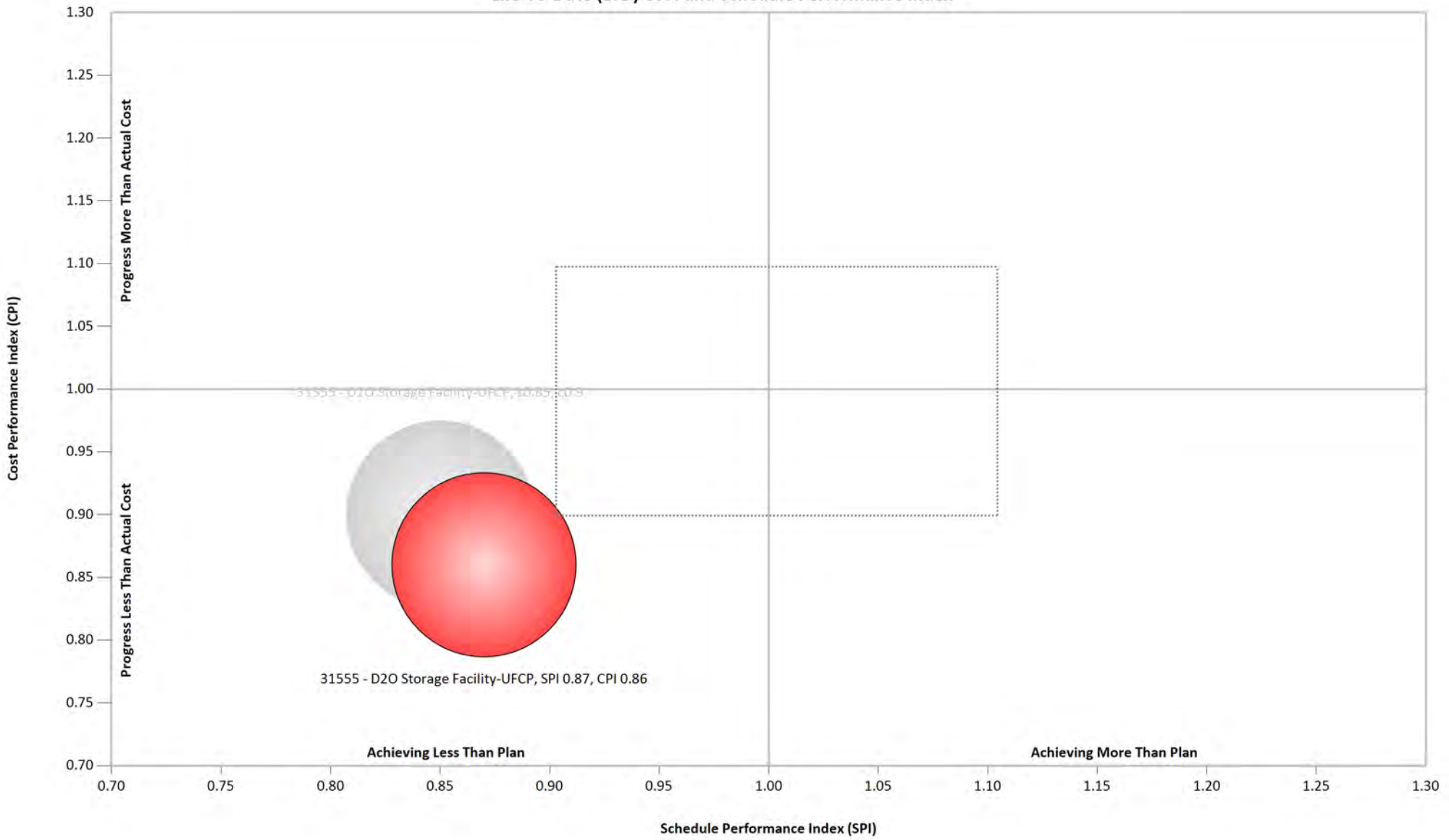
Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied:
Report Type: Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U2, U3, U4, UD, UF, US
Graph Period: Life-To-Date (LTD)
Vendor: All

Life-To-Date (LTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

ONTARIO POWER GENERATION

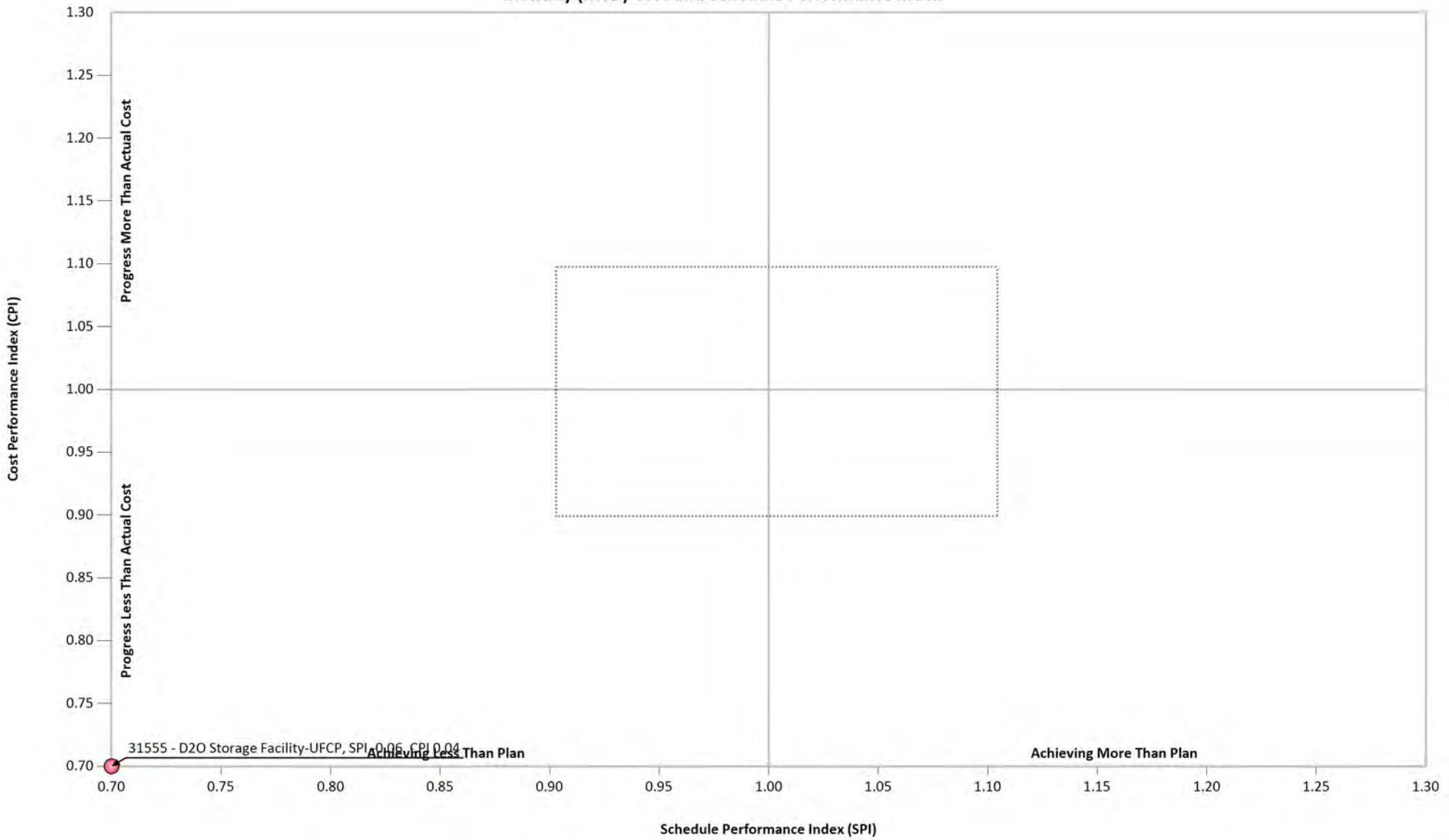
Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied:
Report Type: Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U2, U3, U4, UD, UF, US
Graph Period: Monthly (MTD)
Vendor: All

Monthly (MTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied: **Report Type:** Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U2, U3, U4, UD, UF, US
Performance: Cumulative Negative Performance
Vendor: All
Projects Shown: 10

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (PV)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI	SPI	Plan (PV)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI	SPI	Plan (PV)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	(5,013)	313	8,104	(7,790)	5,326	0.04	-0.06	220,991	193,293	223,484	(30,192)	(27,698)	0.86	0.87	223,003
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	(5,013)	313	8,104	(7,790)	5,326	0.04	-0.06	220,991	193,293	223,484	(30,192)	(27,698)	0.86	0.87	223,003
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	(5,013)	313	8,104	(7,790)	5,326	0.04	-0.06	220,991	193,293	223,484	(30,192)	(27,698)	0.86	0.87	223,003
	Total	**(5,013)**	**313**	**8,104**	**(7,790)**	**5,326**	**0.04**	**-0.06**	**220,991**	**193,293**	**223,484**	**(30,192)**	**(27,698)**	**0.86**	**0.87**	**223,003**

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

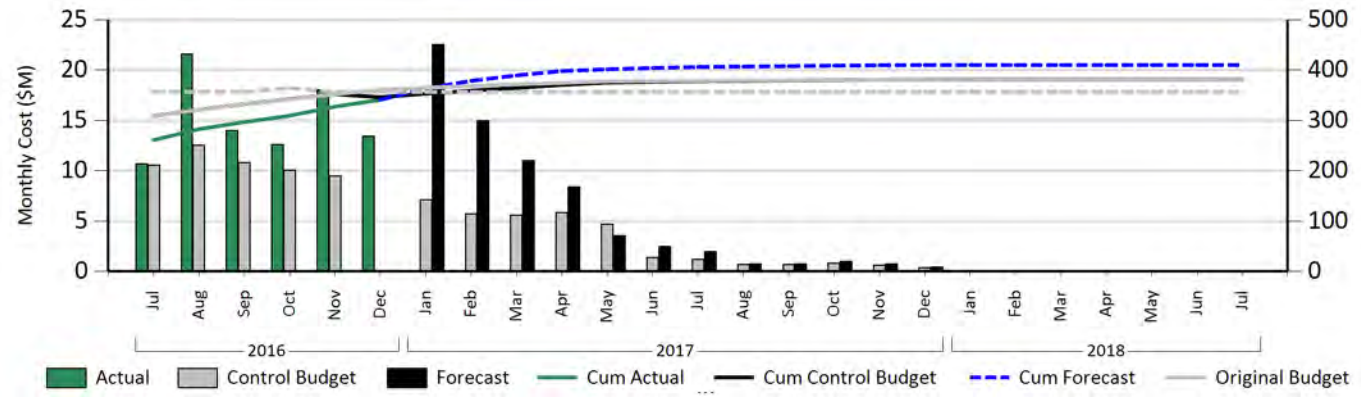
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied: **Program:** Nuclear Refurbishment Program
Unit: U0, U1, U2, U2, U3, U4, UD, UF, US **Vendor:** All

100%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*

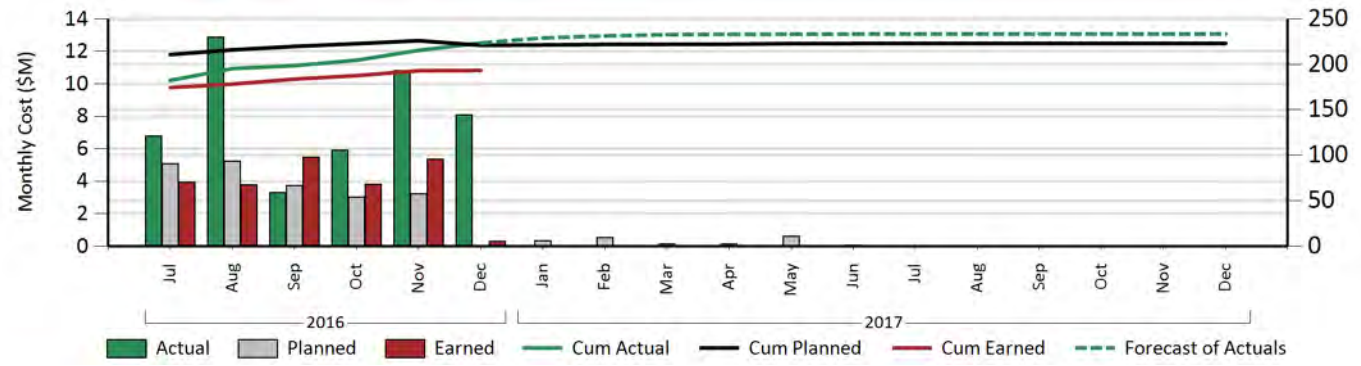


Life-To-Date	
Original Budget	360,941
Control Budget	346,049
Actual	340,896
Variance-to-Control Budget	(5,153)
% of Control Budget Spent	99%
Funding Released to Projects	356,496

=

64%

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*

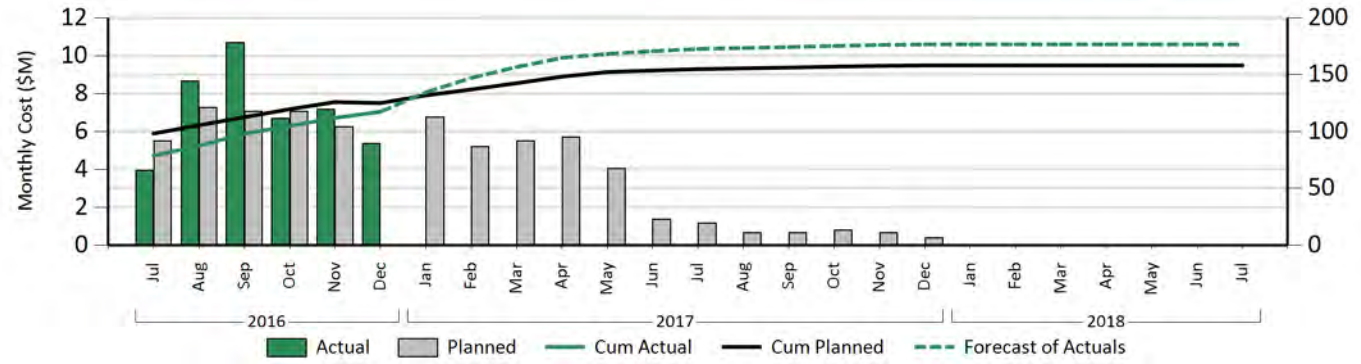


Life-To-Date	
Planned Value	220,991
Earned Value	193,293
Actual	223,484
Variance-to-Planned Value	2,494
Cost Performance Index	0.86
Schedule Performance Index	0.87

+

36%

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	125,058
Actual	117,411
Variance-to-Planned Value	(7,647)

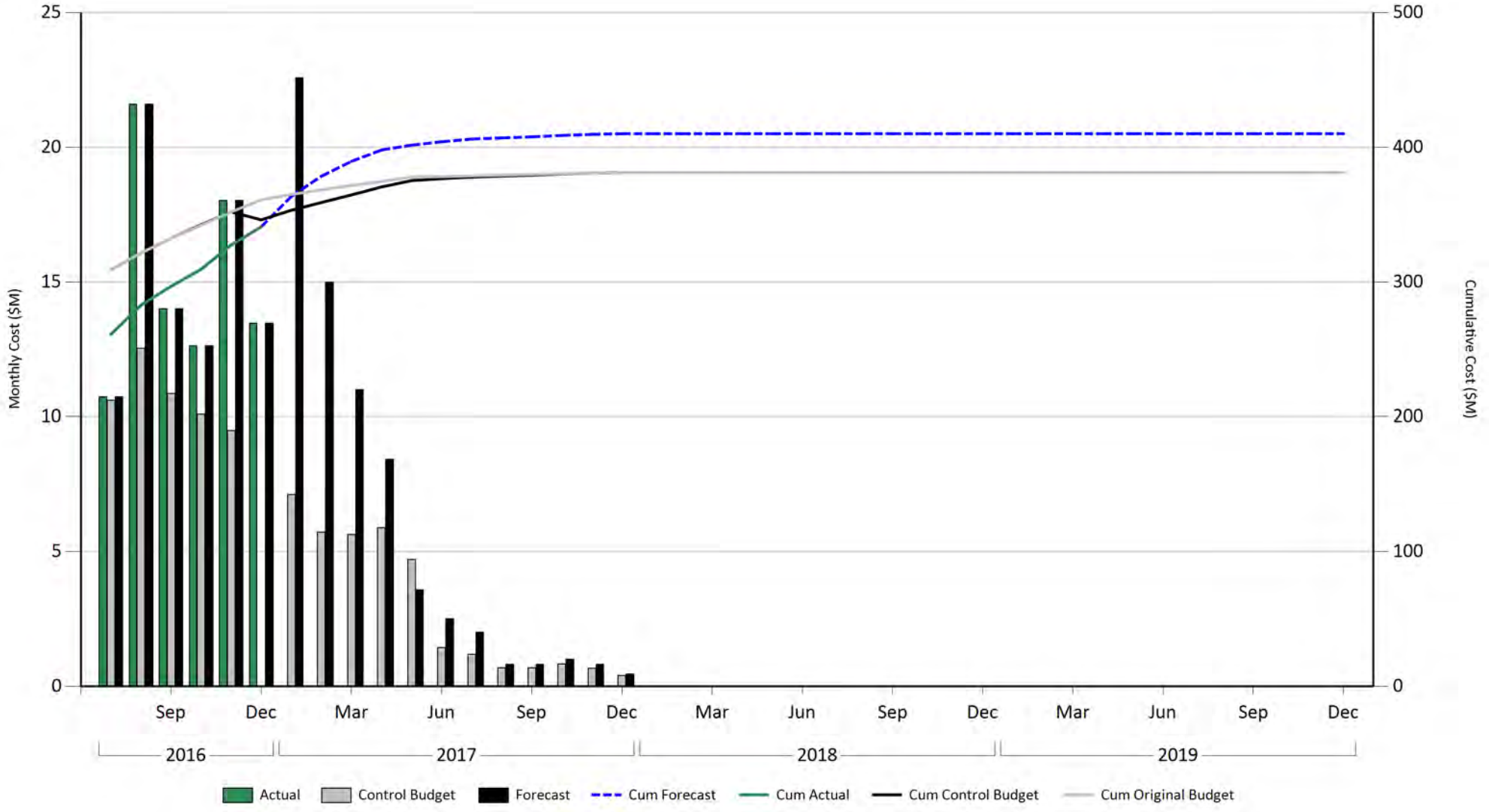
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

COST CURVE *($ MILLIONS) - Units: U2, U0, UD, US, UF*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget At Completion
381,174	381,174	340,896	89%	69,104	410,000	28,826

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

Filters Applied: **Report Type:** Vendor Overview; **Program:** Nuclear Refurbishment Program; **Unit:** U0, U1, U2, U2, U3, U4, UD, UF, US; **Include Interest:** Yes; **Vendor:** All; **Only Show Deliverable Values:** No

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	(5,900)	13,479	19,379	-228%
Life-to-Date	346,049	340,896	(5,153)	99%

	CPI	SPI
2016-Dec Life-To-Date	0.86	0.87
2016-Nov Life-To-Date	0.90	0.85

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	381,174	410,000	28,826
Life Cycle Contingency	0	0	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
	0 - Other	44,927	(6,204)	38,723	(10,229)	1,364	11,593	-	-	29,342	20,501	(8,841)	-	-	16,151	-	36,652	(2,070)	(864)
	1 - Project Management	6,562	3,119	9,681	1,870	246	(1,624)	2.18	2.19	7,404	8,440	1,036	1.05	0.99	1,651	0.61	10,091	410	(155)
	3 - Engineering	2,830	967	3,797	120	83	(37)	-	-	1,037	1,293	256	-	-	2,749	-	4,042	246	(259)
	4 - Procurement	13,940	(7,444)	6,496	(7,762)	145	7,907	-	0.89	5,051	5,708	657	0.87	0.93	1,102	-0.97	6,810	315	(104)
	6 - Commissioning	378	244	621	53	11	(42)	-	-	256	82	(174)	-	-	451	1.15	533	(89)	(42)
1	**Vendors Managed by Projects and**	**68,636**	**(9,319)**	**59,317**	**(15,948)**	**1,849**	**17,797**	**-56.14**	**0.87**	**43,091**	**36,024**	**(7,066)**	**0.95**	**0.90**	**22,104**	**1.27**	**58,128**	**(1,189)**	**(1,424)**
	0 - Other	1,306	94	1,401	94	0	(94)	-	-	1,401	1,401	0	-	-	0	-	1,401	0	0
	5 - Construction	28,198	664	28,862	816	0	(816)	-	1.10	28,862	28,862	0	1.00	1.00	0	-	28,862	0	0
2	**P&M Ellis Don**	**29,504**	**758**	**30,262**	**910**	**0**	**(910)**	**-**	**1.10**	**30,262**	**30,262**	**0**	**1.00**	**1.00**	**0**	**-**	**30,262**	**0**	**0**
	1 - Project Management	121	(1)	120	(1)	0	1	-	-	120	120	0	-	-	0	-	120	0	0
	5 - Construction	6,157	1,365	7,523	1,361	298	(1,063)	8.35	3.83	7,523	7,402	(121)	0.51	0.50	388	20.16	7,791	268	261
3	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**1,361**	**298**	**(1,063)**	**8.35**	**3.83**	**7,643**	**7,522**	**(121)**	**0.51**	**0.50**	**388**	**20.16**	**7,911**	**268**	**261**
	0 - Other	1,869	(1,869)	0	(1,869)	0	1,869	-	-	0	0	0	-	-	0	-	0	0	0
	1 - Project Management	3,513	2,355	5,868	2,355	0	(2,355)	-	1.00	5,868	5,868	0	1.00	1.00	0	-	5,868	0	0
	3 - Engineering	17,417	1,915	19,332	2,052	0	(2,052)	-	1.00	18,492	18,282	(210)	1.10	1.00	0	-	18,282	(1,050)	0
	4 - Procurement	15,710	8,225	23,936	8,214	0	(8,214)	-	1.00	23,924	23,936	12	1.00	1.00	137	-	24,073	137	(13)
	5 - Construction	76,602	(6,793)	69,809	(6,793)	0	6,793	-	1.00	69,809	69,810	1	1.00	1.00	0	-	69,810	1	0
	9 - Closeout	375	(2)	374	(2)	0	2	-	1.00	374	374	0	1.00	1.00	0	-	374	0	0
4	**P&M Legacy**	**115,486**	**3,831**	**119,318**	**3,956**	**0**	**(3,956)**	**20656.1**	**1.00**	**118,466**	**118,268**	**(198)**	**1.01**	**1.00**	**137**	**-**	**118,405**	**(912)**	**(13)**
	1 - Project Management	1,128	1,309	2,437	43	133	90	-	-	1,171	2,406	1,235	-	-	244	-	2,650	213	(23)
	3 - Engineering	5,897	(798)	5,099	(1,328)	670	1,998	-126.61	-0.80	4,569	4,932	363	0.52	0.55	131	14.80	5,064	(36)	666
	4 - Procurement	4,553	(128)	4,425	(128)	32	161	-3.95	1.00	4,425	4,250	(175)	1.04	1.00	0	-	4,250	(175)	32
	5 - Construction	7,578	(2,095)	5,483	(2,056)	177	2,233	0.53	-0.42	4,983	5,442	459	0.81	0.65	65	1.39	5,507	24	(6)
5	**P&M Other Vendors**	**19,156**	**(1,712)**	**17,444**	**(3,469)**	**1,012**	**4,481**	**5.45**	**-0.62**	**15,148**	**17,030**	**1,882**	**0.77**	**0.74**	**440**	**2.84**	**17,470**	**26**	**670**
	0 - Other	2,282	4,986	7,267	1,073	(1,029)	(2,101)	-	-	1,073	385	(688)	-	-	3,459	-	3,844	(3,424)	(326)
	1 - Project Management	20,618	37	20,656	1,034	1,267	233	-	-	16,361	22,571	6,209	-	-	8,022	-	30,593	9,937	(756)
	3 - Engineering	15,438	520	15,958	614	1,152	538	-2.41	2.61	14,050	22,130	8,080	0.73	1.03	4,062	-0.04	26,192	10,235	(378)
	4 - Procurement	36,000	(157)	35,844	1,367	1,816	449	0.04	0.07	35,369	33,172	(2,197)	0.64	0.62	2,602	8.39	35,774	(70)	(235)
	5 - Construction	67,245	(306)	66,939	3,203	3,263	60	0.83	2.36	64,586	47,308	(17,278)	0.80	0.76	25,622	4.94	72,929	5,991	(1,436)
	6 - Commissioning	531	(4)	527	0	0	0	-	-	0	0	0	-	-	2,268	-	2,268	1,741	(214)
	U - Unallocated Cost	0	0	0	0	3,850	3,850	-	-	0	6,223	6,223	-	-	0	-	6,223	6,223	3,850

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
6	**P&M SNC/AECON JV**	**142,114**	**5,076**	**147,190**	**7,291**	**10,320**	**3,029**	**0.25**	**0.99**	**131,439**	**131,789**	**349**	**0.67**	**0.71**	**46,035**	**-6.06**	**177,823**	**30,634**	**506**
	Nuclear Refurbishment Program	**381,174**	**0**	**381,174**	**(5,900)**	**13,479**	**19,379**	**0.04**	**-0.06**	**346,049**	**340,896**	**(5,153)**	**0.86**	**0.87**	**69,104**	**-61.73**	**410,000**	**28,826**	**0**

Note: - CPI and SPI are calculated on Deliverable Based work packages only.
- All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2016

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: December 2016

ID	Title	Risk Description	Current Score	Post Score
14287	16-31555 - Building Structural Steel Delivery Dates	Event: Changes to the 100el slab thickness Cause: Design changes to an accepted EC Impact: Late fabrication and delivery of structural steel	25	8
14177	16-31555 - 11 New Design EC's Completion Date	Event: Late start of new EPC Vendor Cause: Amount of design work to complete including equipment vendor information. Impact: Late procurement/installation/commissioning activities The 11 new DEC's for JV to complete have a completion date (per the latest recovery schedule) of late 2016, threatening the installation and commissioning milestones.	20	15
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor and continued construction delays. Cause: Insufficient QA resources to support CWP/ITP/Materials. Impact: Expedited construction schedule with many activities progressing in parallel.	20	15
12334	16-31555 D2O Storage Project: Construction Delays Due to Material Ordering Delays	Event: Late placement of purchase orders or long lead times of materials/equipment Cause: Lack of procurement resources Impact: There is a risk that long lead materials (LLM)/Bulk materials will not be ordered/delivered in time to support the construction schedule.	16	16
14987	16- 31555 - Commissioning schedule delay due to late submission of design manuals	Delays in issuance of new design manuals by the JV has the potential of affecting dates for issuance of commissioning workplans by OPG. In turn this has the potential to delay execution of commissioning activities.	12	6

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

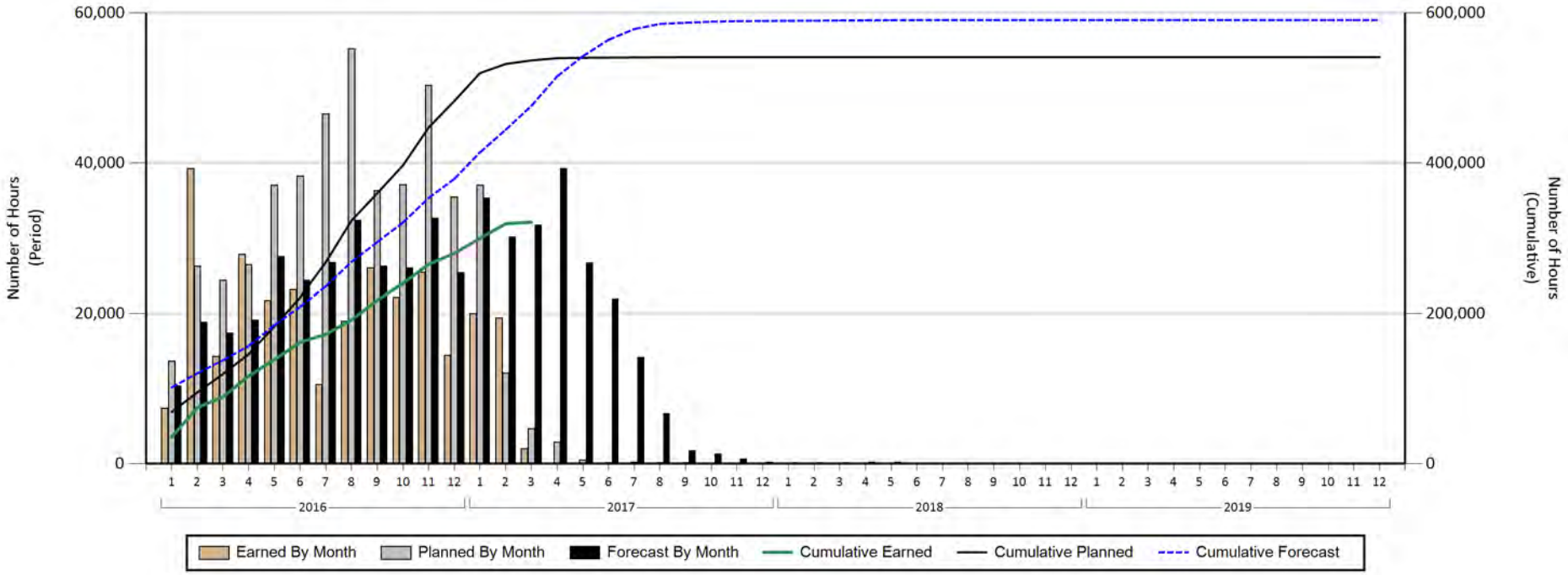
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,243	422,246
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,157	590,561

	Planned %	Earned %	Variance
Cumulative Progress	**99.2%**	**59.4%**	**-39.8%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	4,738	2,063	-2,675	0.44	N/A
Cumulative	536,847	321,333	-215,514	0.60	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

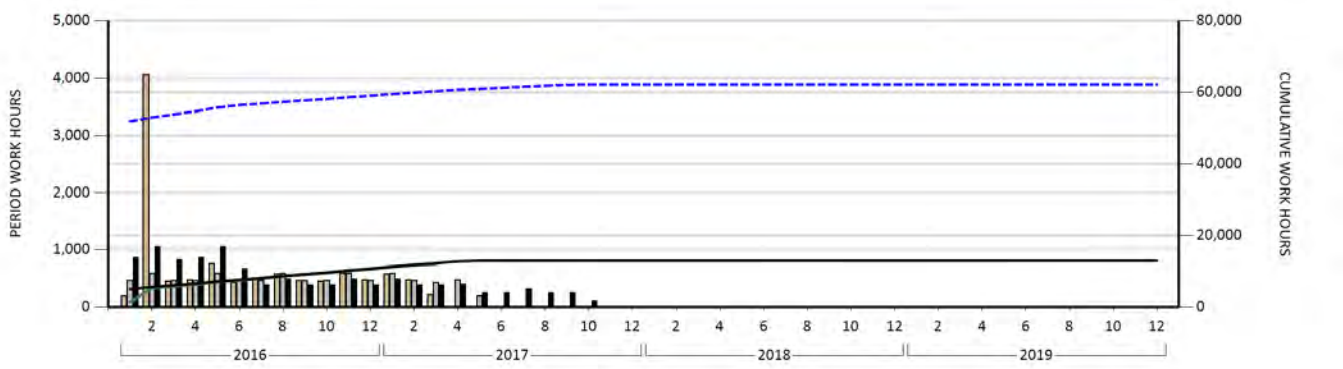
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**395**	**60,343**	**62,242**
Baseline Hours	443	12,260	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	224	11,963	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(219)	(297)	
SPI on Baseline	0.51	0.98	

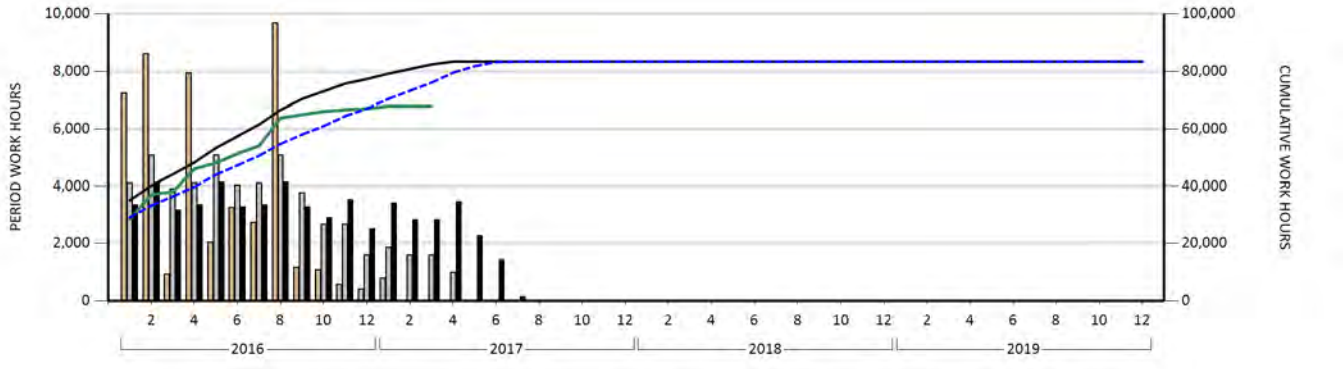
	Planned %	Earned %	Variance
Cumulative Progress	**94.7%**	**92.4%**	**-2.3%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**2,828**	**76,093**	**83,447**
Baseline Hours	1,595	82,437	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	67,878	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(1,595)	(14,559)	
SPI on Baseline	-	0.82	

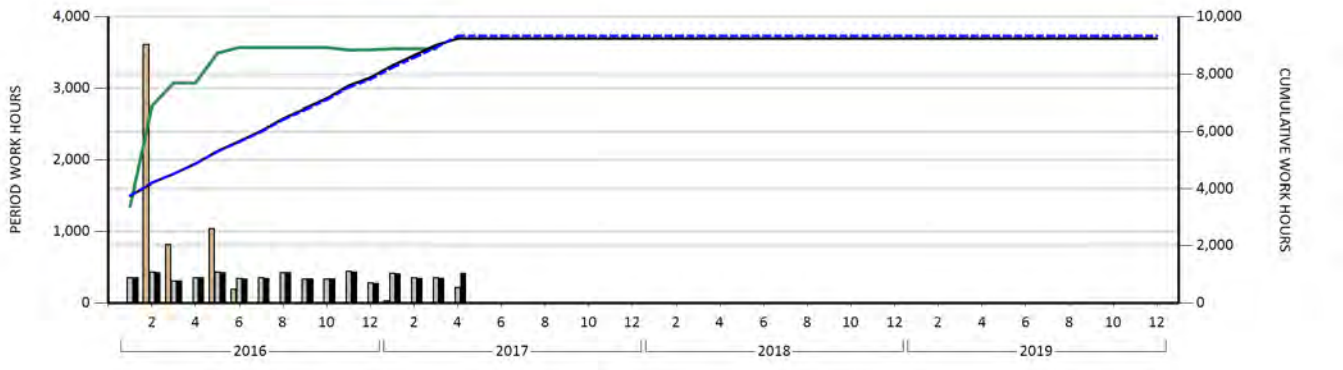
	Planned %	Earned %	Variance
Cumulative Progress	**98.8%**	**81.3%**	**-17.5%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**354**	**8,938**	**9,357**
Baseline Hours	361	9,028	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	8,899	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(361)	(130)	
SPI on Baseline	-	0.99	

	Planned %	Earned %	Variance
Cumulative Progress	**97.5%**	**96.1%**	**-1.4%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

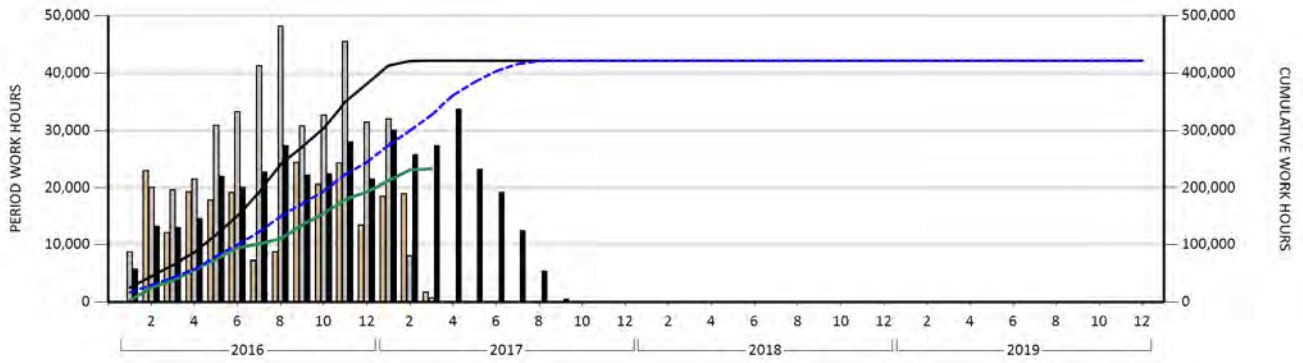
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**27,419**	**327,442**	**422,246**
Baseline Hours	724	422,243	422,243
Forecast (Recovery)	N/A	N/A	
Earned Hours	1,839	232,594	
Actual	N/A	N/A	
Variance (Earned From Baseline)	1,116	(189,649)	
SPI on Baseline	2.54	0.55	

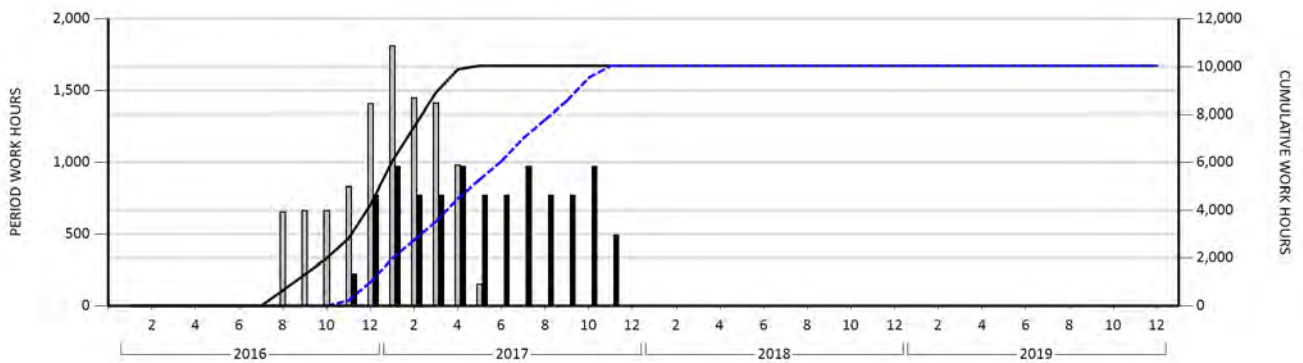
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**55.1%**	**-44.9%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**777**	**3,529**	**10,053**
Baseline Hours	1,417	8,919	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(1,417)	(8,919)	
SPI on Baseline	-	-	

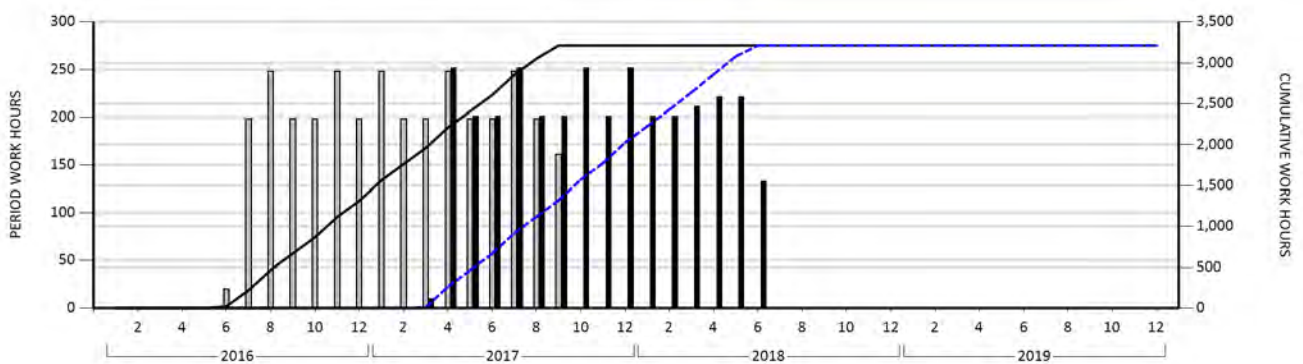
	Planned %	Earned %	Variance
Cumulative Progress	**88.7%**	**0.0%**	**-88.7%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**10**	**10**	**3,216**
Baseline Hours	199	1,960	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(199)	(1,960)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**60.9%**	**0.0%**	**-60.9%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

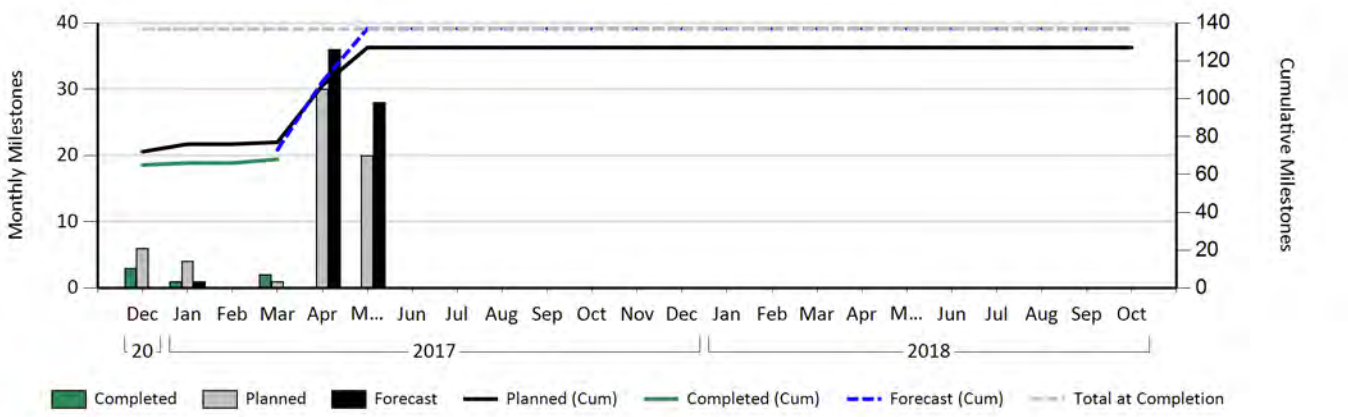
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	47
Milestones Planned to Date Completed	30 | 64%
Variance Ahead / (Behind)	(17)
Milestones Completed on Time	10 | 21%
Milestones Forecasting Late	15 | 68%
# of Milestones Completed | Remaining	30 | 22
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	38 | 47
Total # of Milestones	**137**
# of Milestones Completed | Remaining	68 | 69



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		07-Sep-16	0	302	XX
31555SM101	Start of Commissioning (CMS)	3	CMS		05-Jan-17	0	109	XX
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		19-Apr-17	0	-47	-
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		19-Apr-17	0	-47	-
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		19-Apr-17	0	-47	-
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		19-Apr-17	0	-47	-
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		19-Apr-17	0	-47	-
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		19-Apr-17	0	-47	-
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		19-Apr-17	0	-47	-
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		19-Apr-17	0	-47	-
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		19-Apr-17	0	-47	-
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		19-Apr-17	0	-47	-
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		19-Apr-17	0	-47	-
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		19-Apr-17	0	-47	-
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		19-Apr-17	0	-47	-
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		19-Apr-17	0	-47	-
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		19-Apr-17	0	-47	-
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		19-Apr-17	0	-47	-
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		19-Apr-17	0	-47	-

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		19-Apr-17	0	-47	-
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		19-Apr-17	0	-47	-
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		19-Apr-17	0	-47	-
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		19-Apr-17	0	-47	-
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		19-Apr-17	0	-47	-
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		19-Apr-17	0	-47	-
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		19-Apr-17	0	-47	-
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		19-Apr-17	0	-47	-
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		19-Apr-17	0	-47	-
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		19-Apr-17	0	-47	-
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		19-Apr-17	0	-47	-
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		23-May-17	0	44	-
31555FM171	Final AFS - All Commissioning Complete	3	CMF		23-May-17	0	157	-
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		23-May-17	0	-81	-
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		23-May-17	0	-81	-
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		23-May-17	0	-81	-
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		23-May-17	0	-81	-
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		23-May-17	0	-81	-
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		23-May-17	0	-81	-
AA1618	CCD-HVAC Start-up		CCD		23-May-17	0	-81	-
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		23-May-17	0	-81	-
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		23-May-17	0	-81	-
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		23-May-17	0	-81	-
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		23-May-17	0	-81	-
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		23-May-17	0	-81	-
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		23-May-17	0	-81	-
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		23-May-17	0	-81	-
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		23-May-17	0	-81	-
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	23-May-17	-330	27	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	19-Apr-17	-281	-47	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	19-Apr-17	-268	2	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	19-Apr-17	-258	71	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	23-May-17	-292	62	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	03-May-16	168	308	XX
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	23-May-17	-211	-64	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	19-Apr-17	-177	15	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	19-Apr-17	-175	-34	XX
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	19-Apr-17	-168	77	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	19-Apr-17	-154	117	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A23440	Manufacturing Equipment/Material Completed 100% and Delivered to Site - MCC	5	MED	18-Nov-16	23-Mar-17 A	-125	-15	✓
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	07-Apr-16	236	357	XX
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	21-Jun-16	164	283	XX
31555M0110	Building Shell Complete		CCD	07-Dec-16	16-Mar-17 A	-99	-9	✓
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	23-May-17	-146	-35	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	23-May-17	-132	8	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	23-May-17	-132	21	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	23-May-17	-63	37	XX
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	19-Apr-17	0	191	-
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4	CMF	19-Apr-17	23-May-17	-34	157	X
31555M0130	Project Close-out Complete	4	PCO	23-May-17	23-May-17	0	191	-
31555PED30	Project Close out complete	4	PCO	23-May-17	23-May-17	0	191	-
31555M0240	Final Completion / Project Closeout	4	PCO	23-May-17	23-May-17	0	191	-

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

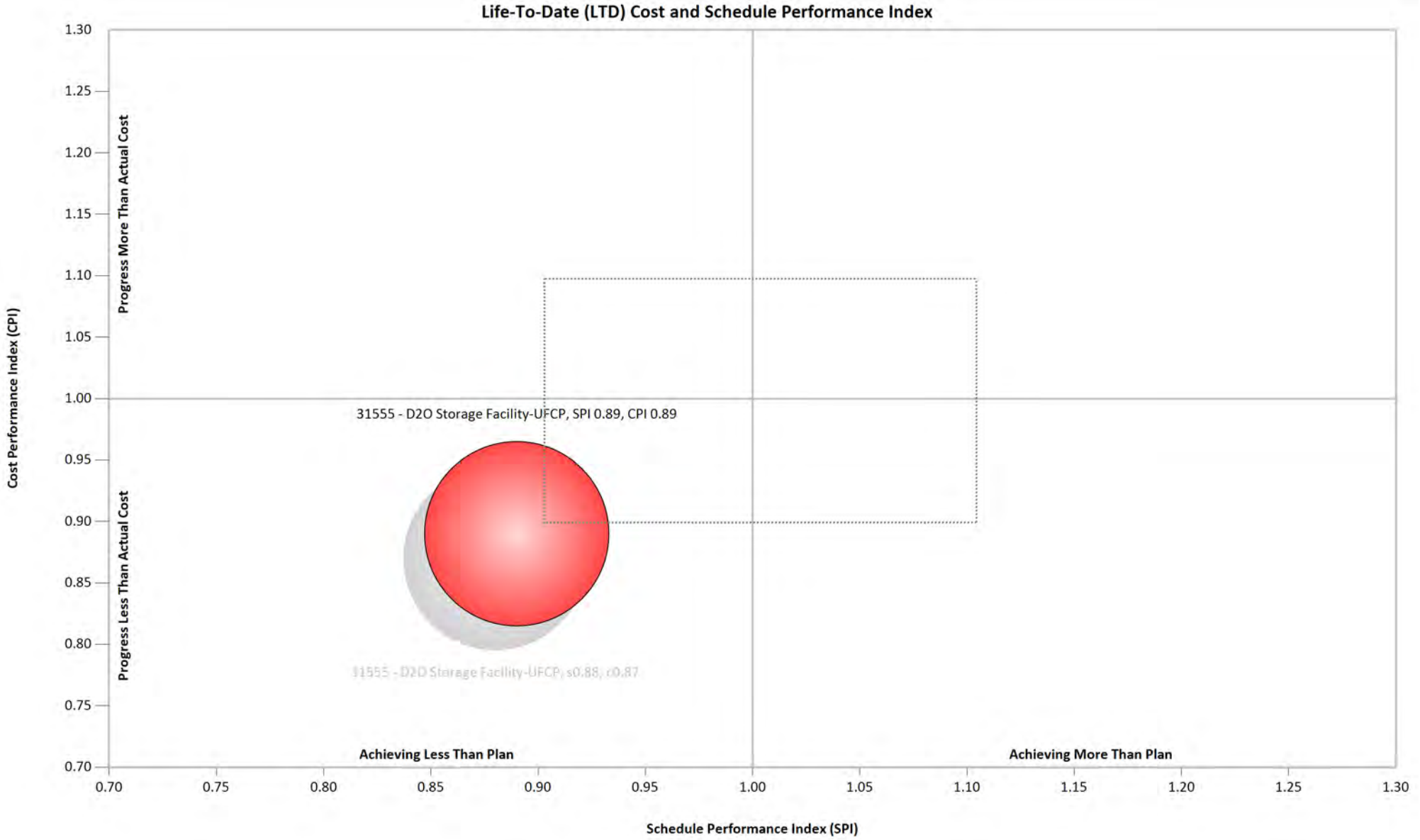
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied:
Report Type: Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Graph Period: Life-To-Date (LTD)
Vendor: All



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

ONTARIO POWER GENERATION

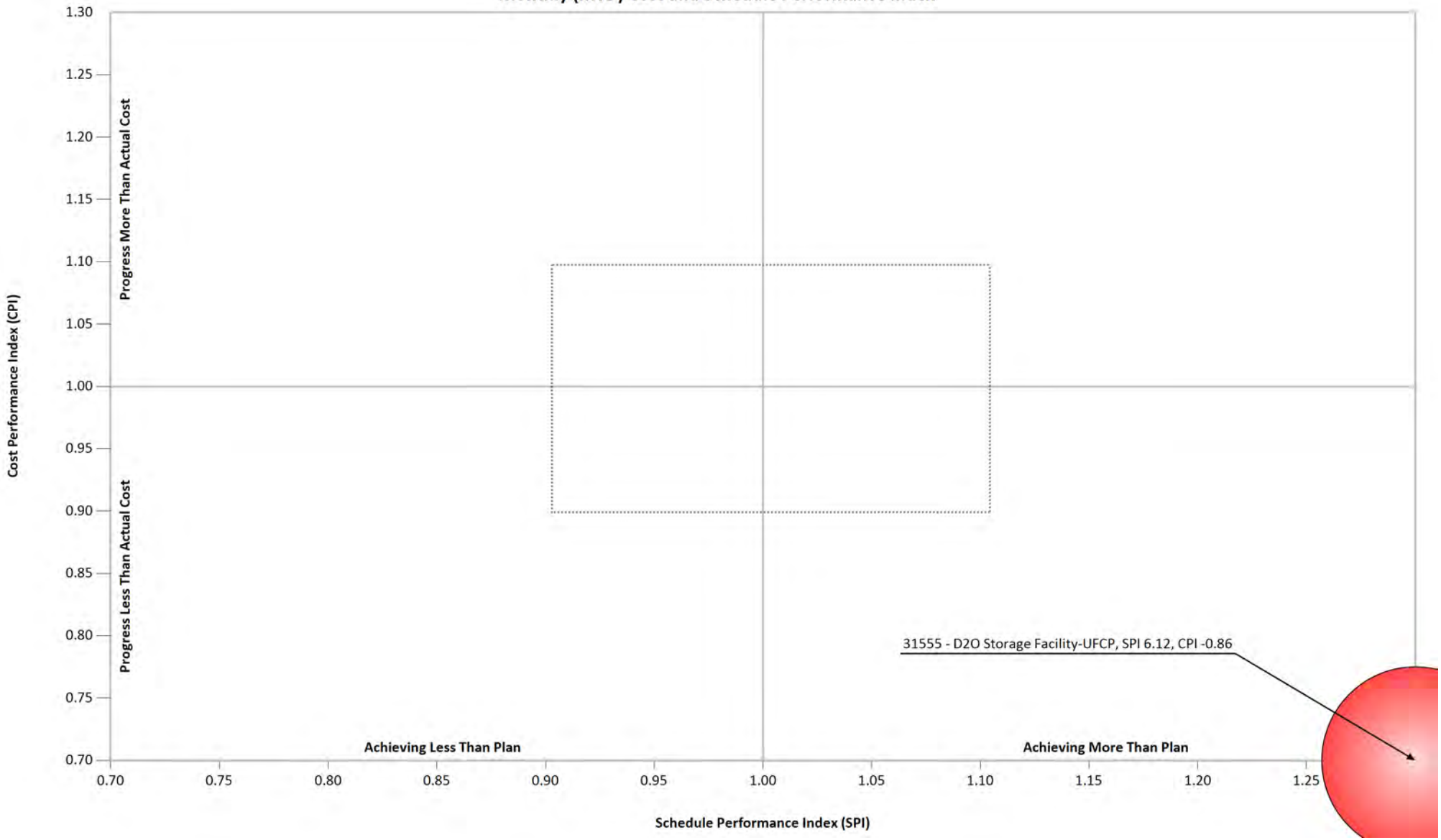
Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied:
Report Type: Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Graph Period: Monthly (MTD)
Vendor: All

Monthly (MTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied: **Report Type:** Projects
Program: Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US
Performance: Cumulative Negative Performance
Vendor: All
Projects Shown: 10

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (PV)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI	SPI	Plan (PV)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI	SPI	Plan (PV)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	395	2,417	(2,822)	5,239	2,022	-0.86	6.12	216,098	192,402	216,675	(24,273)	(23,695)	0.89	0.89	217,083
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	395	2,417	(2,822)	5,239	2,022	-0.86	6.12	216,098	192,402	216,675	(24,273)	(23,695)	0.89	0.89	217,083
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	395	2,417	(2,822)	5,239	2,022	-0.86	6.12	216,098	192,402	216,675	(24,273)	(23,695)	0.89	0.89	217,083
	Total	**395**	**2,417**	**(2,822)**	**5,239**	**2,022**	**-0.86**	**6.12**	**216,098**	**192,402**	**216,675**	**(24,273)**	**(23,695)**	**0.89**	**0.89**	**217,083**

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

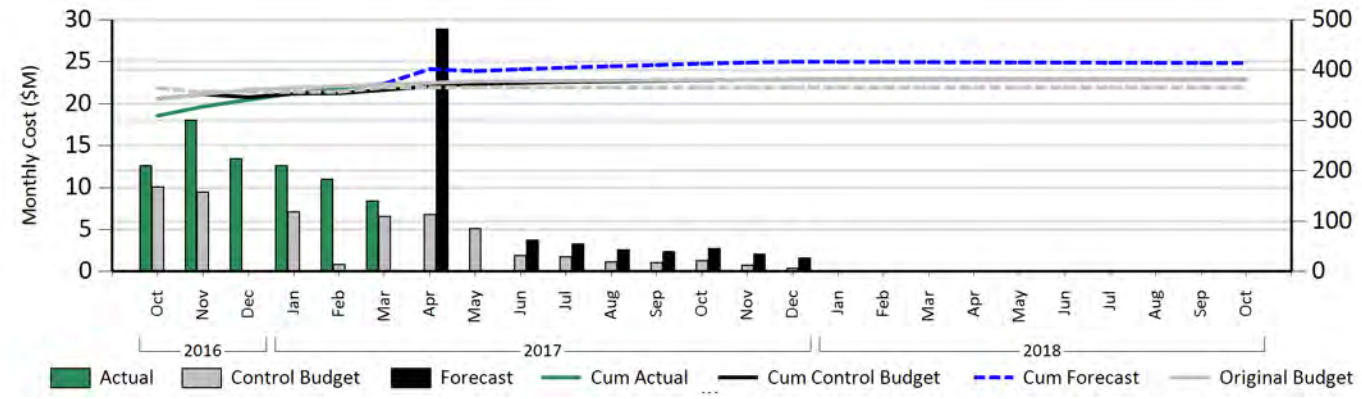
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied: **Program:** Nuclear Refurbishment Program
Unit: U0, U1, U2, U3, U4, UD, UF, US **Vendor:** All

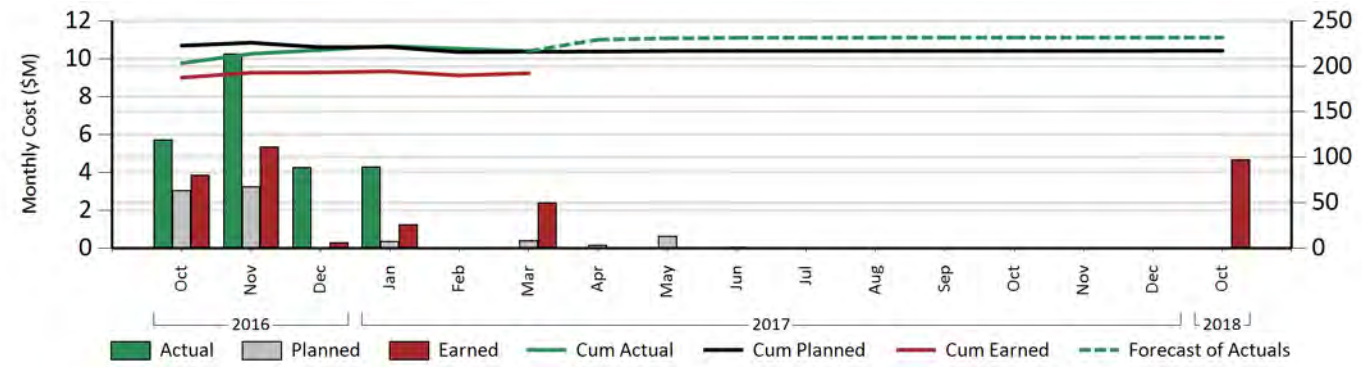
100% = 60% + 40%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*



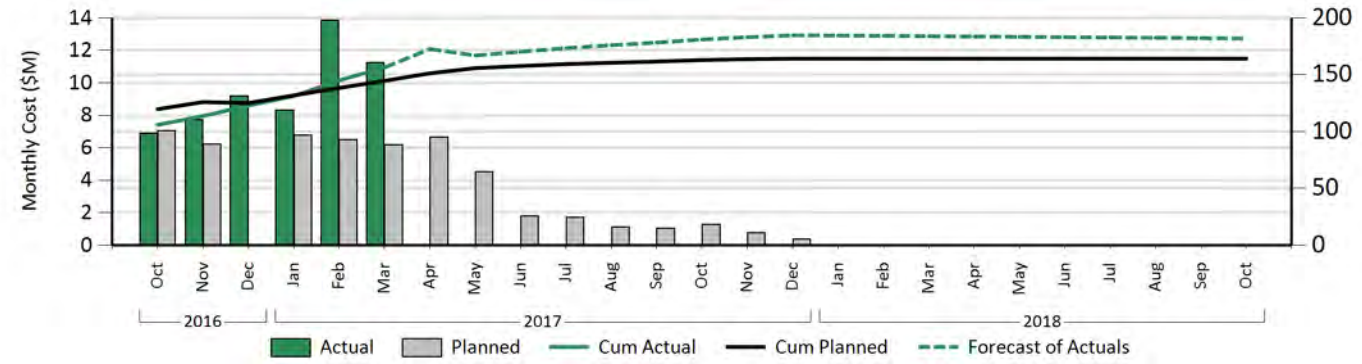
Life-To-Date	
Original Budget	371,541
Control Budget	360,679
Actual	373,007
Variance-to-Control Budget	12,328
% of Control Budget Spent	103%
Funding Released to Projects	365,496

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	216,098
Earned Value	192,402
Actual	216,675
Variance-to-Planned Value	578
Cost Performance Index	0.89
Schedule Performance Index	0.89

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	144,581
Actual	156,332
Variance-to-Planned Value	11,750

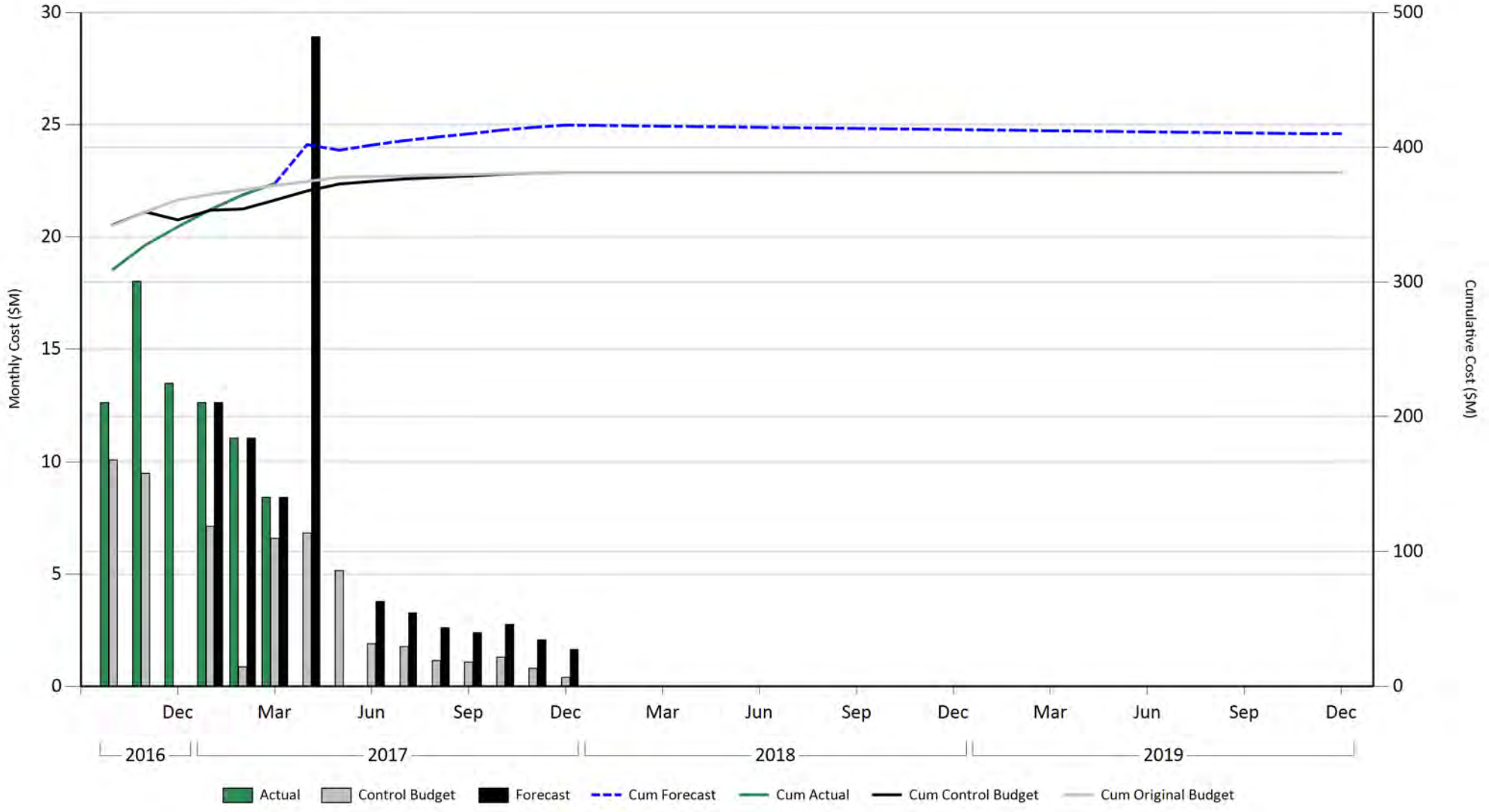
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

COST CURVE *($ MILLIONS) - Units: U2, U0, UD, US, UF*



Original Budget	Control Budget	Actual	% of Control Budget Spent	Estimate To Complete	Estimate At Completion	Variance To Control Budget At Completion
381,174	381,174	373,007	98%	37,009	410,016	28,842

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

Filters Applied: **Report Type:** Vendor Overview; **Program:** Nuclear Refurbishment Program; **Unit:** U0, U1, U2, U3, U4, UD, UF, US; **Include Interest:** Yes; **Vendor:** All; **Only Show Deliverable Values:** No

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	6,617	8,431	1,814	127%
Life-to-Date	360,679	373,007	12,328	103%

	CPI	SPI
2017-Mar Life-To-Date	0.89	0.89
2017-Feb Life-To-Date	0.87	0.88

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	381,174	410,016	28,842
Life Cycle Contingency	0	0	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
	0 - Other	44,927	(7,175)	37,752	1,257	633	(624)	-	-	33,467	22,980	(10,487)	-	-	(3,081)	-	19,899	(17,853)	(11,100)
	1 - Project Management	6,562	3,119	9,681	263	188	(75)	0.00	0.00	8,241	9,826	1,585	0.92	0.96	636	-4.87	10,462	781	0
	3 - Engineering	2,830	967	3,797	616	58	(558)	-	-	1,996	1,599	(397)	-	-	1,742	-	3,341	(456)	0
	4 - Procurement	13,940	(7,444)	6,496	111	102	(9)	-	-	5,412	6,082	670	0.87	0.93	528	-0.97	6,609	114	0
	6 - Commissioning	378	244	621	48	10	(38)	0.00	0.00	412	117	(295)	0.00	0.00	263	1.23	381	(241)	0
1	**Vendors Managed by Projects and**	**68,636**	**(10,289)**	**58,347**	**2,296**	**992**	**(1,305)**	**0.00**	**0.00**	**49,527**	**40,604**	**(8,924)**	**0.87**	**0.86**	**88**	**2.43**	**40,691**	**(17,655)**	**(11,100)**
	0 - Other	1,306	94	1,401	0	0	0	-	-	1,401	1,401	0	-	-	0	-	1,401	0	0
	5 - Construction	28,198	664	28,862	0	0	0	-	-	28,862	28,862	0	1.00	1.00	0	0.00	28,862	0	0
2	**P&M Ellis Don**	**29,504**	**758**	**30,262**	**0**	**0**	**0**	**-**	**-**	**30,262**	**30,262**	**0**	**1.00**	**1.00**	**0**	**0.00**	**30,262**	**0**	**0**
	1 - Project Management	121	(1)	120	0	0	0	-	-	120	120	0	-	-	0	-	120	0	0
	5 - Construction	6,157	1,365	7,523	0	260	260	0.00	-	7,523	7,590	67	0.49	0.50	(196)	-29.36	7,394	(129)	0
3	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**0**	**260**	**260**	**0.00**	**-**	**7,643**	**7,710**	**67**	**0.49**	**0.50**	**(196)**	**-29.36**	**7,514**	**(129)**	**0**
	0 - Other	1,869	(1,869)	0	0	0	0	-	-	0	0	0	-	-	0	-	0	0	0
	1 - Project Management	3,513	2,355	5,868	0	0	0	-	-	5,868	5,868	0	1.00	1.00	0	0.00	5,868	0	0
	3 - Engineering	17,417	1,915	19,332	137	0	(137)	-	-	18,902	18,282	(620)	1.10	1.00	0	0.00	18,282	(1,050)	0
	4 - Procurement	15,710	8,225	23,936	0	0	0	-	-	23,936	23,935	(1)	1.00	1.00	0	0.00	23,935	(1)	0
	5 - Construction	76,602	(6,793)	69,809	0	0	0	-	-	69,809	69,810	1	1.00	1.00	0	0.00	69,810	1	0
	9 - Closeout	375	(2)	374	0	0	0	-	-	374	374	0	1.00	1.00	0	0.00	374	0	0
4	**P&M Legacy**	**115,486**	**3,831**	**119,318**	**137**	**0**	**(137)**	**-**	**-**	**118,888**	**118,268**	**(620)**	**1.01**	**1.00**	**0**	**0.00**	**118,268**	**(1,050)**	**0**
	1 - Project Management	876	1,562	2,437	295	133	(162)	-	-	2,131	2,710	579	-	-	128	-	2,838	401	0
	3 - Engineering	5,897	(798)	5,099	79	2	(77)	0.00	0.00	4,825	4,994	169	0.51	0.52	92	23.28	5,085	(14)	0
	4 - Procurement	4,553	(128)	4,425	0	(12)	(12)	0.00	-	4,425	4,301	(123)	1.03	1.00	12	0.00	4,313	(112)	0
	5 - Construction	7,578	(2,095)	5,483	0	(8)	(8)	-	-	4,983	5,501	518	0.78	0.65	166	1.54	5,667	184	0
5	**P&M Other Vendors**	**18,904**	**(1,460)**	**17,444**	**374**	**116**	**(258)**	**0.00**	**0.00**	**16,363**	**17,505**	**1,142**	**0.76**	**0.73**	**398**	**3.35**	**17,903**	**459**	**0**
	0 - Other	2,282	922	3,204	1,372	5	(1,368)	-	-	82	2,164	2,082	-	-	1,172	-	3,336	132	210
	1 - Project Management	20,870	5,318	26,189	1,490	409	(1,081)	-	-	20,318	26,292	5,974	-	-	5,975	-	32,267	6,079	3,018
	3 - Engineering	15,438	446	15,883	395	(782)	(1,178)	0.00	-	15,382	24,530	9,148	0.67	0.99	3,408	-0.03	27,937	12,054	0
	4 - Procurement	36,000	(72)	35,929	261	(7,989)	(8,250)	-0.37	9.27	35,926	29,048	(6,878)	0.81	0.68	17,496	1.98	46,545	10,616	3,430
	5 - Construction	67,245	(816)	66,429	115	(6,998)	(7,113)	0.00	-	65,937	54,369	(11,569)	0.68	0.80	29,936	-1.13	84,305	17,876	4,442
	6 - Commissioning	531	(4)	527	177	0	(177)	-	-	350	0	(350)	-	-	1,151	-	1,151	624	0
	U - Unallocated Cost	0	0	0	0	22,419	22,419	-	-	0	22,254	22,254	-	-	(22,419)	-	(164)	(164)	0

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Control Budget	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	Plan (PV)	Actual (AC)	Cost Variance	CPI	SPI	ETC	CPI on ETC	EAC	Variance from Control Budget	Variance to EAC over Period
6	**P&M SNC/AECON JV**	**142,366**	**5,794**	**148,160**	**3,810**	**7,063**	**3,253**	**-0.76**	**9.27**	**137,995**	**158,658**	**20,662**	**0.73**	**0.75**	**36,720**	**-8.35**	**195,377**	**47,217**	**11,100**
	Nuclear Refurbishment Program	**381,174**	**0**	**381,174**	**6,617**	**8,431**	**1,814**	**-0.86**	**6.12**	**360,679**	**373,007**	**12,328**	**0.89**	**0.89**	**37,009**	**60.61**	**410,016**	**28,842**	**0**

Note: - CPI and SPI are calculated on Deliverable Based work packages only.
- All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End March 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: March 2017

ID	Title	Risk Description	Current Score	Post Score
14287	16-31555 - Building Structural Steel Delivery Dates	Event: Changes to the 100el slab thickness Cause: Design changes to an accepted EC Impact: Late fabrication and delivery of structural steel	25	8
14177	16-31555 - 11 New Design EC's Completion Date	Event: Late start of new EPC Vendor Cause: Amount of design work to complete including equipment vendor information. Impact: Late procurement/installation/commissioning activities The 11 new DEC's for JV to complete have a completion date (per the latest recovery schedule) of late 2016, threatening the installation and commissioning milestones. Diesel generator EC and multiple software ECs are outstanding and will need constant revisions. Ongoing revisions will cause more delays.	20	15
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor and continued construction delays. Cause: Insufficient QA resources to support CWP/ITP development and material verification. Impact: Quality issues due to expedited construction schedule with many activities progressing in parallel.	20	15
12334	16-31555 D2O Storage Project: Construction Delays Due to Material Ordering Delays	Event: Late placement of purchase orders or long lead times of materials/equipment Cause: Lack of procurement resources Impact: There is a risk that long lead materials (LLM)/Bulk materials will not be ordered/delivered in time to support the construction schedule.	16	16
14987	16-31555 D20 Storage Project: Commissioning schedule delay due to late submission of design manuals	Delays in issuance of new design manuals by the JV has the potential of affecting dates for issuance of commissioning workplans by OPG. In turn this has the potential to delay execution of commissioning activities.	12	6

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

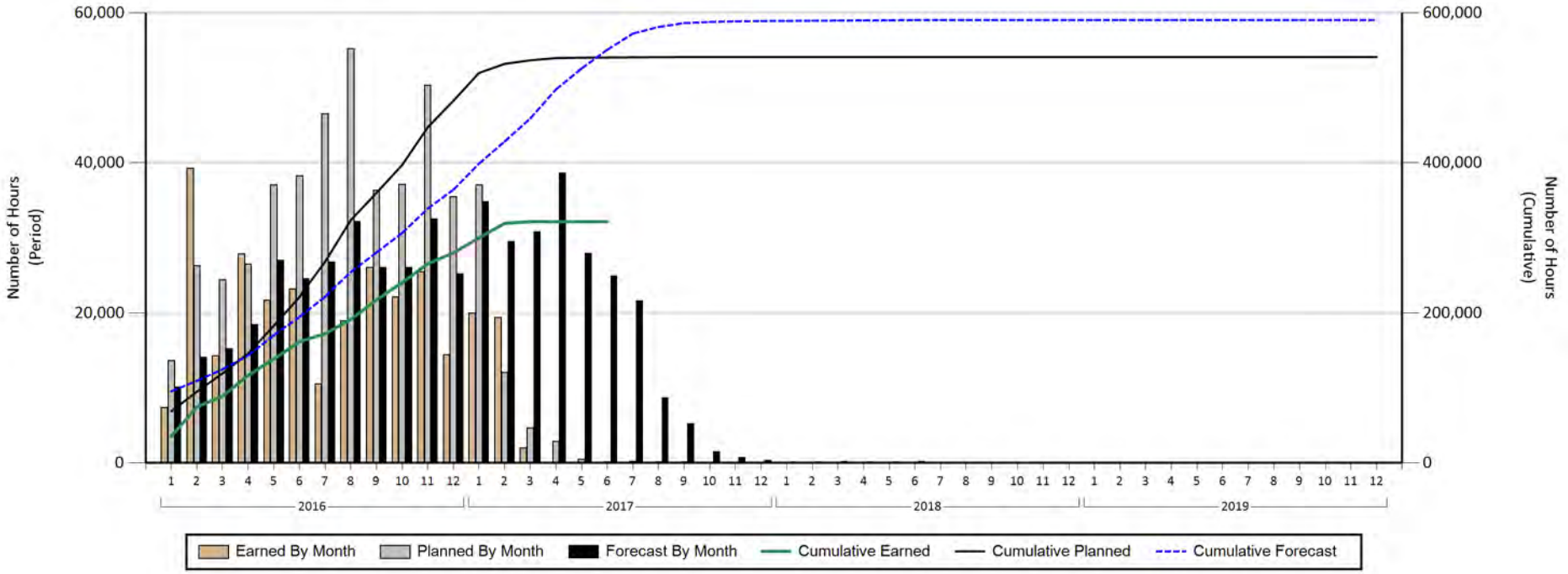
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,243	422,251
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,157	590,566

	Planned %	Earned %	Variance
Cumulative Progress	**99.9%**	**59.4%**	**-40.5%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	199	0	-199	0.00	N/A
Cumulative	540,548	321,333	-219,215	0.59	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

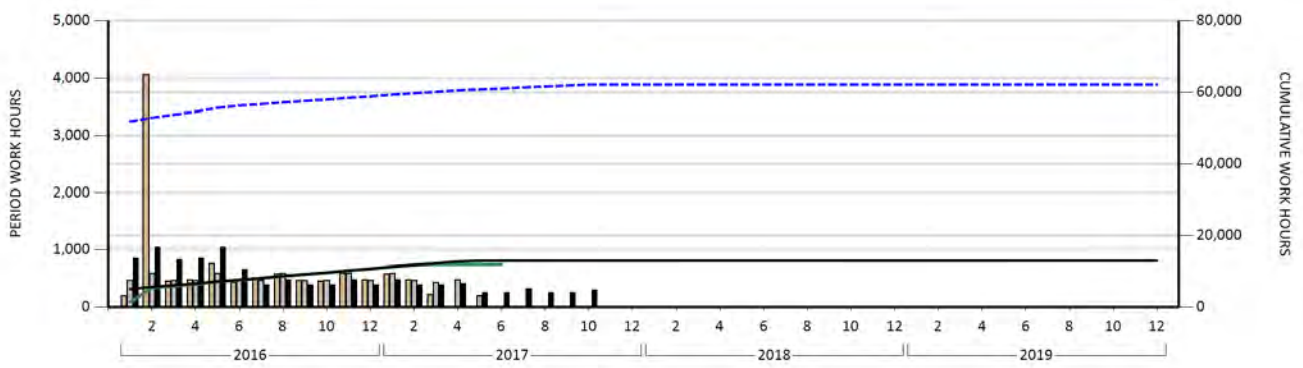
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**257**	**61,102**	**62,242**
Baseline Hours	0	12,942	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	11,963	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(979)	
SPI on Baseline	-	0.92	

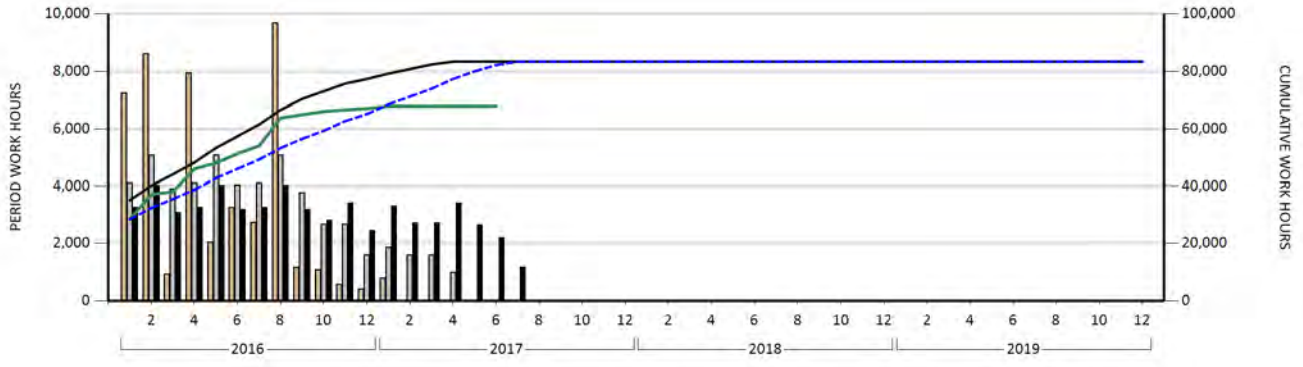
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**92.4%**	**-7.6%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**2,207**	**82,249**	**83,447**
Baseline Hours	0	83,447	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	67,878	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(15,569)	
SPI on Baseline	-	0.81	

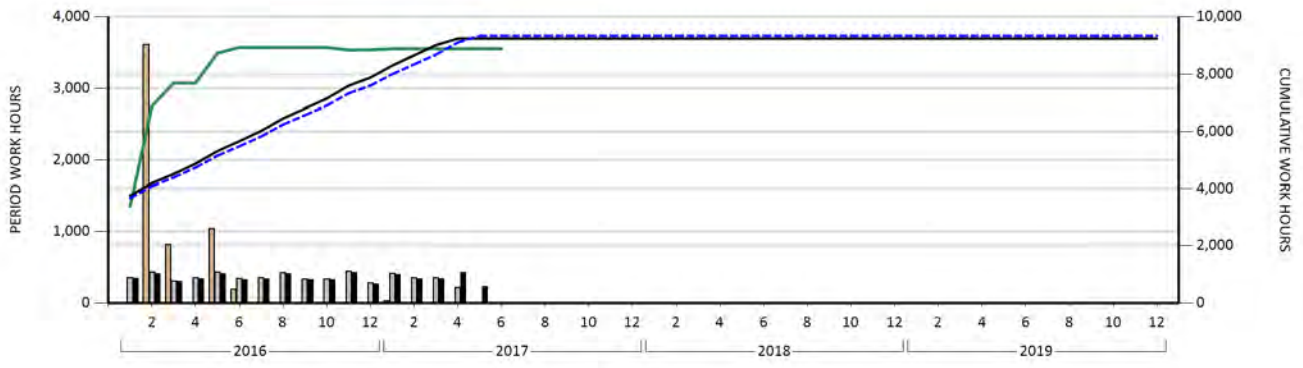
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**81.3%**	**-18.7%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**9,357**	**9,357**
Baseline Hours	0	9,257	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	8,899	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(358)	
SPI on Baseline	-	0.96	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**96.1%**	**-3.9%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

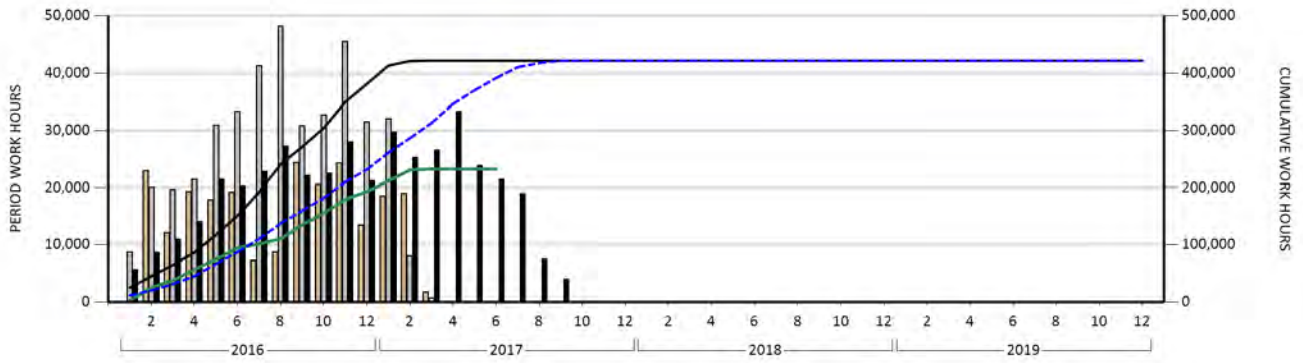
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**21,484**	**391,721**	**422,251**
Baseline Hours	0	422,243	422,243
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	232,594	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(189,649)	
SPI on Baseline	-	0.55	

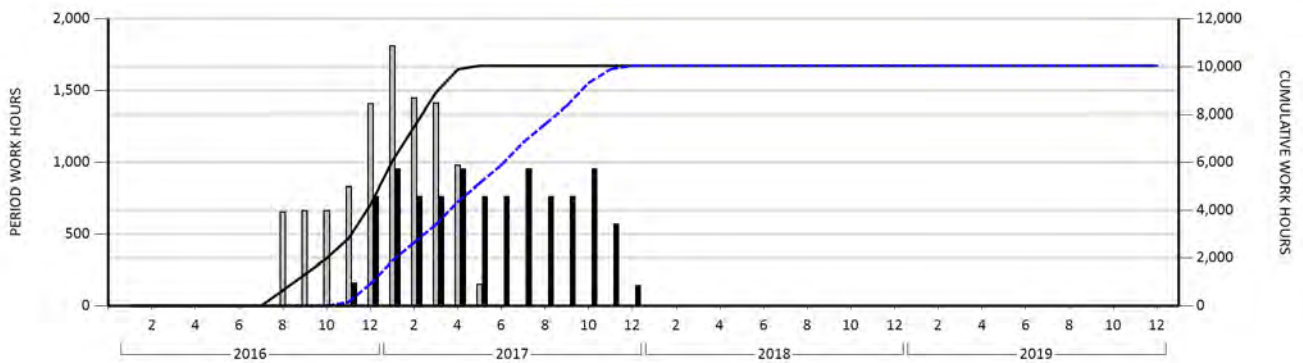
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**55.1%**	**-44.9%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**765**	**5,895**	**10,053**
Baseline Hours	0	10,053	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(10,053)	
SPI on Baseline	-	-	

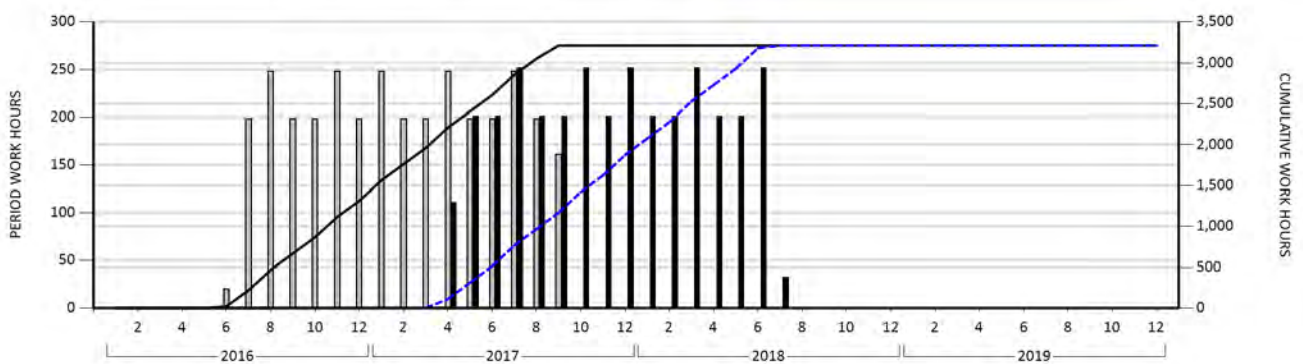
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**202**	**514**	**3,216**
Baseline Hours	199	2,606	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(199)	(2,606)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**81.0%**	**0.0%**	**-81.0%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

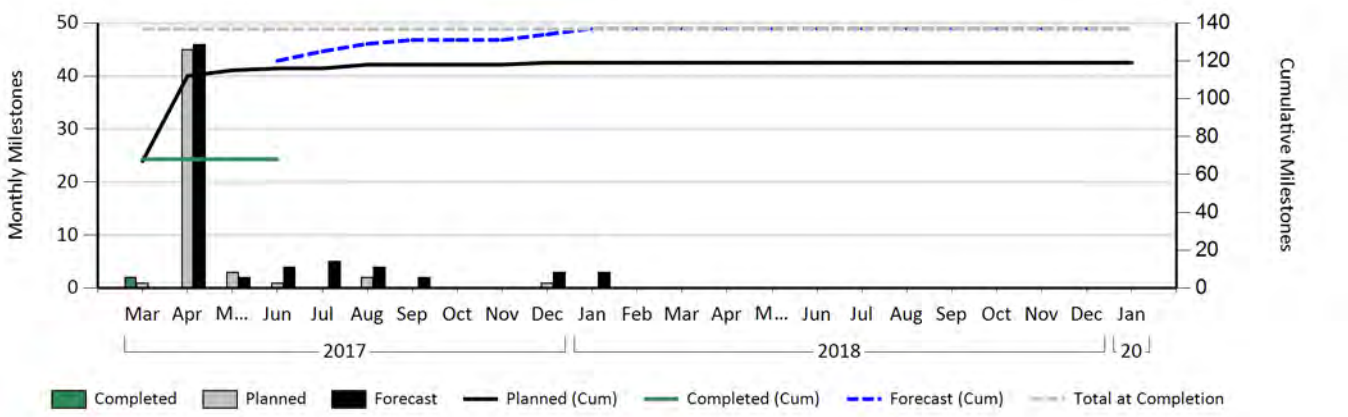
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	52
Milestones Planned to Date Completed	30 | 58%
Variance Ahead / (Behind)	(22)
Milestones Completed on Time	10 | 19%
Milestones Forecasting Late	22 | 100%
# of Milestones Completed | Remaining	30 | 22
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	38 | 47
Total # of Milestones	**137**
# of Milestones Completed | Remaining	68 | 69



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		21-Apr-17	0	0	XX
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		21-Apr-17	0	0	XX
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		21-Apr-17	0	0	XX
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		21-Apr-17	0	0	XX
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		21-Apr-17	0	0	XX
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		21-Apr-17	0	0	XX
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		21-Apr-17	0	0	XX
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		21-Apr-17	0	0	XX
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		21-Apr-17	0	0	XX
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		21-Apr-17	0	0	XX
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		21-Apr-17	0	0	XX
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		21-Apr-17	0	0	XX
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		21-Apr-17	0	0	XX
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		21-Apr-17	0	0	XX
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		21-Apr-17	0	0	XX
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		21-Apr-17	0	0	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		21-Apr-17	0	0	XX
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		21-Apr-17	0	0	XX
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		21-Apr-17	0	0	XX
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		21-Apr-17	0	0	XX
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		21-Apr-17	0	0	XX
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		21-Apr-17	0	0	XX
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		21-Apr-17	0	0	XX
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		21-Apr-17	0	0	XX
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		21-Apr-17	0	0	XX
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		21-Apr-17	0	0	XX
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		21-Apr-17	0	0	XX
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		21-Apr-17	0	0	XX
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		21-Apr-17	0	0	XX
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		21-Apr-17	0	0	XX
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		21-Apr-17	0	0	XX
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		21-Apr-17	0	0	XX
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		21-Apr-17	0	0	XX
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		21-Apr-17	0	0	XX
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		21-Apr-17	0	0	XX
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		21-Apr-17	0	0	XX
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		21-Apr-17	0	0	XX
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		21-Apr-17	0	0	XX
AA1618	CCD-HVAC Start-up		CCD		21-Apr-17	0	0	XX
31555SM101	Start of Commissioning (CMS)	3	CMS		09-Jun-17	0	0	XX
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		10-Aug-17	0	0	-
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		10-Aug-17	0	0	-
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	17-Jul-17	-385	0	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	21-Apr-17	-283	0	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	23-Jun-17	-333	0	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	29-Jun-17	-329	0	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	08-Sep-17	-400	0	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	21-Apr-17	-185	0	XX
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	05-May-17	-193	0	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	19-Jun-17	-238	0	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	27-Apr-17	-183	0	XX
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	17-Aug-17	-288	0	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	25-Sep-17	-313	0	XX
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	24-May-17	-176	0	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	06-Jul-17	-216	0	XX
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	06-Jun-17	-160	0	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	19-Jul-17	-189	0	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	01-Aug-17	-202	0	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	10-Aug-17	-142	0	XX
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4	CMF	19-Apr-17	14-Dec-17	-239	0	XX
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	14-Dec-17	-239	0	XX
31555M0240	Final Completion / Project Closeout	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555M0130	Project Close-out Complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555PED30	Project Close out complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

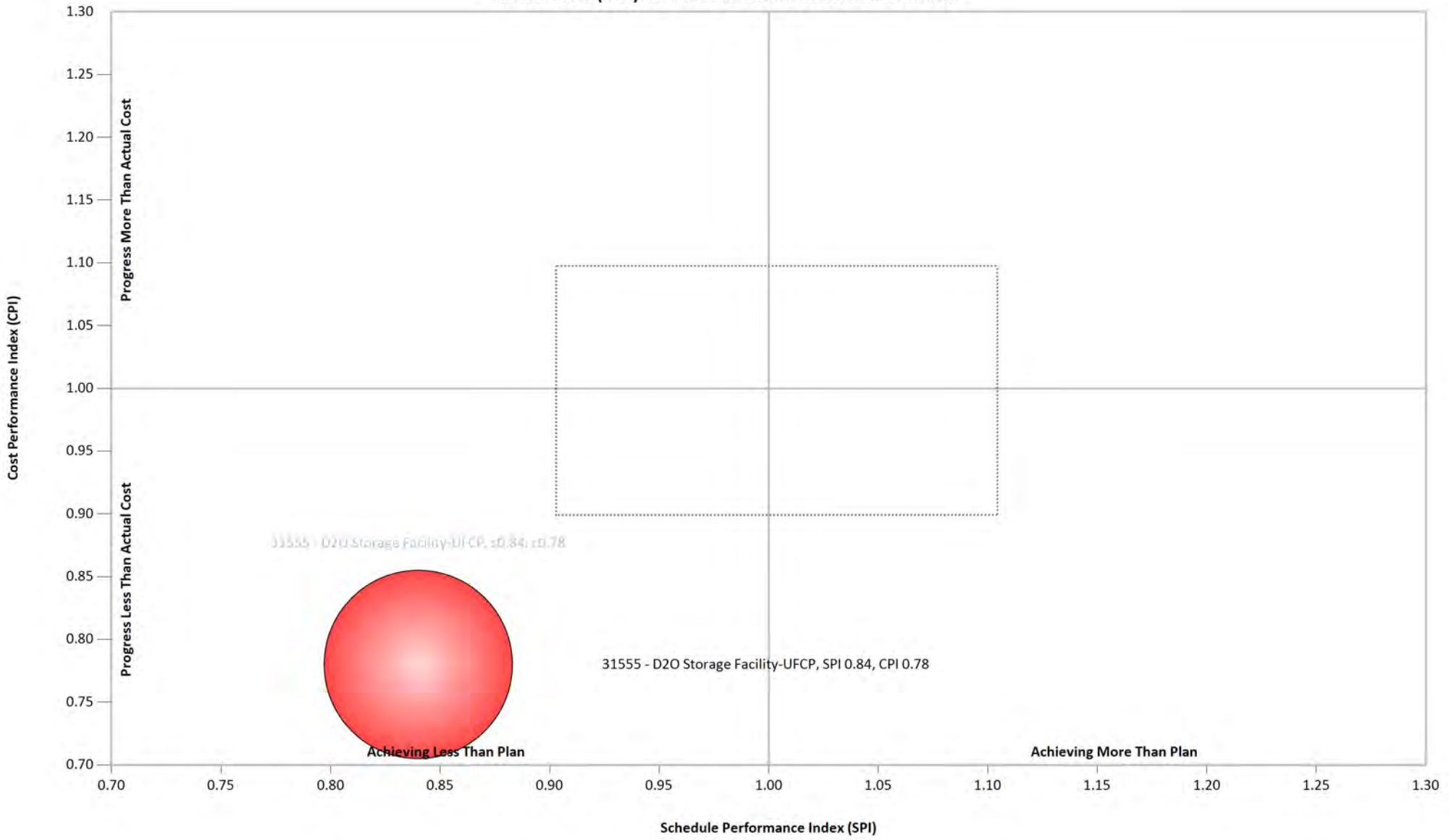
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Life-To-Date (LTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

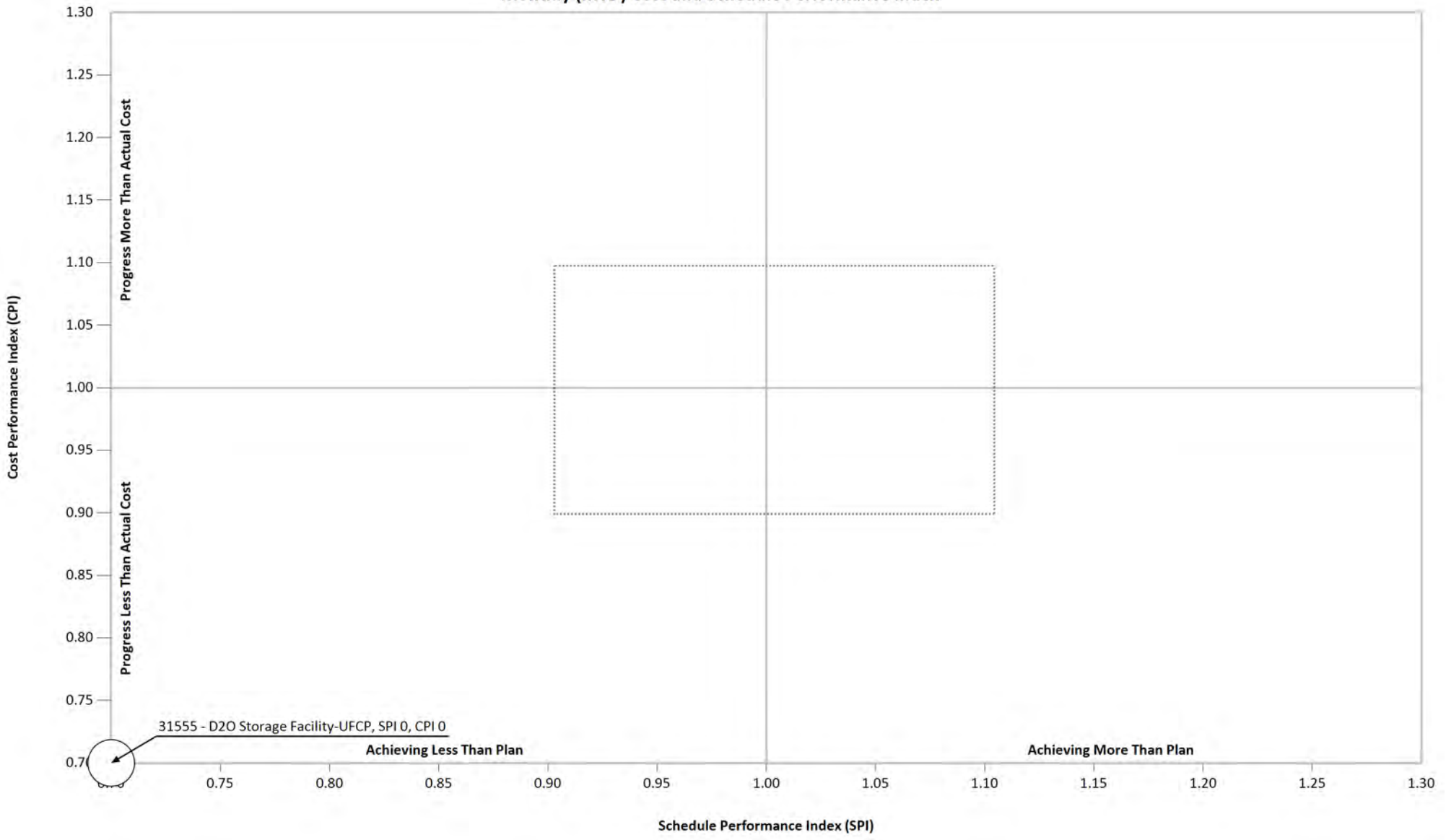
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

Monthly (MTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	126	0	51	(51)	(126)	0.00	0.00	240,695	201,096	257,595	(56,499)	(39,599)	0.78	0.84	241,132
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	126	0	51	(51)	(126)	0.00	0.00	240,695	201,096	257,595	(56,499)	(39,599)	0.78	0.84	241,132
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	126	0	51	(51)	(126)	0.00	0.00	240,695	201,096	257,595	(56,499)	(39,599)	0.78	0.84	241,132
	Total	**126**	**0**	**51**	**(51)**	**(126)**	**0.00**	**0.00**	**240,695**	**201,096**	**257,595**	**(56,499)**	**(39,599)**	**0.78**	**0.84**	**241,132**

[1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.

ONTARIO POWER GENERATION

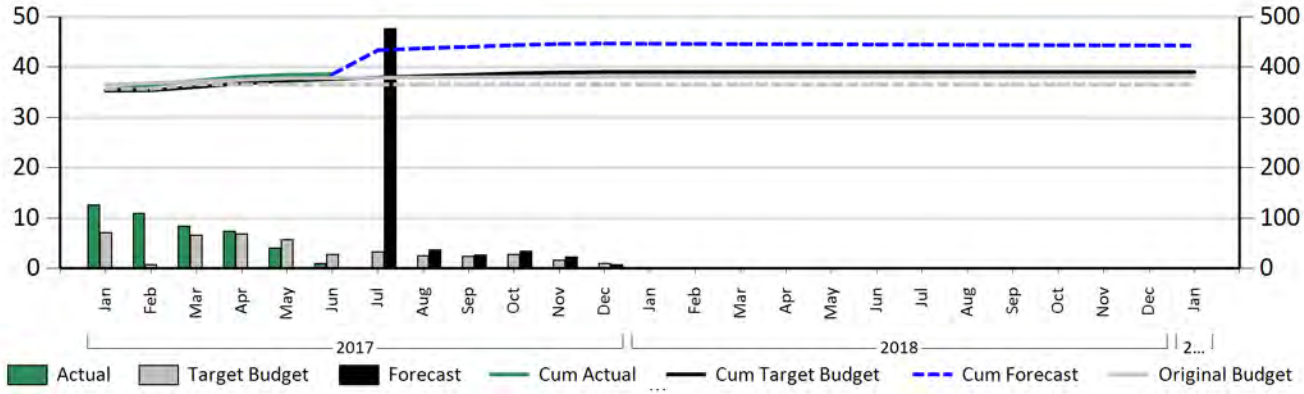
Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

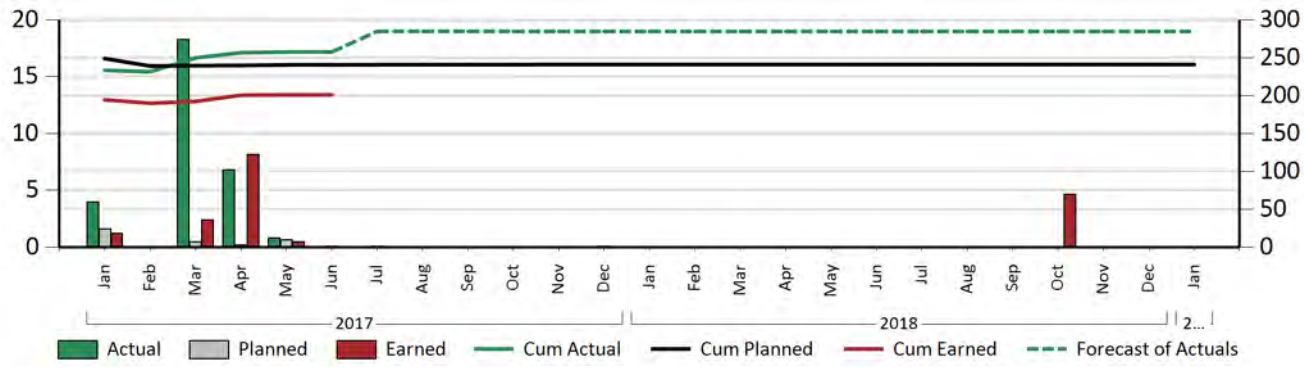
100% = 64% + 36%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*



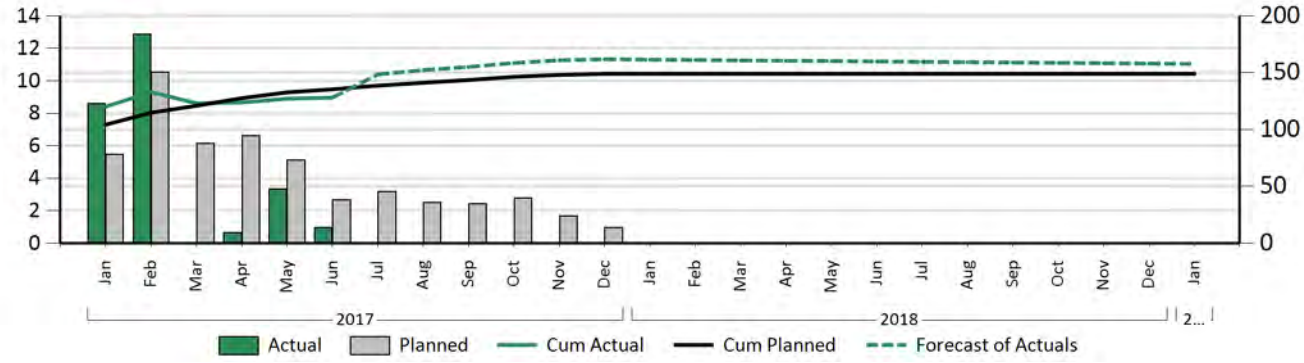
Life-To-Date	
Original Budget	378,188
Target Budget	376,111
Actual	385,729
Variance-to-Target Budget	9,618
% of Target Budget Spent	103%
Funding Released to Projects	365,496

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	240,695
Earned Value	201,096
Actual	257,595
Variance-to-Planned Value	16,900
Cost Performance Index	0.78
Schedule Performance Index	0.84

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	135,416
Actual	128,134
Variance-to-Planned Value	(7,282)

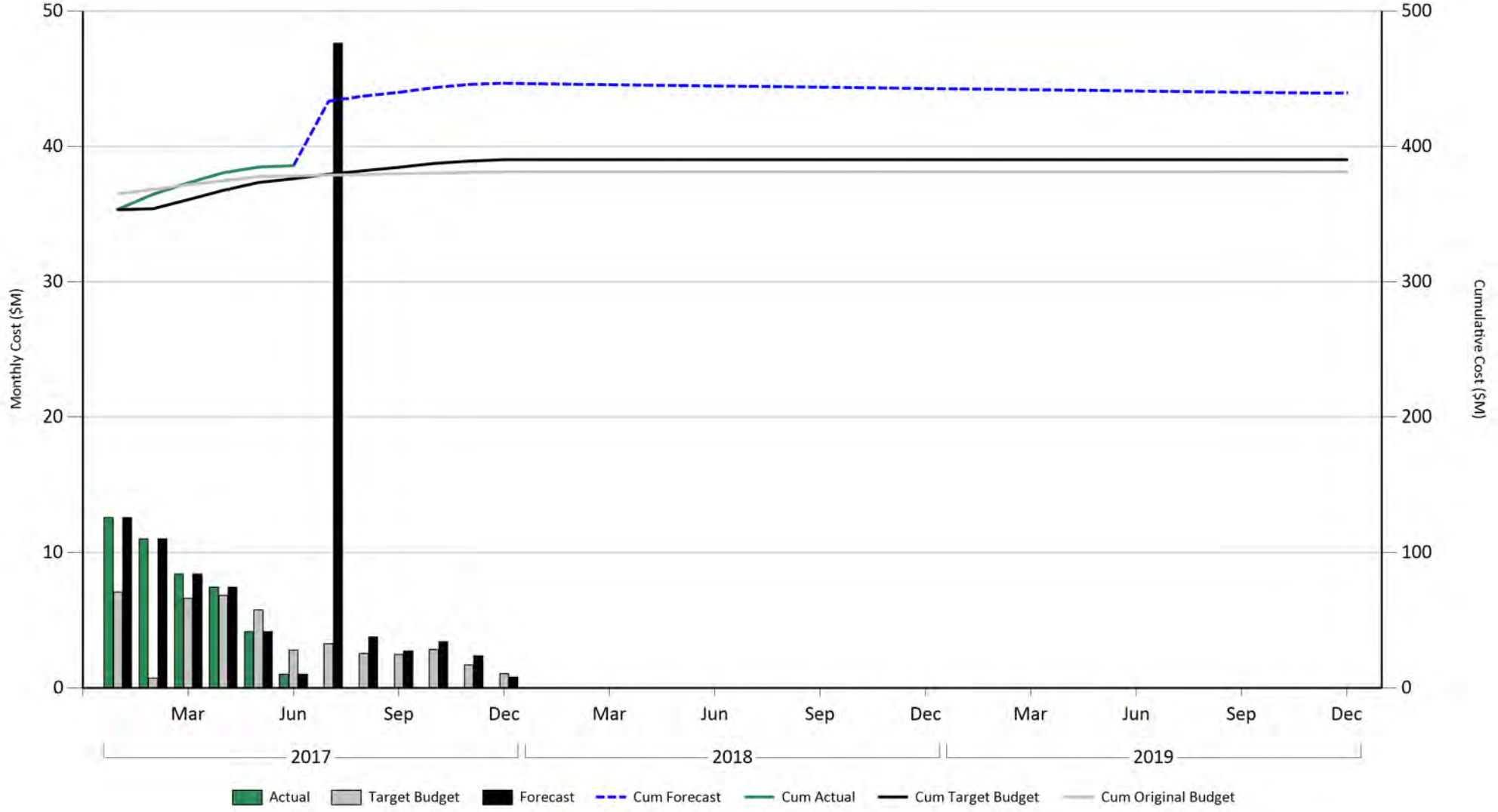
COST CURVE *($ MILLIONS) - Units: U2, U0, UD, US, UF*

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017



Life Cycle Budget		Cumulative (Life-To-Date)			Forecast = Estimate at Completion		
Original Budget	**Target Budget**	**Target Budget**	**Actual**	**Cost Variance**	**ETC**	**EAC**	**Var. FromTarget**
381,174	390,174	376,111	385,772	9,661	53,645	439,417	49,244

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	2,819	1,054	(1,766)	37%
Life-to-Date	376,111	385,729	9,618	103%

	CPI[1]		SPI[1]	
2017-Jun Life-To-Date	0.78		0.84	
2017-May Life-To-Date	0.78		0.84	

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	390,174	439,417	49,244
Life Cycle Contingency	-	-	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Target Budget	Plan (TB)	Actual (AC)	Cost Variance	CPI[1]	SPI[1]	Plan (TB)	Actual (AC)	Cost Variance	CPI[1]	SPI[1]	ETC	CPI on ETC[1]	EAC	Variance from Target Budget	Variance to EAC over Period
	3 - Engineering	2,830	967	3,797	159	13	(146)	-	-	3,415	1,706	(1,709)	-	-	1,635	-	3,341	(456)	-
1	**OPG Design Support in Vendor**	**2,830**	**967**	**3,797**	**159**	**13**	**(146)**	**-**	**-**	**3,415**	**1,706**	**(1,709)**	**-**	**-**	**1,635**	**-**	**3,341**	**(456)**	**-**
	0 - Other	44,927	(9,492)	35,435	(4)	711	715	-	-	33,741	25,201	(8,540)	-	-	(5,303)	-	19,899	(15,536)	-
	1 - Project Management	6,562	3,119	9,681	261	169	(92)	-	-	9,075	10,476	1,400	0.84	0.94	(14)	(6.61)	10,462	781	-
	4 - Procurement	13,940	(7,444)	6,496	111	139	28	-	-	5,773	6,459	686	0.87	0.93	151	1.35	6,609	114	-
	6 - Commissioning	378	244	621	21	7	(13)	-	-	541	144	(397)	-	-	236	2.63	381	(241)	-
2	**OPG Non Design Support in**	**65,806**	**(13,573)**	**52,233**	**389**	**1,027**	**638**	**-**	**-**	**49,130**	**42,280**	**(6,850)**	**0.82**	**0.82**	**(4,929)**	**3.08**	**37,351**	**(14,883)**	**-**
	0 - Other	1,869	(1,869)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1 - Project Management	4,388	3,917	8,305	-	-	-	-	-	8,305	8,696	391	1.00	1.00	10	-	8,706	401	-
	3 - Engineering	23,314	1,117	24,431	76	-	(76)	-	-	24,253	23,353	(900)	0.92	0.85	14	43.06	23,367	(1,064)	-
	4 - Procurement	20,263	8,097	28,360	-	-	-	-	-	28,360	28,236	(124)	1.00	1.00	12	-	28,248	(112)	-
	5 - Construction	84,180	(8,888)	75,292	-	15	15	-	-	75,292	75,450	158	1.00	0.99	27	41.90	75,477	185	-
	9 - Closeout	375	(2)	374	-	-	-	-	-	374	374	-	1.00	1.00	-	-	374	-	-
3	**Vendors Managed by Projects and**	**134,390**	**2,372**	**136,761**	**76**	**15**	**(61)**	**-**	**-**	**136,583**	**136,109**	**(474)**	**0.99**	**0.97**	**62**	**37.38**	**136,171**	**(590)**	**-**
	0 - Other	1,306	94	1,401	-	-	-	-	-	1,401	1,401	-	-	-	-	-	1,401	-	-
	5 - Construction	28,198	664	28,862	-	-	-	-	-	28,862	28,862	-	1.00	1.00	-	-	28,862	-	-
4	**P&M Ellis Don**	**29,504**	**758**	**30,262**	**-**	**-**	**-**	**-**	**-**	**30,262**	**30,262**	**-**	**1.00**	**1.00**	**-**	**-**	**30,262**	**-**	**-**
	1 - Project Management	121	(1)	120	-	-	-	-	-	120	120	-	-	-	-	-	120	-	-
	5 - Construction	6,157	1,365	7,523	-	1	1	-	-	7,523	7,592	69	0.49	0.50	(198)	(11.59)	7,394	(129)	-
5	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**-**	**1**	**1**	**-**	**-**	**7,643**	**7,712**	**69**	**0.49**	**0.50**	**(198)**	**(11.59)**	**7,514**	**(129)**	**-**
	0 - Other	-	210	210	20	-	(20)	-	-	63	-	(63)	-	-	210	-	210	-	-
6	**P&M SNC/AECON JV**	**-**	**210**	**210**	**20**	**-**	**(20)**	**-**	**-**	**63**	**-**	**(63)**	**-**	**-**	**210**	**-**	**210**	**-**	**-**
	0 - Other	2,282	923	3,205	404	-	(404)	-	-	3,205	2,134	(1,071)	-	-	992	-	3,126	(79)	-
	1 - Project Management	20,870	8,340	29,211	858	-	(858)	-	-	24,499	28,236	3,737	-	-	4,032	-	32,267	3,057	-
	3 - Engineering	15,438	598	16,036	6	-	(6)	-	-	16,036	24,409	8,373	0.67	0.99	3,529	0.20	27,937	11,901	-
	4 - Procurement	36,000	3,370	39,371	375	-	(375)	-	-	37,102	29,039	(8,063)	0.79	0.65	17,506	0.93	46,545	7,174	-
	5 - Construction	67,245	3,673	70,918	531	(3)	(534)	-	-	67,646	54,606	(13,040)	0.70	0.64	29,699	1.57	84,305	13,387	-
	6 - Commissioning	531	(4)	527	-	-	-	-	-	527	-	(527)	-	-	1,151	-	1,151	624	-
	U - Unallocated Cost	-	-	-	-	-	-	-	-	-	29,237	29,237	-	-	-	-	29,237	29,237	29,402
7	**SNC AECON for ESMSA under PM**	**142,366**	**16,901**	**159,267**	**2,175**	**(3)**	**(2,177)**	**-**	**-**	**149,014**	**167,660**	**18,646**	**0.54**	**0.65**	**56,909**	**1.24**	**224,569**	**65,302**	**29,402**
	Nuclear Refurbishment Program	**381,174**	**9,000**	**390,174**	**2,819**	**1,054**	**(1,766)**	**-**	**-**	**376,111**	**385,729**	**9,618**	**0.78**	**0.84**	**53,689**	**1.48**	**439,417**	**49,244**	**29,402**

Note: [1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.
[2] All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End June 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: June 2017

ID	Title	Risk Description	Current Score	Post Score
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor and continued construction delays. Cause: Insufficient QA resources to support CWP/ITP development and material verification. Impact: Quality issues due to expedited construction schedule with many activities progressing in parallel.	20	15
14987	16-31555 D20 Storage Project: Commissioning schedule delay due to late submission of design manuals	Delays in issuance of new design manuals by the JV has the potential of affecting dates for issuance of commissioning workplans by OPG. In turn this has the potential to delay execution of commissioning activities.	12	6

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

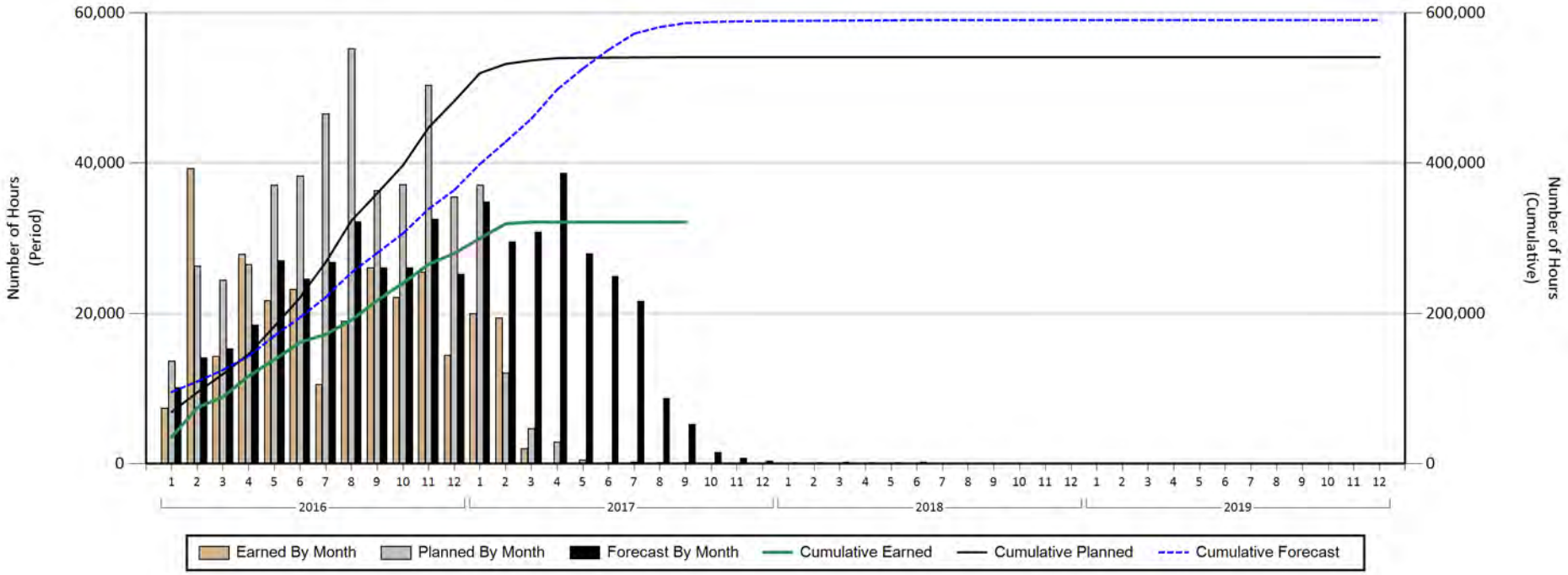
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,243	422,251
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,157	590,566

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**59.4%**	**-40.6%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	162	0	-162	0.00	N/A
Cumulative	541,157	321,333	-219,824	0.59	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

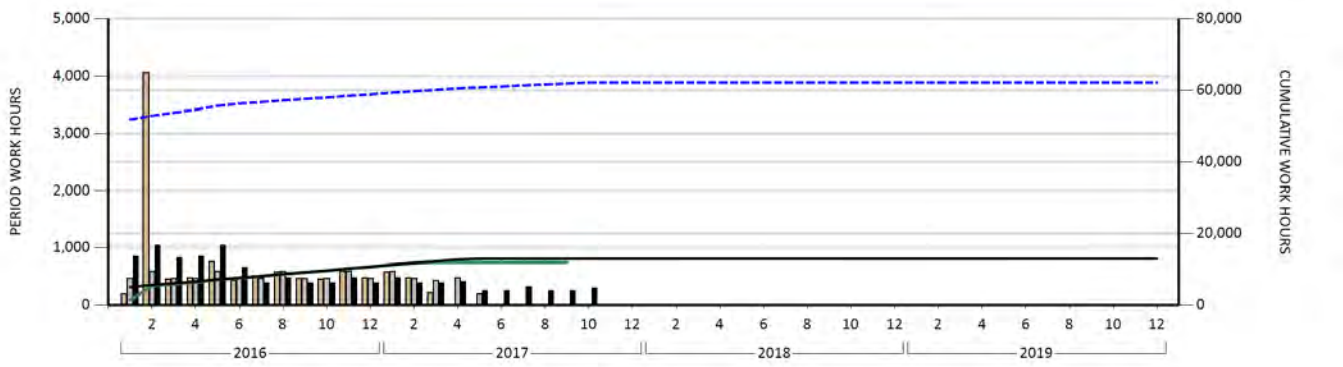
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**257**	**61,937**	**62,242**
Baseline Hours	0	12,942	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	11,963	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(979)	
SPI on Baseline	-	0.92	

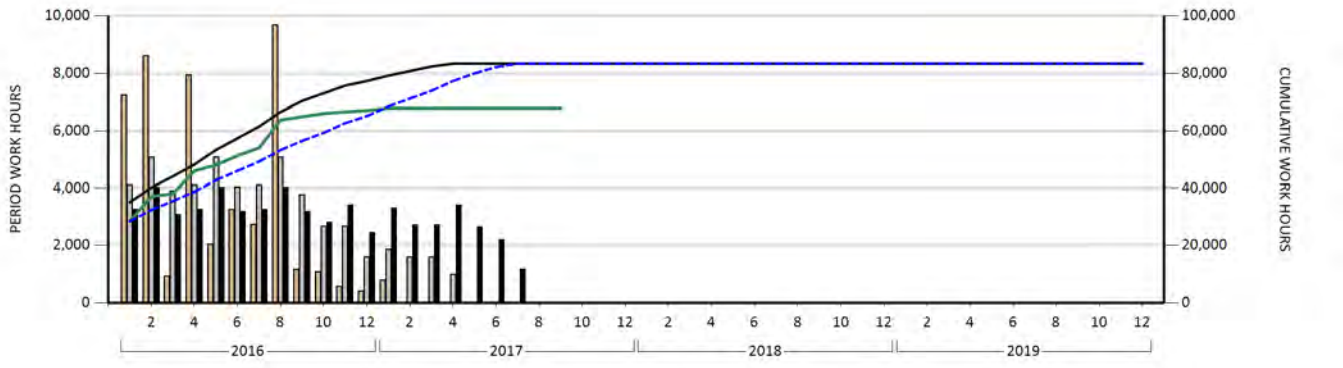
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**92.4%**	**-7.6%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**83,447**	**83,447**
Baseline Hours	0	83,447	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	67,878	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(15,569)	
SPI on Baseline	-	0.81	

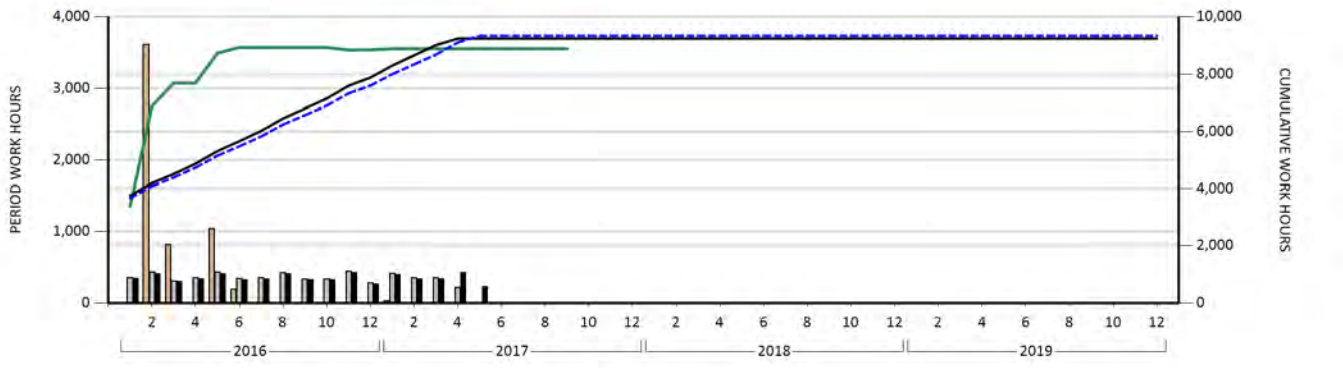
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**81.3%**	**-18.7%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**9,357**	**9,357**
Baseline Hours	0	9,257	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	8,899	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(358)	
SPI on Baseline	-	0.96	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**96.1%**	**-3.9%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

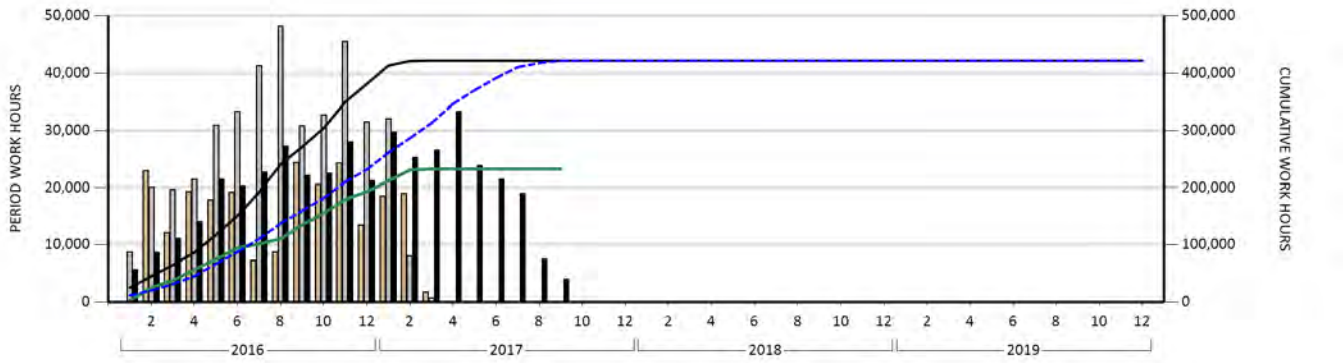
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**4,041**	**422,251**	**422,251**
Baseline Hours	0	422,243	422,243
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	232,594	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(189,649)	
SPI on Baseline	-	0.55	

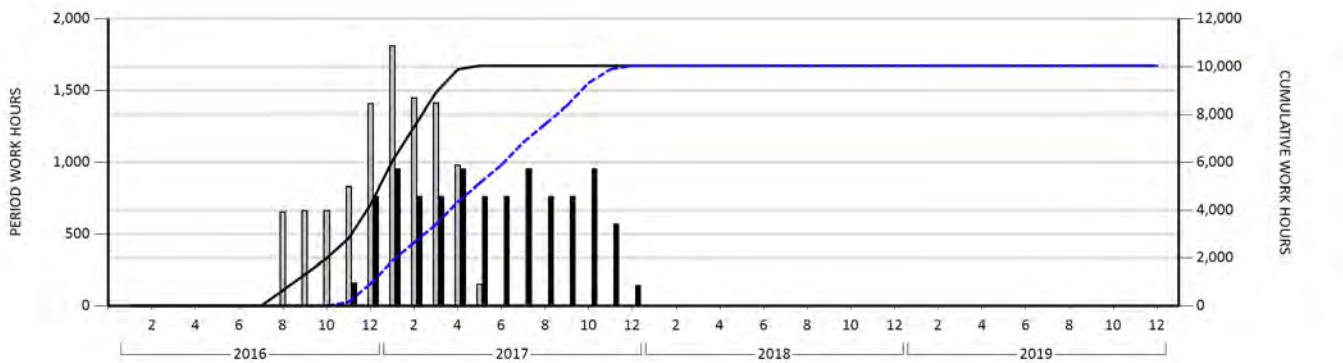
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**55.1%**	**-44.9%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**765**	**8,381**	**10,053**
Baseline Hours	0	10,053	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(10,053)	
SPI on Baseline	-	-	

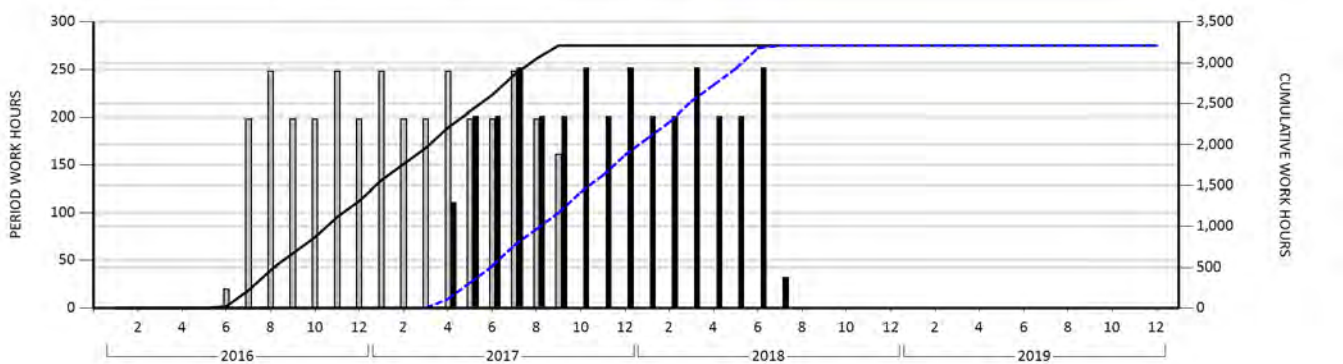
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**202**	**1,169**	**3,216**
Baseline Hours	162	3,216	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	(162)	(3,216)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

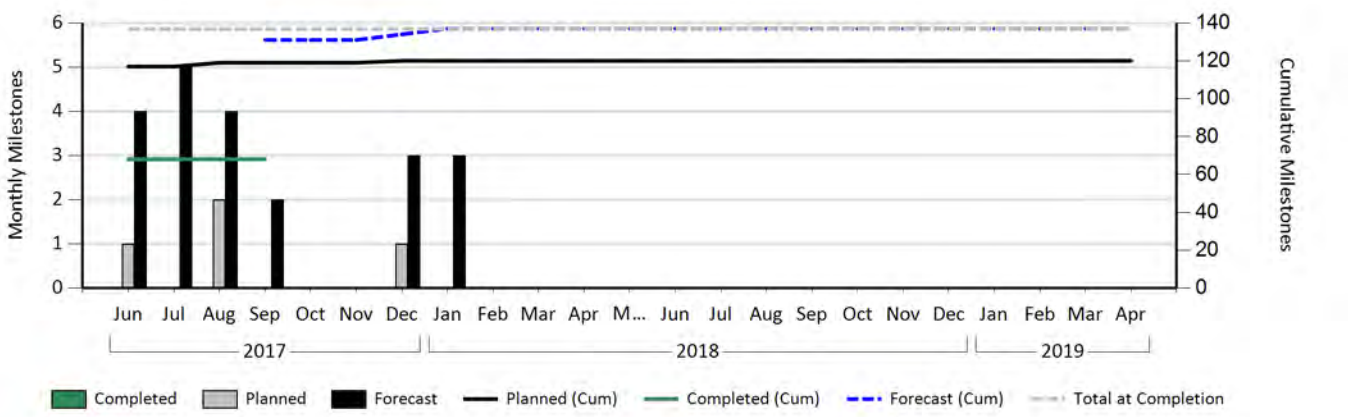
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	52
Milestones Planned to Date Completed	30 | 58%
Variance Ahead / (Behind)	(22)
Milestones Completed on Time	10 | 19%
Milestones Forecasting Late	22 | 100%
# of Milestones Completed | Remaining	30 | 22
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	38 | 47
Total # of Milestones	**137**
# of Milestones Completed | Remaining	68 | 69



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		21-Apr-17	0	0	XX
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		21-Apr-17	0	0	XX
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		21-Apr-17	0	0	XX
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		21-Apr-17	0	0	XX
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		21-Apr-17	0	0	XX
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		21-Apr-17	0	0	XX
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		21-Apr-17	0	0	XX
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		21-Apr-17	0	0	XX
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		21-Apr-17	0	0	XX
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		21-Apr-17	0	0	XX
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		21-Apr-17	0	0	XX
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		21-Apr-17	0	0	XX
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		21-Apr-17	0	0	XX
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		21-Apr-17	0	0	XX
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		21-Apr-17	0	0	XX
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		21-Apr-17	0	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		21-Apr-17	0	0	XX
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		21-Apr-17	0	0	XX
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		21-Apr-17	0	0	XX
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		21-Apr-17	0	0	XX
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		21-Apr-17	0	0	XX
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		21-Apr-17	0	0	XX
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		21-Apr-17	0	0	XX
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		21-Apr-17	0	0	XX
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		21-Apr-17	0	0	XX
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		21-Apr-17	0	0	XX
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		21-Apr-17	0	0	XX
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		21-Apr-17	0	0	XX
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		21-Apr-17	0	0	XX
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		21-Apr-17	0	0	XX
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		21-Apr-17	0	0	XX
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		21-Apr-17	0	0	XX
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		21-Apr-17	0	0	XX
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		21-Apr-17	0	0	XX
AA1618	CCD-HVAC Start-up		CCD		21-Apr-17	0	0	XX
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		21-Apr-17	0	0	XX
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		21-Apr-17	0	0	XX
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		21-Apr-17	0	0	XX
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		21-Apr-17	0	0	XX
31555SM101	Start of Commissioning (CMS)	3	CMS		09-Jun-17	0	0	XX
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		10-Aug-17	0	0	XX
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		10-Aug-17	0	0	XX
31555FM171	Final AFS - All Commissioning Complete	3	CMF		14-Dec-17	0	0	-
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	17-Jul-17	-385	0	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	21-Apr-17	-283	0	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	23-Jun-17	-333	0	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	29-Jun-17	-329	0	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	08-Sep-17	-400	0	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	21-Apr-17	-185	0	XX
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	05-May-17	-193	0	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	19-Jun-17	-238	0	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	27-Apr-17	-183	0	XX
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	17-Aug-17	-288	0	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	25-Sep-17	-313	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	24-May-17	-176	0	XX
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	06-Jul-17	-216	0	XX
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	06-Jun-17	-160	0	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	19-Jul-17	-189	0	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	01-Aug-17	-202	0	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	10-Aug-17	-142	0	XX
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4	CMF	19-Apr-17	14-Dec-17	-239	0	XX
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	14-Dec-17	-239	0	XX
31555M0240	Final Completion / Project Closeout	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555M0130	Project Close-out Complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555PED30	Project Close out complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

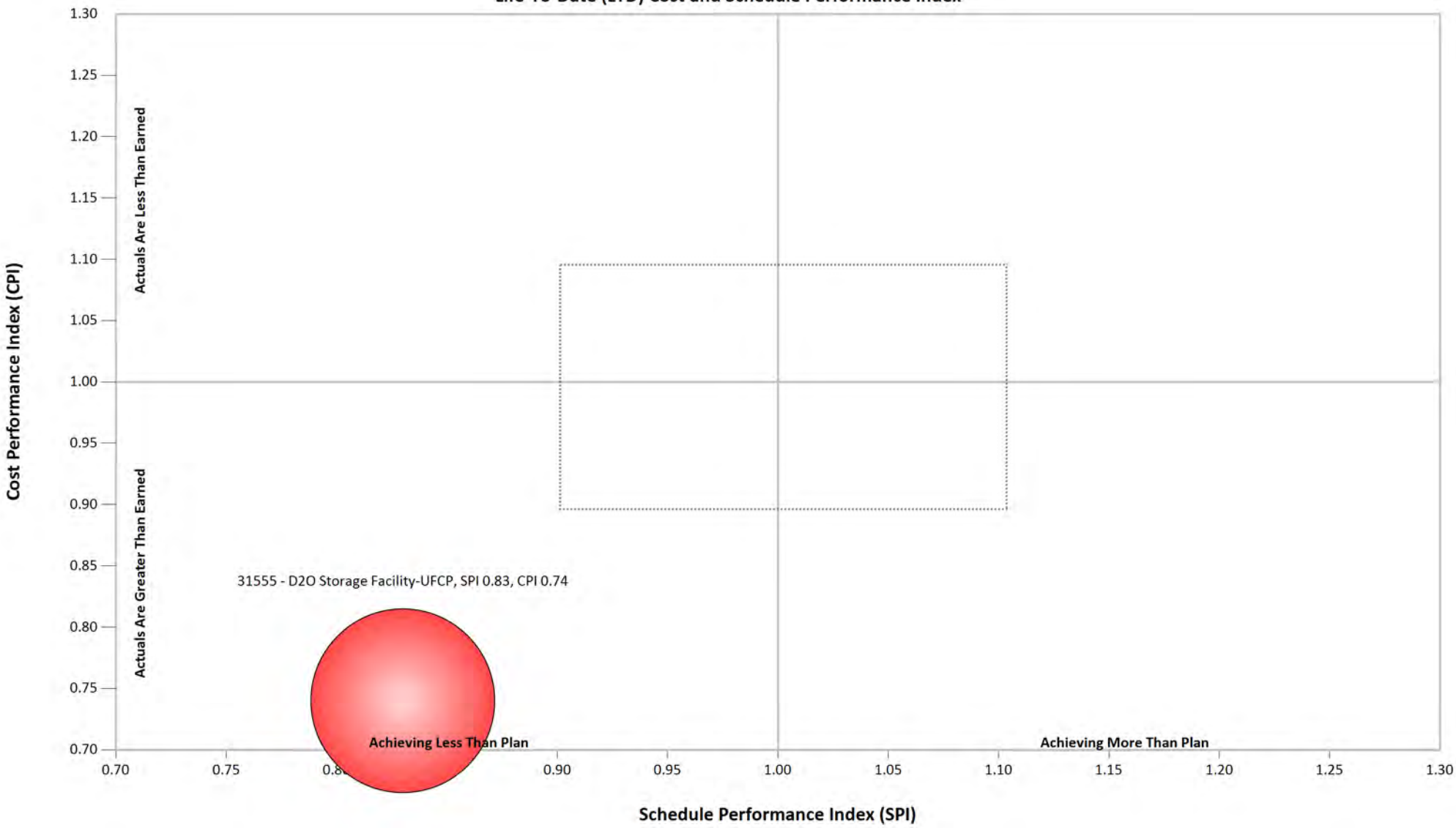
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

Life-To-Date (LTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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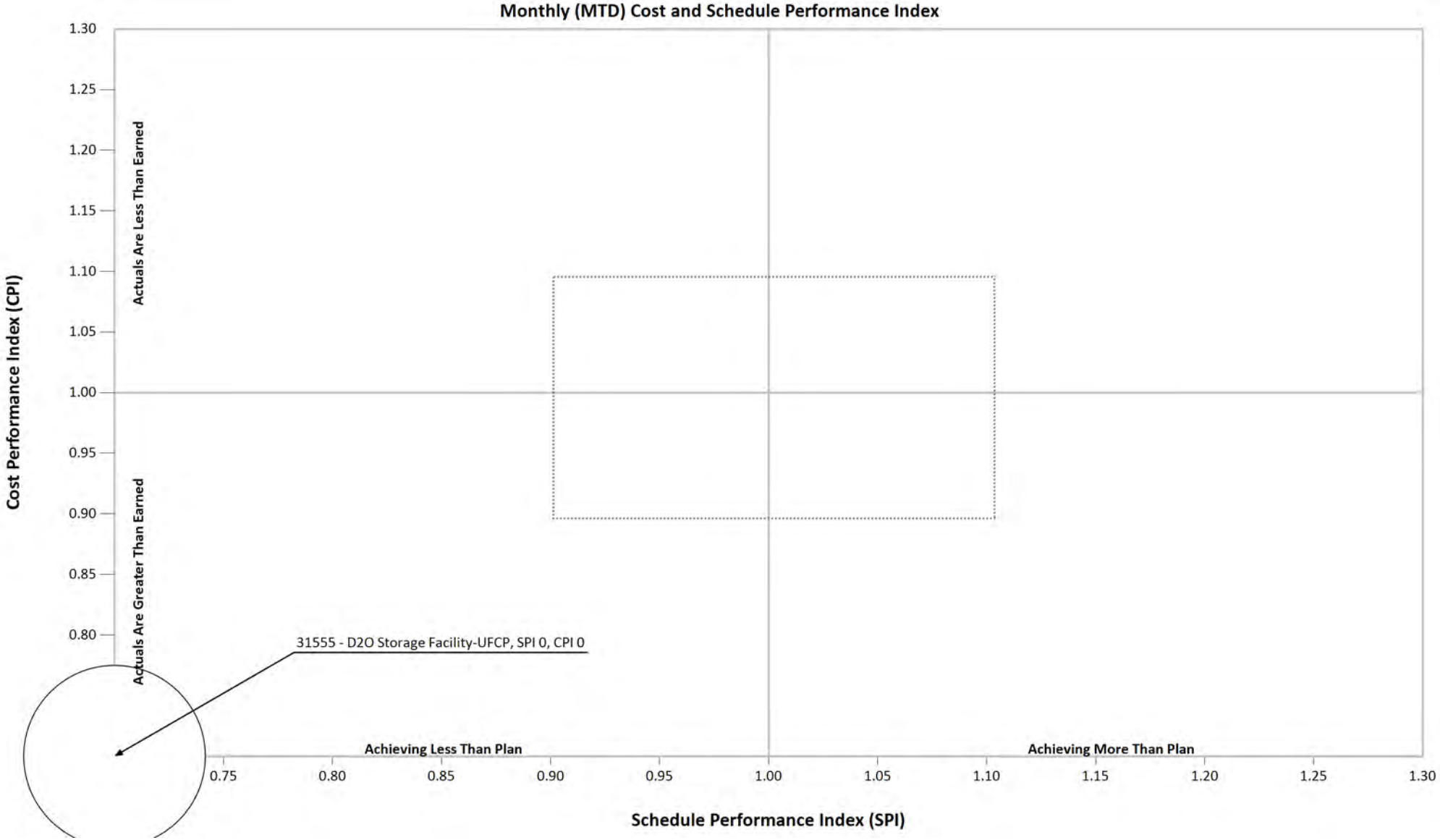
Process Owner: Multiple
Period Ending: September 2017



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	59	0	1,809	(1,809)	(59)	0.00	0.00	240,911	201,096	273,169	(72,072)	(39,815)	0.74	0.83	241,132
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	59	0	1,809	(1,809)	(59)	0.00	0.00	240,911	201,096	273,169	(72,072)	(39,815)	0.74	0.83	241,132
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	59	0	1,809	(1,809)	(59)	0.00	0.00	240,911	201,096	273,169	(72,072)	(39,815)	0.74	0.83	241,132
	Total	**59**	**0**	**1,809**	**(1,809)**	**(59)**	**0.00**	**0.00**	**240,911**	**201,096**	**273,169**	**(72,072)**	**(39,815)**	**0.74**	**0.83**	**241,132**

[1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.

ONTARIO POWER GENERATION

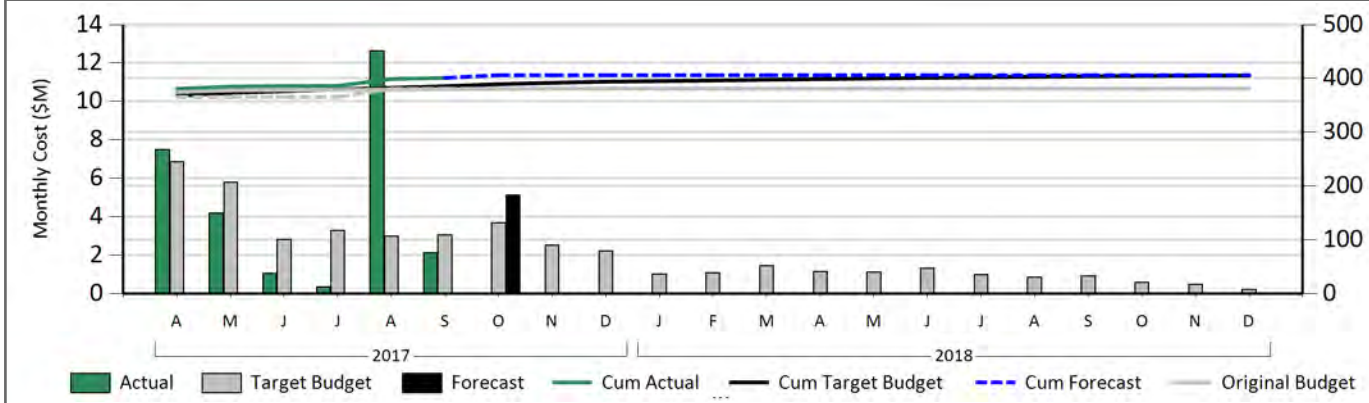
Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

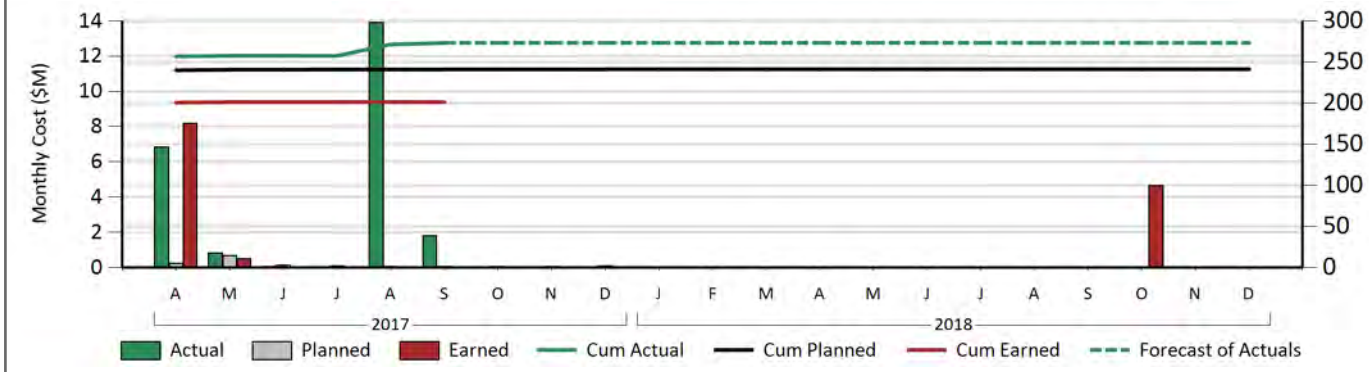
100% = 63% + 37%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*



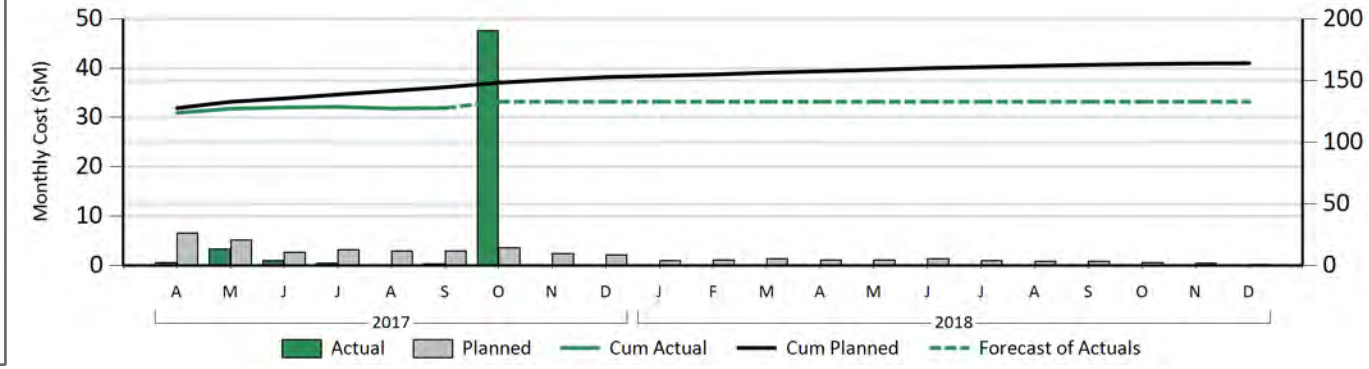
Life-To-Date	
Original Budget	379,737
Target Budget	385,452
Actual	400,855
Variance-to-Target Budget	15,403
% of Target Budget Spent	104%
Funding Released to Projects	380,496

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	240,911
Earned Value	201,096
Actual	273,169
Variance-to-Planned Value	32,258
Cost Performance Index	0.74
Schedule Performance Index	0.83

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	144,541
Actual	127,686
Variance-to-Planned Value	(16,855)

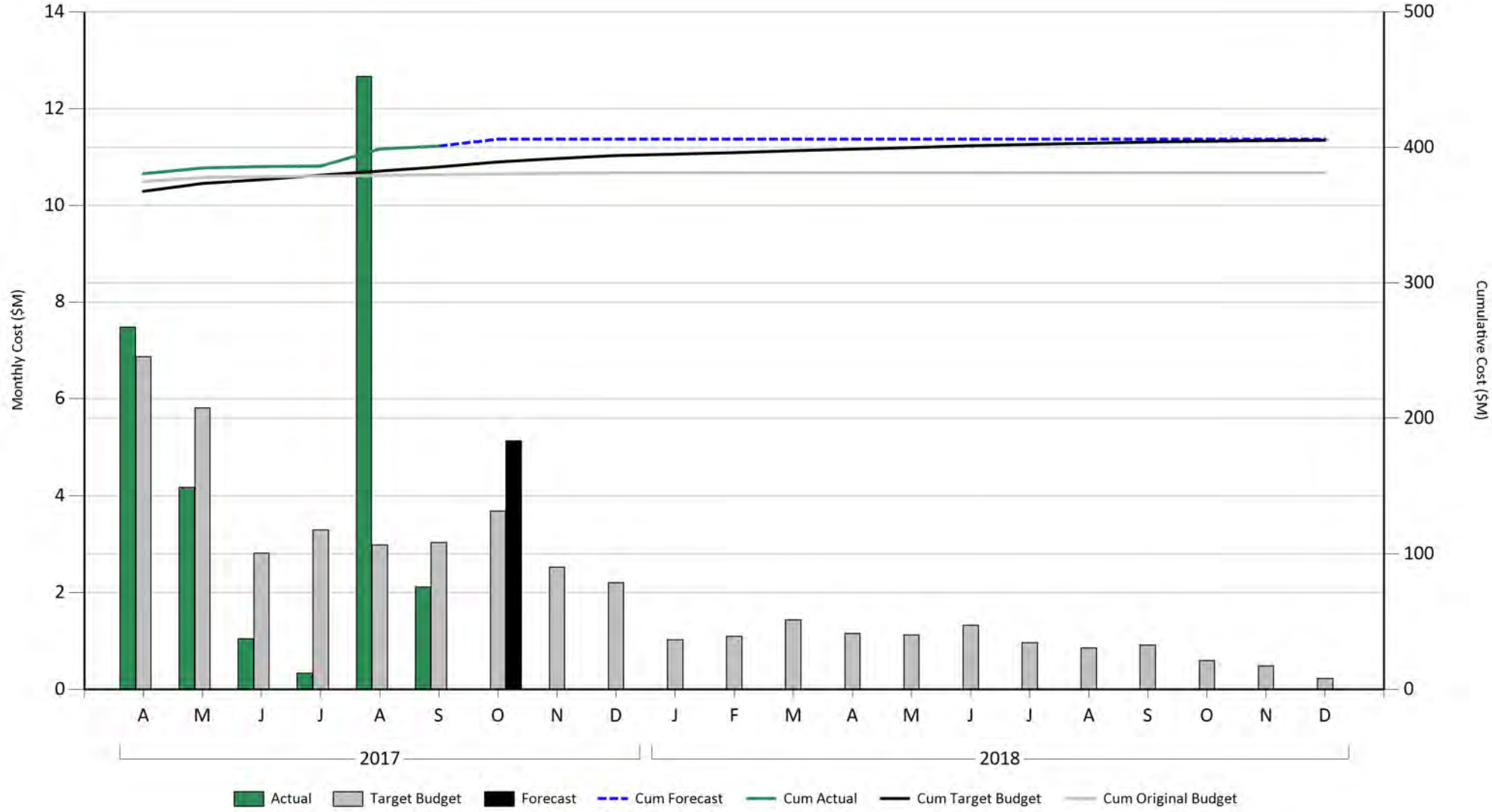
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

COST CURVE *($ MILLIONS) - Units: U0, U1, U2, U3, U4, UD, UF, US*



Life Cycle Budget	
Original Budget	**Target Budget**
381,174	405,174

Cumulative (Life-To-Date)		
Target Budget	**Actual**	**Cost Variance**
385,452	400,855	15,403

Forecast = Estimate at Completion		
ETC	**EAC**	**Var. FromTarget**
5,145	406,000	826

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

COST SUMMARY ($ THOUSAND)

	Plan	Actual	Variance	% Spent
This Period	3,047	2,122	(925)	70%
Life-to-Date	385,452	400,855	15,403	104%

	CPI[1]		SPI[1]	
2017-Sep Life-To-Date	0.74		0.83	
2017-Aug Life-To-Date	0.74		0.83	

At Completion	Budgeted	Forecast	Variance
Life Cycle (excl. Contingency)	405,174	406,000	826
Life Cycle Contingency	-	-	

COST DETAIL ($ THOUSAND)

		Life Cycle Budget			This Period					Cumulative (Life-To-Date)					Forecast = Estimate at Completion				
		a	*b*	*c = a + b*	*d*	*e*	*f = e - d*	*g*	*h*	*i*	*j*	*k = j - i*	*l*	*m*	*n*	*o*	*p = j + n*	*q = p - c*	*r*
Line #	Description	Original Budget	Approved Changes	Target Budget	Plan (TB)	Actual (AC)	Cost Variance	CPI[1]	SPI[1]	Plan (TB)	Actual (AC)	Cost Variance	CPI[1]	SPI[1]	ETC	CPI on ETC[1]	EAC	Variance from Target Budget	Variance to EAC over Period
	3 - Engineering	2,830	967	3,797	49	43	(6)	-	-	3,699	1,821	(1,878)	-	-	-	-	1,821	(1,976)	(166)
1	**OPG Design Support in Vendor**	**2,830**	**967**	**3,797**	**49**	**43**	**(6)**	**-**	**-**	**3,699**	**1,821**	**(1,878)**	**-**	**-**	**-**	**-**	**1,821**	**(1,976)**	**(166)**
	0 - Cost Management	44,927	5,508	50,435	1,050	-	(1,050)	-	-	36,106	24,490	(11,615)	-	-	5,145	-	29,635	(20,800)	3,057
	1 - Project Management	6,562	3,119	9,681	74	70	(5)	-	-	9,532	10,762	1,230	0.80	0.93	-	-	10,762	1,081	69
	4 - Procurement	13,940	(7,444)	6,496	111	47	(64)	-	-	6,133	6,706	573	0.87	0.93	-	-	6,706	211	36
	6 - Commissioning	378	244	621	12	4	(8)	-	-	580	156	(424)	-	-	-	-	156	(465)	(28)
2	**OPG Non Design Support in**	**65,806**	**1,427**	**67,233**	**1,248**	**121**	**(1,127)**	**-**	**-**	**52,351**	**42,115**	**(10,237)**	**0.80**	**0.81**	**5,145**	**-**	**47,259**	**(19,974)**	**3,135**
	0 - Cost Management	1,869	(1,869)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1 - Project Management	4,388	3,917	8,305	-	7	7	-	-	8,305	8,703	399	1.00	1.00	-	-	8,703	399	6
	3 - Engineering	23,314	1,117	24,431	37	71	33	-	-	24,367	23,422	(945)	0.92	0.85	-	-	23,422	(1,009)	62
	4 - Procurement	20,263	8,097	28,360	-	-	-	-	-	28,360	28,236	(124)	1.00	1.00	-	-	28,236	(124)	(2)
	5 - Construction	84,180	(8,888)	75,292	-	19	19	-	-	75,292	75,529	237	1.00	0.99	-	-	75,529	237	5
	9 - Closeout	375	(2)	374	-	-	-	-	-	374	374	-	1.00	1.00	-	-	374	-	-
3	**Vendors Managed by Projects and**	**134,390**	**2,372**	**136,761**	**37**	**97**	**60**	**-**	**-**	**136,698**	**136,264**	**(434)**	**0.99**	**0.97**	**-**	**-**	**136,264**	**(497)**	**71**
	0 - Cost Management	1,306	94	1,401	-	-	-	-	-	1,401	1,401	-	-	-	-	-	1,401	-	-
	5 - Construction	28,198	664	28,862	-	-	-	-	-	28,862	28,862	-	1.00	1.00	-	-	28,862	-	-
4	**P&M Ellis Don**	**29,504**	**758**	**30,262**	**-**	**-**	**-**	**-**	**-**	**30,262**	**30,262**	**-**	**1.00**	**1.00**	**-**	**-**	**30,262**	**-**	**-**
	1 - Project Management	121	(1)	120	-	-	-	-	-	120	120	-	-	-	-	-	120	-	-
	5 - Construction	6,157	1,365	7,523	-	-	-	-	-	7,523	7,595	72	0.49	0.50	-	-	7,595	72	-
5	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**-**	**-**	**-**	**-**	**-**	**7,643**	**7,715**	**72**	**0.49**	**0.50**	**-**	**-**	**7,715**	**72**	**-**
	0 - Cost Management	-	210	210	20	-	(20)	-	-	130	-	(130)	-	-	-	-	-	(210)	(30)
6	**P&M SNC/AECON JV**	**-**	**210**	**210**	**20**	**-**	**(20)**	**-**	**-**	**130**	**-**	**(130)**	**-**	**-**	**-**	**-**	**-**	**(210)**	**(30)**
	0 - Cost Management	2,282	923	3,205	-	-	-	-	-	3,205	2,333	(872)	-	-	-	-	2,333	(872)	(150)
	1 - Project Management	20,870	8,340	29,211	787	41	(747)	-	-	27,212	26,857	(355)	-	-	-	-	26,857	(2,353)	(1,203)
	3 - Engineering	15,438	598	16,036	-	69	69	-	-	16,036	24,831	8,795	0.66	0.99	-	-	24,831	8,795	(331)
	4 - Procurement	36,000	3,370	39,371	374	6	(368)	-	1.00	38,316	30,411	(7,905)	0.75	0.65	-	-	30,411	(8,960)	(1,969)
	5 - Construction	67,245	3,673	70,918	531	-	(532)	-	-	69,373	56,093	(13,280)	0.69	0.64	-	-	56,093	(14,825)	(4,957)
	6 - Commissioning	531	(4)	527	-	-	-	-	-	527	-	(527)	-	-	-	-	-	(527)	(163)
	U - Unallocated Cost	-	-	-	-	1,746	1,746	-	-	-	42,153	42,153	-	-	-	-	42,153	42,153	1,746
7	**SNC AECON for ESMSA under PM**	**142,366**	**16,901**	**159,267**	**1,693**	**1,861**	**169**	**-**	**-**	**154,669**	**182,679**	**28,009**	**0.48**	**0.65**	**-**	**-**	**182,679**	**23,412**	**(7,026)**
	Nuclear Refurbishment	**381,174**	**24,000**	**405,174**	**3,047**	**2,122**	**(925)**	**-**	**-**	**385,452**	**400,855**	**15,403**	**0.74**	**0.83**	**5,145**	**-**	**406,000**	**826**	**(4,016)**

Note: [1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.
[2] All Values Include Interest and Escalation

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End September 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: L. Greenland
Process Owner: Multiple
Period Ending: September 2017

ID	Title	Risk Description	Current Score	Post Score
12455	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited Construction	Event: Late start of new EPC Vendor and continued construction delays. Cause: Insufficient QA resources to support CWP/ITP development and material verification. Impact: Quality issues due to expedited construction schedule with many activities progressing in parallel.	20	15
14987	16-31555 D20 Storage Project: Commissioning schedule delay due to late submission of design manuals	Delays in issuance of new design manuals by the JV has the potential of affecting dates for issuance of commissioning workplans by OPG. In turn this has the potential to delay execution of commissioning activities.	12	6

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

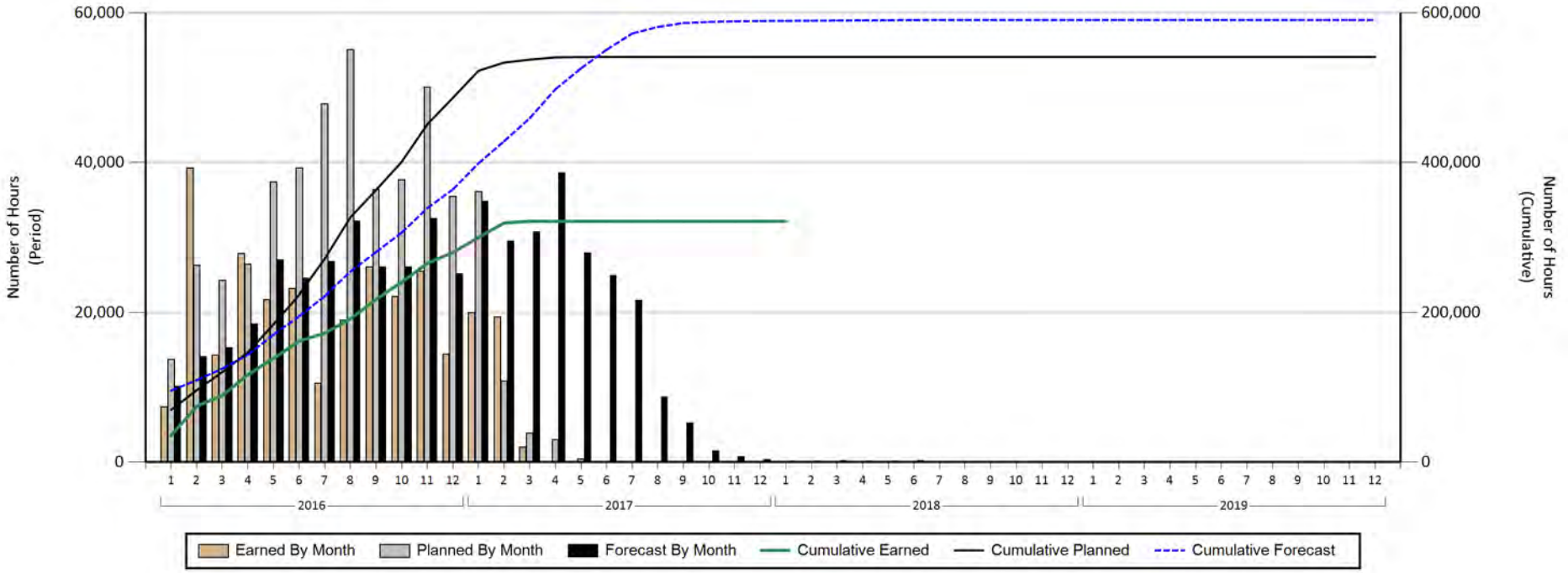
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,246	422,246
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,161	590,561

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**59.4%**	**-40.6%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	0	0	0	0.00	N/A
Cumulative	541,161	321,333	-219,828	0.59	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

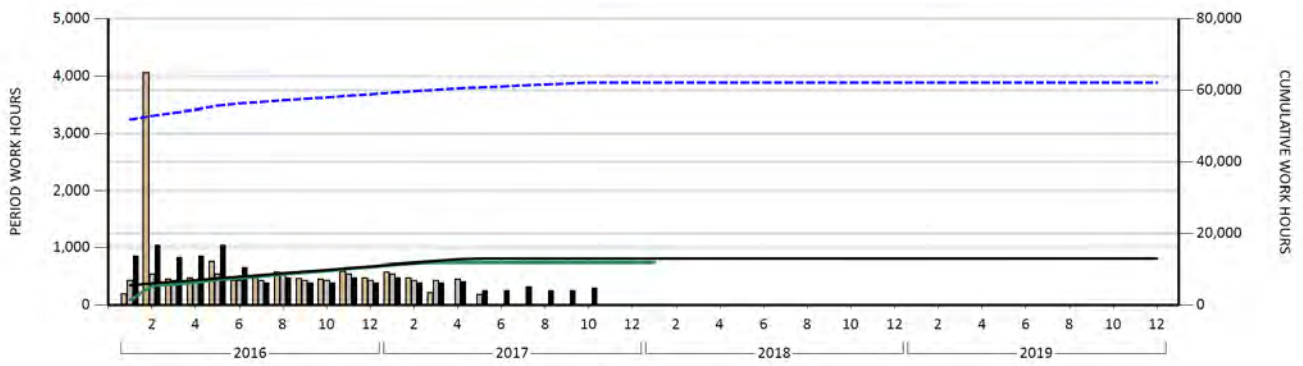
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**62,242**	**62,242**
Baseline Hours	0	12,942	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	11,963	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(979)	
SPI on Baseline	-	0.92	

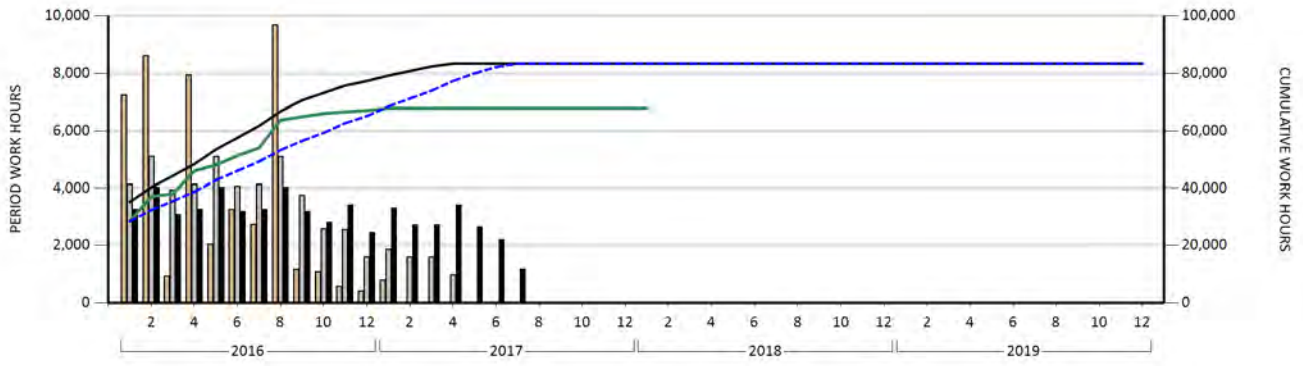
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**92.4%**	**-7.6%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**83,447**	**83,447**
Baseline Hours	0	83,447	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	67,878	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(15,569)	
SPI on Baseline	-	0.81	

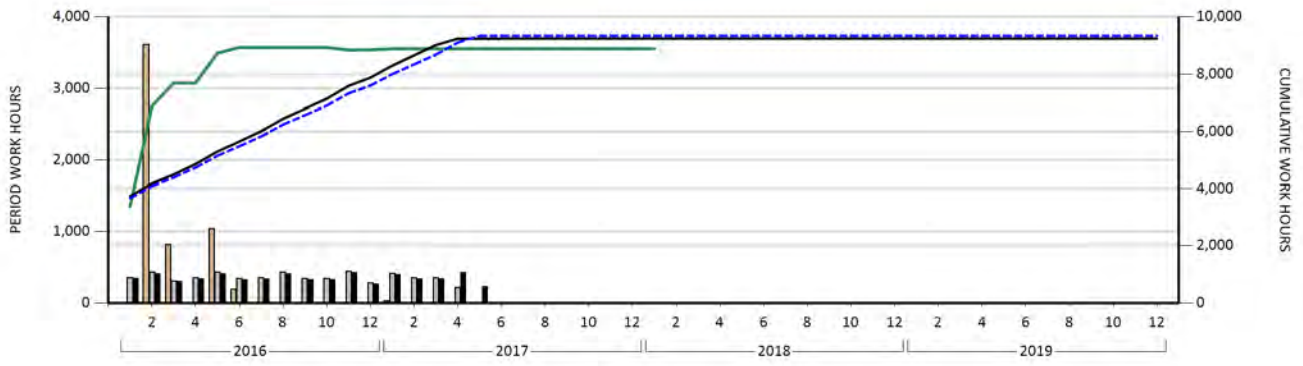
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**81.3%**	**-18.7%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**9,357**	**9,357**
Baseline Hours	0	9,257	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	8,899	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(358)	
SPI on Baseline	-	0.96	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**96.1%**	**-3.9%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

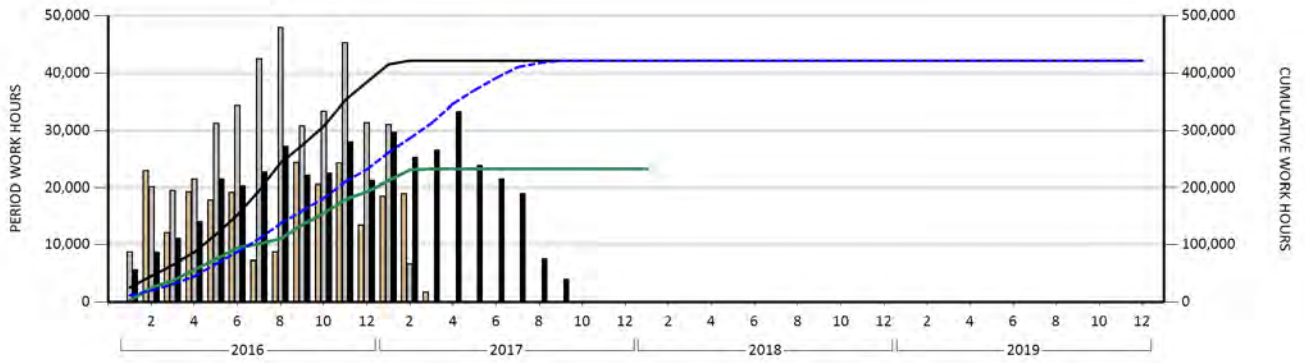
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**422,246**	**422,246**
Baseline Hours	0	422,246	422,246
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	232,594	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(189,652)	
SPI on Baseline	-	0.55	

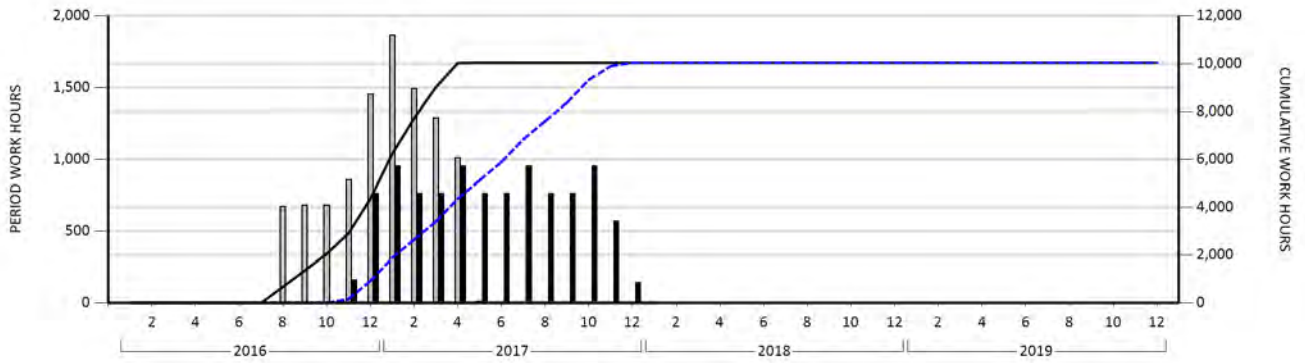
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**55.1%**	**-44.9%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**10,053**	**10,053**
Baseline Hours	0	10,053	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(10,053)	
SPI on Baseline	-	-	

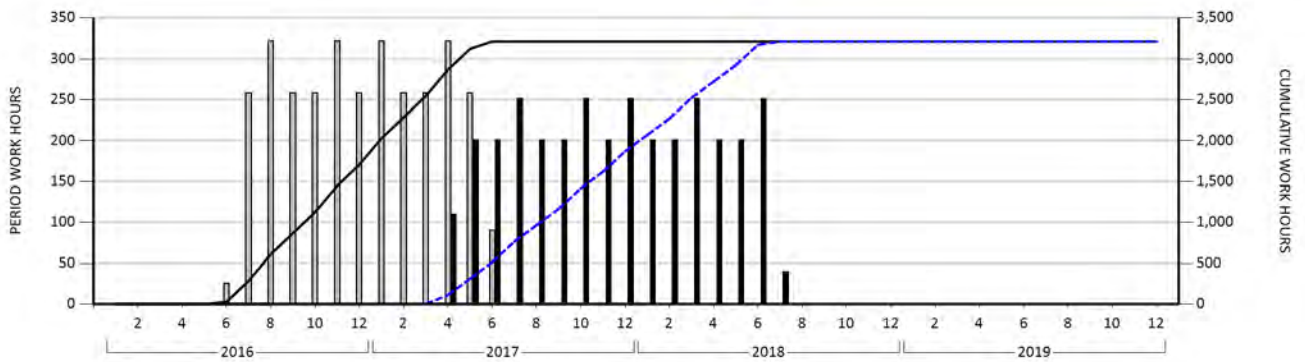
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**201**	**2,070**	**3,216**
Baseline Hours	0	3,216	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(3,216)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

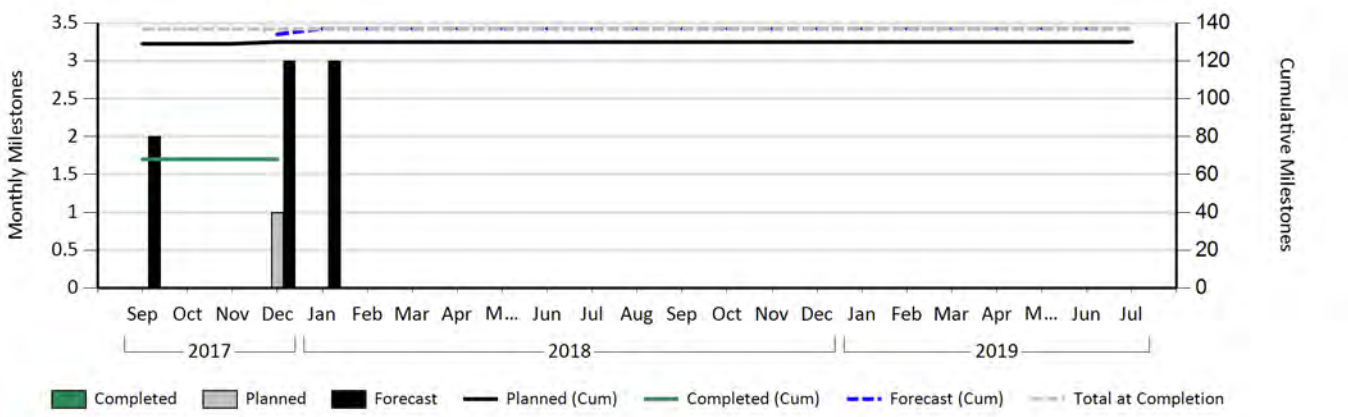
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	52
Milestones Planned to Date Completed	30 | 58%
Variance Ahead / (Behind)	(22)
Milestones Completed on Time	10 | 19%
Milestones Forecasting Late	22 | 100%
# of Milestones Completed | Remaining	30 | 22
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	38 | 47
Total # of Milestones	**137**
# of Milestones Completed | Remaining	68 | 69



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		21-Apr-17	0	0	XX
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		21-Apr-17	0	0	XX
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		21-Apr-17	0	0	XX
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		21-Apr-17	0	0	XX
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		21-Apr-17	0	0	XX
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		21-Apr-17	0	0	XX
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		21-Apr-17	0	0	XX
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		21-Apr-17	0	0	XX
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		21-Apr-17	0	0	XX
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		21-Apr-17	0	0	XX
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		21-Apr-17	0	0	XX
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		21-Apr-17	0	0	XX
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		21-Apr-17	0	0	XX
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		21-Apr-17	0	0	XX
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		21-Apr-17	0	0	XX
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		21-Apr-17	0	0	XX
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		21-Apr-17	0	0	XX
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		21-Apr-17	0	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		21-Apr-17	0	0	XX
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		21-Apr-17	0	0	XX
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		21-Apr-17	0	0	XX
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		21-Apr-17	0	0	XX
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		21-Apr-17	0	0	XX
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		21-Apr-17	0	0	XX
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		21-Apr-17	0	0	XX
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		21-Apr-17	0	0	XX
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		21-Apr-17	0	0	XX
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		21-Apr-17	0	0	XX
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		21-Apr-17	0	0	XX
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		21-Apr-17	0	0	XX
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		21-Apr-17	0	0	XX
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		21-Apr-17	0	0	XX
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		21-Apr-17	0	0	XX
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		21-Apr-17	0	0	XX
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		21-Apr-17	0	0	XX
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		21-Apr-17	0	0	XX
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		21-Apr-17	0	0	XX
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		21-Apr-17	0	0	XX
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		21-Apr-17	0	0	XX
AA1618	CCD-HVAC Start-up		CCD		21-Apr-17	0	0	XX
31555SM101	Start of Commissioning (CMS)	3	CMS		09-Jun-17	0	0	XX
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		10-Aug-17	0	0	XX
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		10-Aug-17	0	0	XX
31555FM171	Final AFS - All Commissioning Complete	3	CMF		14-Dec-17	0	0	XX
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	17-Jul-17	-385	0	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	21-Apr-17	-283	0	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	23-Jun-17	-333	0	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	29-Jun-17	-329	0	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	08-Sep-17	-400	0	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	21-Apr-17	-185	0	XX
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	05-May-17	-193	0	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	19-Jun-17	-238	0	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	27-Apr-17	-183	0	XX
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	17-Aug-17	-288	0	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	25-Sep-17	-313	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	24-May-17	-176	0	XX
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	06-Jul-17	-216	0	XX
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	06-Jun-17	-160	0	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	19-Jul-17	-189	0	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	01-Aug-17	-202	0	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	10-Aug-17	-142	0	XX
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	14-Dec-17	-239	0	XX
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4	CMF	19-Apr-17	14-Dec-17	-239	0	XX
31555M0130	Project Close-out Complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555PED30	Project Close out complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555M0240	Final Completion / Project Closeout	4	PCO	23-May-17	15-Jan-18	-237	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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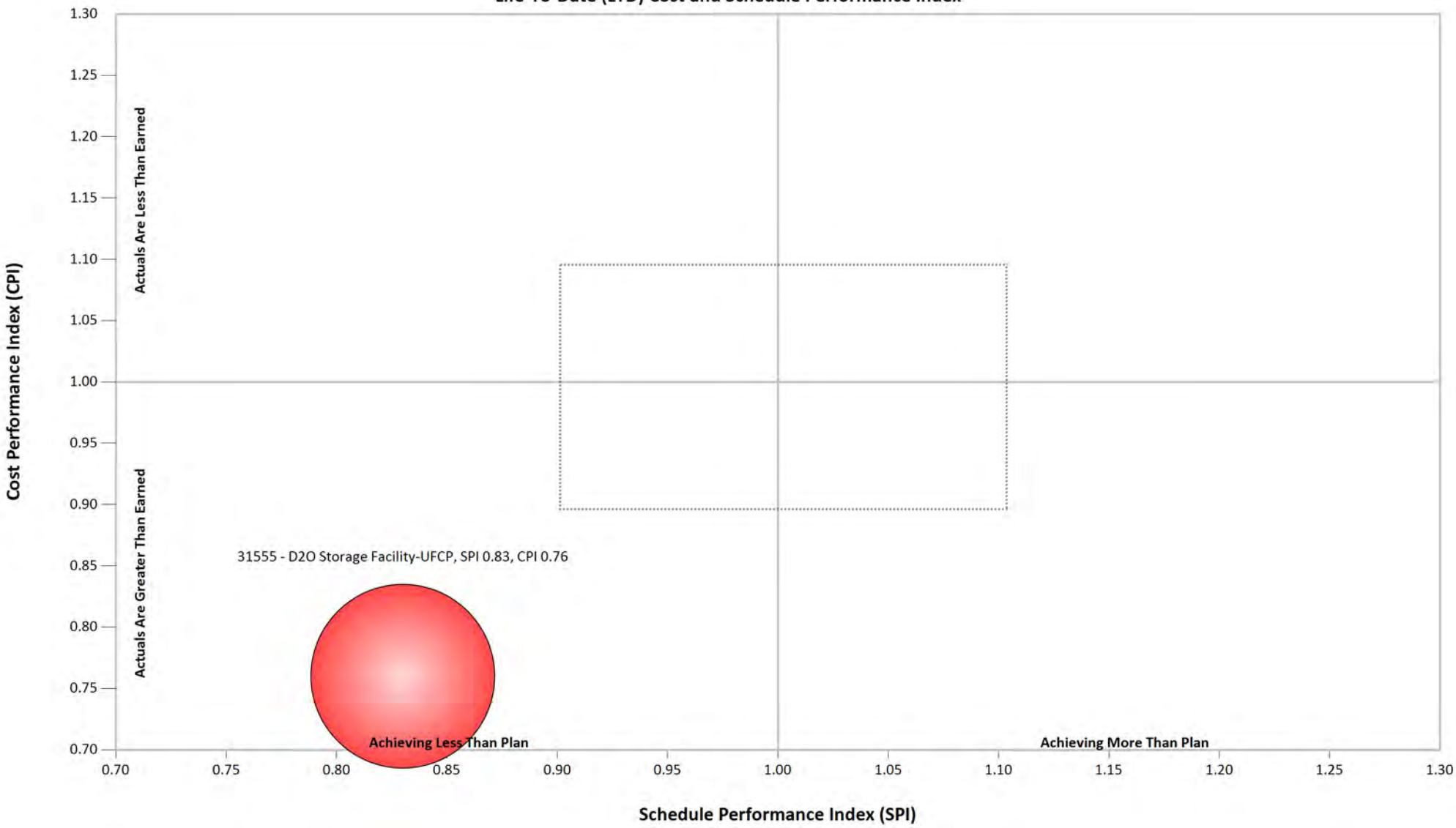
Process Owner: Multiple
Period Ending: December 2017

Life-To-Date (LTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

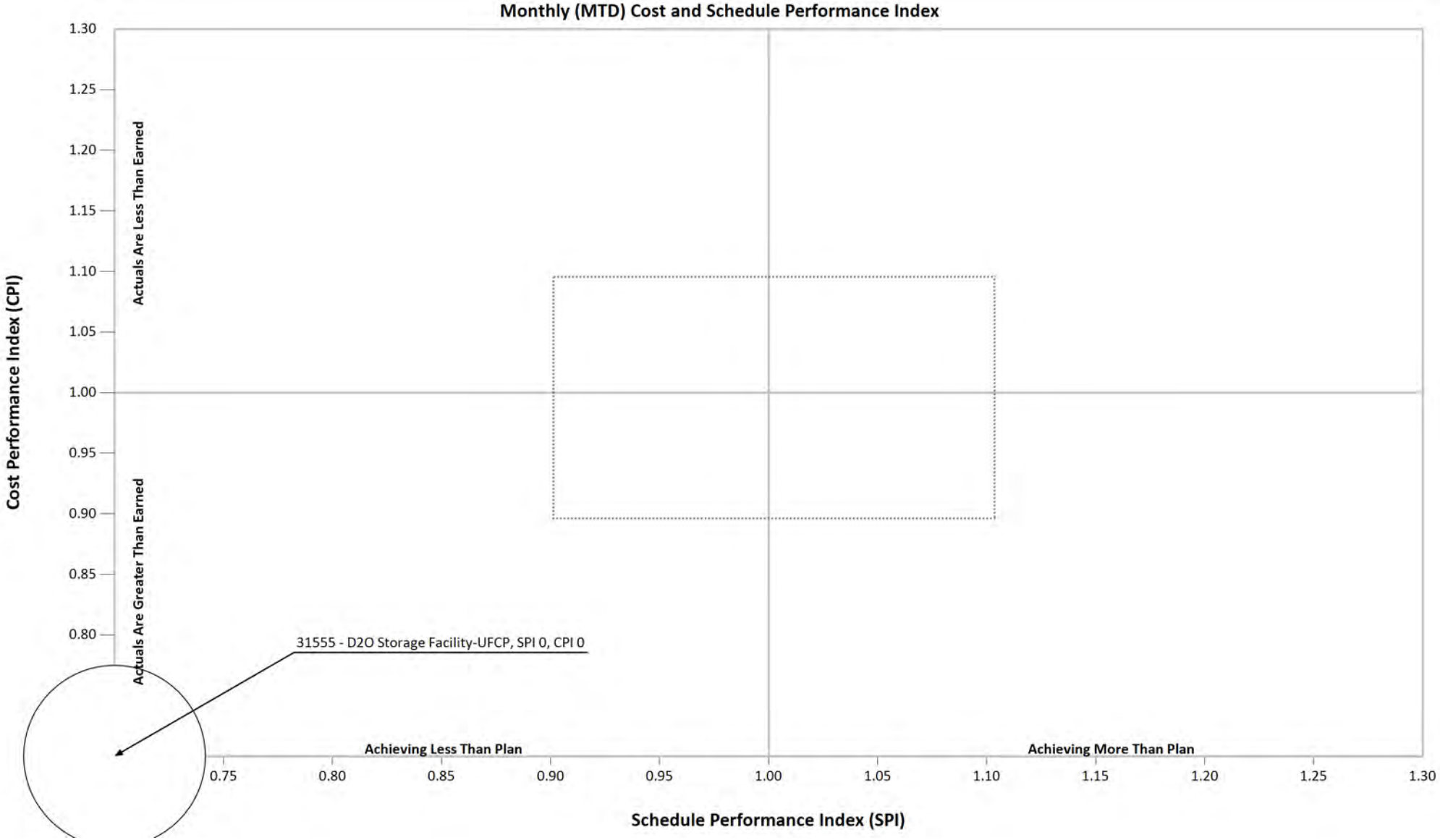
Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	88	0	(13,359)	13,359	(88)	0.00	0.00	241,132	201,096	263,004	(61,908)	(40,036)	0.76	0.83	241,132
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	88	0	(13,359)	13,359	(88)	0.00	0.00	241,132	201,096	263,004	(61,908)	(40,036)	0.76	0.83	241,132
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	88	0	(13,359)	13,359	(88)	0.00	0.00	241,132	201,096	263,004	(61,908)	(40,036)	0.76	0.83	241,132
	Total	**88**	**0**	**(13,359)**	**13,359**	**(88)**	**0.00**	**0.00**	**241,132**	**201,096**	**263,004**	**(61,908)**	**(40,036)**	**0.76**	**0.83**	**241,132**

[1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.

ONTARIO POWER GENERATION

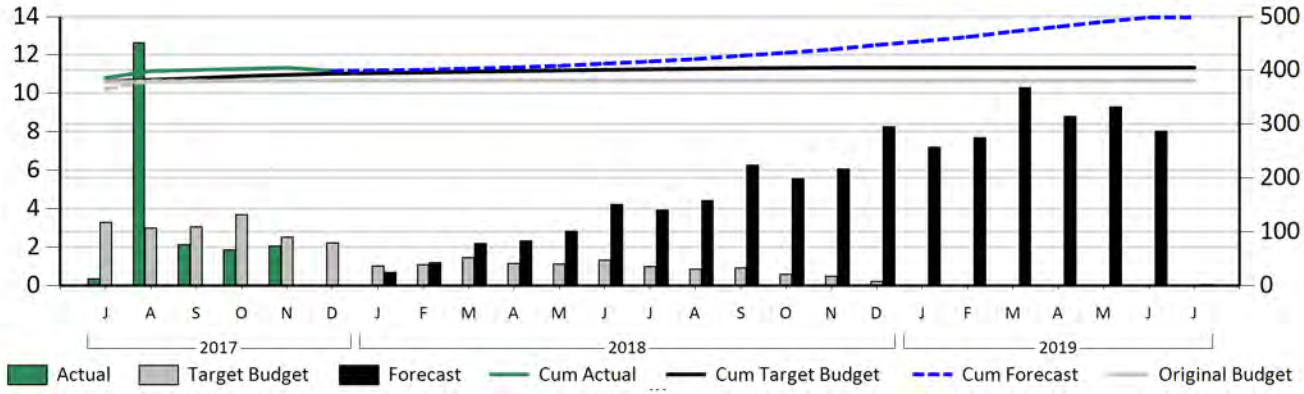
Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

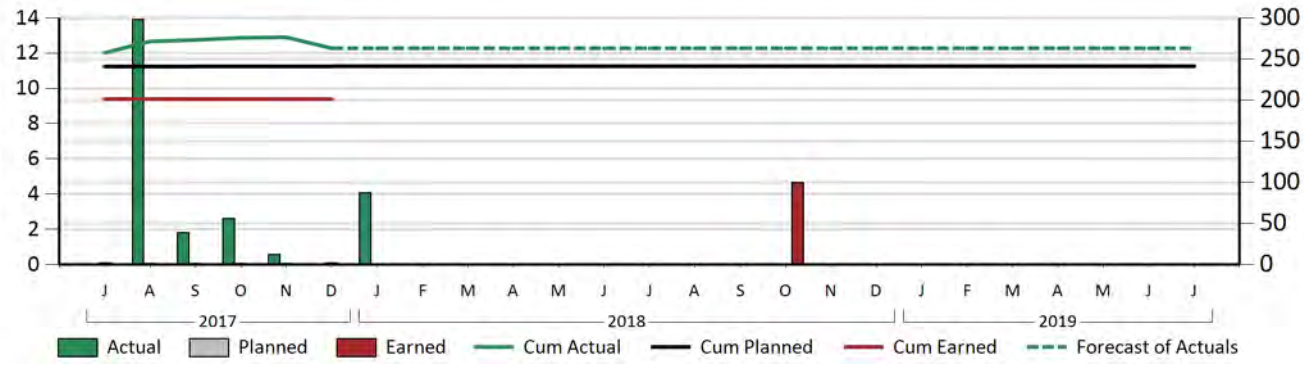
100% = 61% + 39%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*



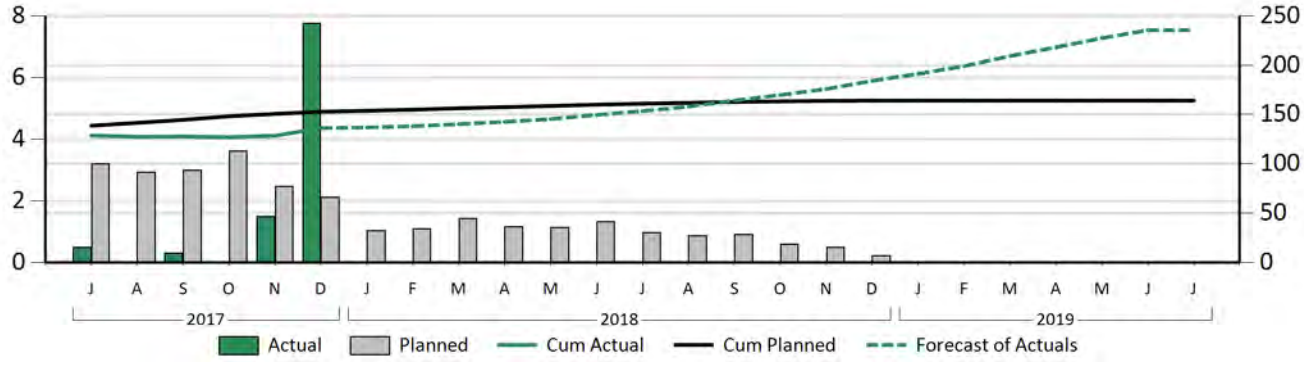
Life-To-Date	
Original Budget	381,174
Target Budget	393,891
Actual	399,207
Variance-to-Target Budget	5,316
% of Target Budget Spent	101%
Funding Released to Projects	380,496

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	241,132
Earned Value	201,096
Actual	263,004
Variance-to-Planned Value	21,871
Cost Performance Index	0.76
Schedule Performance Index	0.83

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	152,759
Actual	136,203
Variance-to-Planned Value	(16,555)

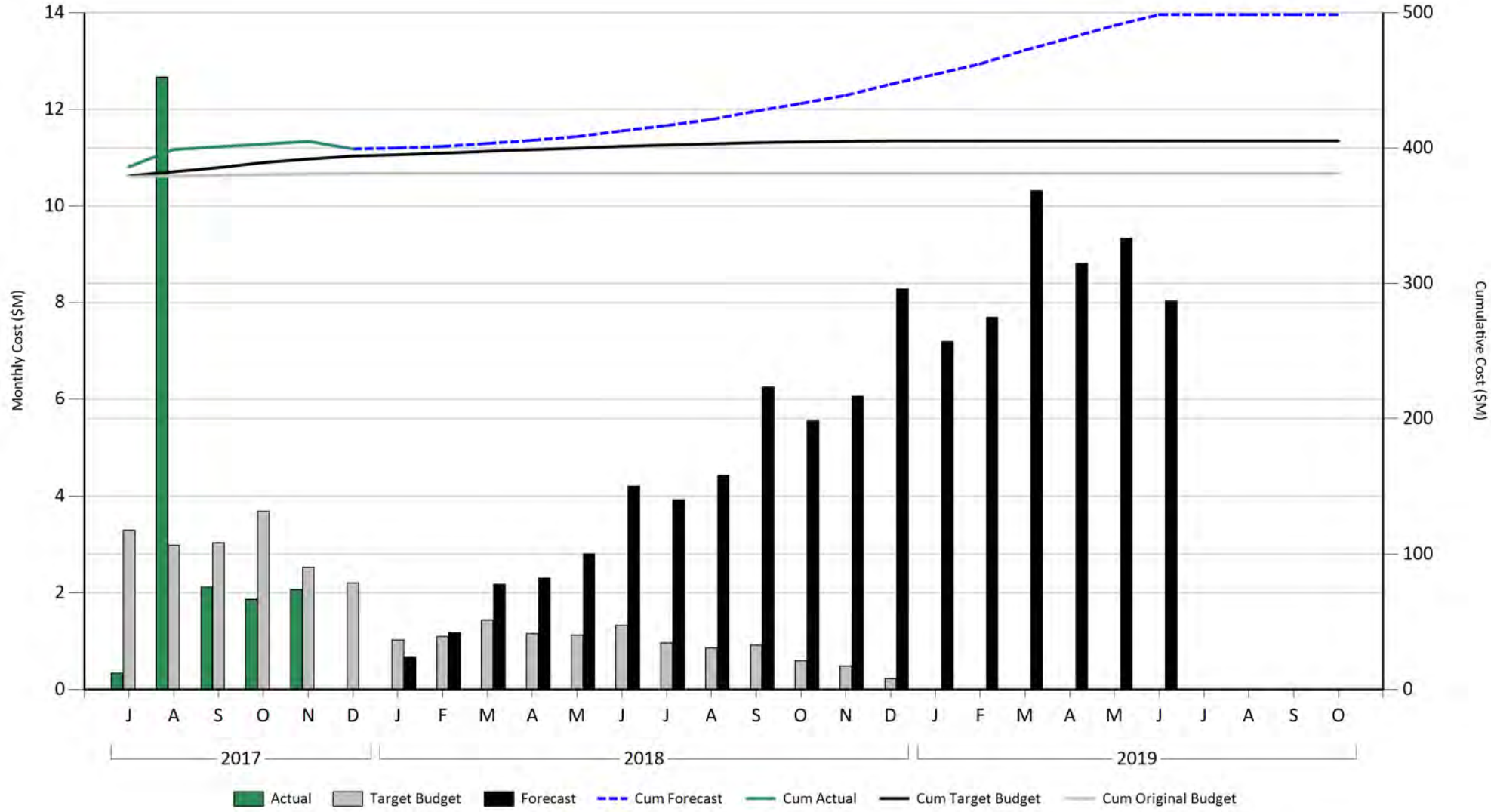
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

COST CURVE *($ MILLIONS) - Units: U2, U4, US, U1, U3, UD, UF, U0*



Life Cycle Budget		Cumulative (Life-To-Date)			Forecast = Estimate at Completion		
Original Budget	Target Budget	Target Budget	Actual	Cost Variance	ETC	EAC	Var. FromTarget
381,174	405,174	393,891	399,207	5,316	99,293	498,500	93,326

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End December 2017

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: December 2017

		Life Cycle Budget					This Period			Cumulative (Life-To-Date)				Forecast = Estimate at Completion			
		a	*b*	*c = a + b*	*d*	*e = c + d*	*f*	*g*	*h = g - f*	*i*	*j*	*k*	*l = k - j*	*m*	*n = k + m*	*o = n - e*	*p*
Line #	Description	Original Budget	Directed Changes[2]	Control Budget	Non Directed Changes[2]	Target Budget	Target Budget	Actual	Cost Variance	Original Budget	Target Budget	Actual	Cost Variance To Target Budget	ETC	EAC	Variance from Target Budget	Variance to EAC over Period
	3 - Engineering	2,830	967	3,797	-	3,797	-	24	24	2,830	3,797	1,883	(1,914)	-	1,883	(1,914)	24
1	**OPG Design Support in Vendor Project**	**2,830**	**967**	**3,797**	**-**	**3,797**	**-**	**24**	**24**	**2,830**	**3,797**	**1,883**	**(1,914)**	**-**	**1,883**	**(1,914)**	**24**
	0 - Cost Management	44,927	(7,175)	37,752	12,683	50,435	1,129	-	(1,129)	44,927	39,287	24,490	(14,797)	99,293	123,783	73,348	5,593
	1 - Project Management	6,562	3,119	9,681	-	9,681	-	159	159	6,562	9,681	11,161	1,479	-	11,161	1,479	159
	4 - Procurement	13,940	(7,444)	6,496	-	6,496	112	66	(46)	13,940	6,496	6,887	391	-	6,887	391	66
	6 - Commissioning	378	244	621	-	621	15	30	15	378	621	240	(381)	-	240	(381)	30
2	**OPG Non Design Support in Vendor**	**65,806**	**(11,256)**	**54,550**	**12,683**	**67,233**	**1,256**	**256**	**(1,000)**	**65,806**	**56,085**	**42,778**	**(13,307)**	**99,293**	**142,071**	**74,837**	**5,848**
	0 - Cost Management	1,869	(1,869)	-	-	-	-	-	-	1,869	-	-	-	-	-	-	-
	1 - Project Management	4,388	3,917	8,305	-	8,305	-	73	73	4,388	8,305	8,819	515	-	8,819	515	73
	3 - Engineering	23,314	1,117	24,431	-	24,431	-	97	97	23,314	24,431	23,712	(719)	-	23,712	(719)	97
	4 - Procurement	20,263	8,097	28,360	-	28,360	-	-	-	20,263	28,360	28,236	(124)	-	28,236	(124)	-
	5 - Construction	84,180	(8,888)	75,292	-	75,292	-	41	41	84,180	75,292	75,606	314	-	75,606	314	41
	9 - Closeout	375	(2)	374	-	374	-	-	-	375	374	374	-	-	374	-	-
3	**Vendors Managed by Projects and**	**134,390**	**2,372**	**136,761**	**-**	**136,761**	**-**	**211**	**211**	**134,390**	**136,761**	**136,747**	**(14)**	**-**	**136,747**	**(14)**	**211**
	0 - Cost Management	1,306	94	1,401	-	1,401	-	-	-	1,306	1,401	1,401	-	-	1,401	-	-
	5 - Construction	28,198	664	28,862	-	28,862	-	-	-	28,198	28,862	28,862	-	-	28,862	-	-
4	**Ellis Don Under P&M**	**29,504**	**758**	**30,262**	**-**	**30,262**	**-**	**-**	**-**	**29,504**	**30,262**	**30,262**	**-**	**-**	**30,262**	**-**	**-**
	1 - Project Management	121	(1)	120	-	120	-	-	-	121	120	120	-	-	120	-	-
	5 - Construction	6,157	1,365	7,523	-	7,523	-	-	-	6,157	7,523	7,595	72	-	7,595	72	-
5	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**-**	**7,643**	**-**	**-**	**-**	**6,278**	**7,643**	**7,715**	**72**	**-**	**7,715**	**72**	**-**
	0 - Cost Management	-	-	-	210	210	26	-	(26)	-	201	1	(200)	-	1	(209)	-
6	**SNC AECON JV Under P&M**	**-**	**-**	**-**	**210**	**210**	**26**	**-**	**(26)**	**-**	**201**	**1**	**(200)**	**-**	**1**	**(209)**	**-**
	0 - Cost Management	2,282	922	3,204	1	3,205	-	196	196	2,282	3,205	2,369	(836)	-	2,369	(836)	196
	1 - Project Management	20,870	5,318	26,189	3,022	29,211	369	3,680	3,311	20,870	29,085	30,474	1,389	-	30,474	1,263	3,680
	3 - Engineering	15,438	446	15,883	152	16,036	-	303	303	15,438	16,036	24,777	8,741	-	24,777	8,741	303
	4 - Procurement	36,000	(72)	35,929	3,442	39,371	214	1,103	889	36,000	39,371	35,351	(4,020)	-	35,351	(4,020)	1,103
	5 - Construction	67,245	(816)	66,429	4,489	70,918	349	(9,663)	(10,012)	67,245	70,918	95,576	24,658	-	95,576	24,658	(9,663)
	6 - Commissioning	531	(4)	527	-	527	-	-	-	531	527	-	(527)	-	-	(527)	-
	U - Unallocated Cost	-	-	-	-	-	-	(1,708)	(1,708)	-	-	(8,731)	(8,731)	-	(8,731)	(8,731)	(1,708)
7	**SNC AECON for ESMSA under PM**	**142,366**	**5,794**	**148,160**	**11,107**	**159,267**	**932**	**(6,089)**	**(7,021)**	**142,366**	**159,141**	**179,815**	**20,674**	**-**	**179,815**	**20,548**	**(6,089)**
	3 - Engineering	-	-	-	-	-	-	6	6	-	-	6	6	-	6	6	6
8	**TETRA TECH WEI INC**	**-**	**-**	**-**	**-**	**-**	**-**	**6**	**6**	**-**	**-**	**6**	**6**	**-**	**6**	**6**	**6**
	Nuclear Refurbishment	**381,174**	**-**	**381,174**	**24,000**	**405,174**	**2,214**	**(5,593)**	**(7,806)**	**381,174**	**393,891**	**399,207**	**5,316**	**99,293**	**498,500**	**93,326**	**-**

Note: [1] All Values Include Interest and Escalation
[2] Direct Changes are PCA's (Project Change Authorization) which are OPG directed changes to scope. Non-Directed Changes are CTP's (Consent To Proceed) which are Contractor forecasts that exceed cost targets.

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Executive Summary:

Updated November 11, 2016

Scope
This project will address the need to store heavy water to facilitate the refurbishment of Darlington Nuclear Generating Station (DNGS).

Safety & Quality

N-2016-27553 - WorkedpPinched finger while handling scaffold material
N-2016-27086 - Lack of FME controls
N-2016-26122 - Rework - Ductwork installed out of sequence

Accomplishments/Issues
- Mini-pile installation for pipe chase complete
- Foundation slab waterproofing/forming, foundation slab pour complete for pipe chase
- Started PHT pipe spool and support installation
- Completed sequence 10 installation of building steel, started sequence 12.
- Installation activities are currently trending off recovery plan

Schedule
- Overall schedule performance is "poor" with an overall SPI of 0.84. This was driven by pipe pre-fabrication and installation, and JV SPI currently reporting 0.61 due to delays in steel fabrication/erection.
- A recovery schedule was put in place on June 10, 2016, and the JV is falling behind this recovery plan with an SPI of 0.85, and this SPI has slightly decreased since last month. OPG has reviewed the latest JV schedule and revised logic ties together with JV.
- Commissioning activities continue to be developed and logic tied into the schedule.
- Current AFS date is off-plan for May 8, 2017 and is shown as Jun 13, 2017.

Cost
- The Project spent $12.6M in October against a plan of $14.4M bringing total project spend to $309.4M LTD at October month end.
- Current EAC remains in alignment with BCS released value of $381.1M however is at risk due to a recent change notice provided by the JV which is being reviewed by OPG Senior Management.

Resource Summary:

Milestone Summary:

Overall, JV schedule performance is being negatively impacted by delays ordering bulk materials, which has delayed prefabrication work.

In addition, delays processing and issuing CWPs due to resource constraints are causing negative impact on field work/schedule.

Revised schedule loaded into P6 Production on June 10, 2016.

Cost Summary:

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Life to Date costs are $309.4M against a control budget of $349.7M, with an overall CPI of 0.92. Forecasted EAC is $381.1M.

A complete review of all open accruals took place for October month end and all past costs have been cleaned up. A CCF is being prepared and routed for review this month to draw on project contingency to cover all legacy and current subcontractor costs to align budgets with actuals with exception of the JV. The JV budgeted cost will align with current purchase order value. A future CCF is planned when agreement on the changes notices provide by the JV is reached.

Risk Summary:

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Filters Applied:

Vendors: All Vendors Included

Unit: U0, U1, U2, U3, U4, US, UF, UD, Unknown

Sub Bundles: All Sub Bundles Included

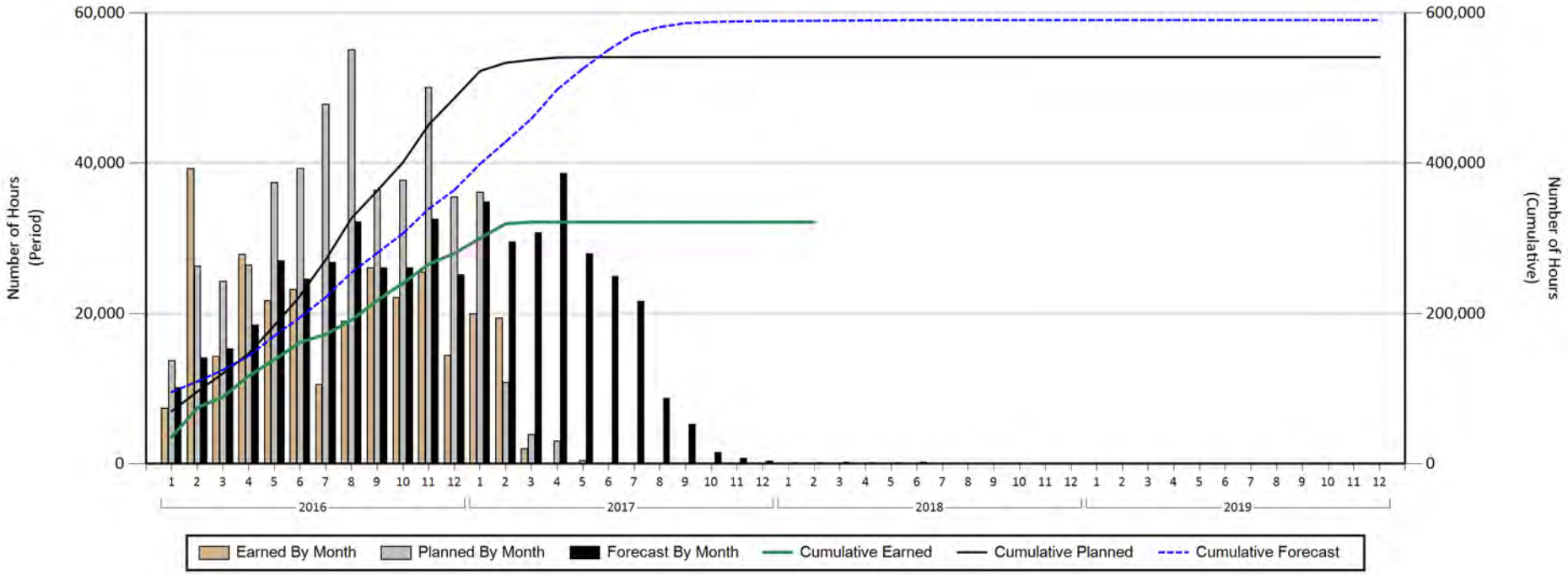
TOTAL BUNDLE RESOURCES - PIEPCCC

Total Budgeted Work Hours

		Baseline	Forecast
P	Proj Mgmt	12,942	62,242
I	Inspections	0	0
E	Engineering	83,447	83,447
P	Procurement	9,257	9,357
C	Construction	422,246	422,246
C	Commissioning	10,053	10,053
C	Closeout	3,216	3,216
	Others	0	0
	Total	541,161	590,561

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**59.4%**	**-40.6%**

	Planned	Earned	Variance	SPI	CPI
Period (Previous Month)	0	0	0	0.00	N/A
Cumulative	541,161	321,333	-219,828	0.59	N/A



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

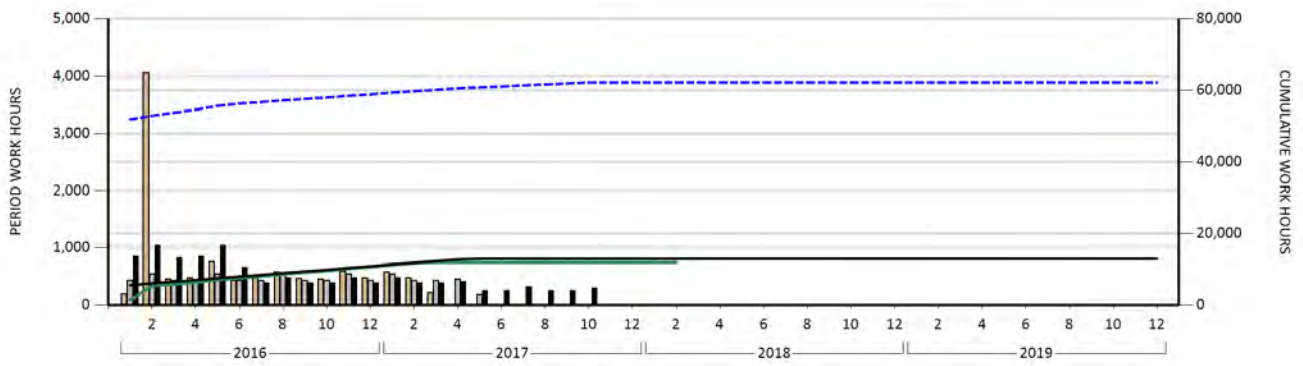
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

P - PROJECT MANGEMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**62,242**	**62,242**
Baseline Hours	0	12,942	12,942
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	11,963	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(979)	
SPI on Baseline	-	0.92	

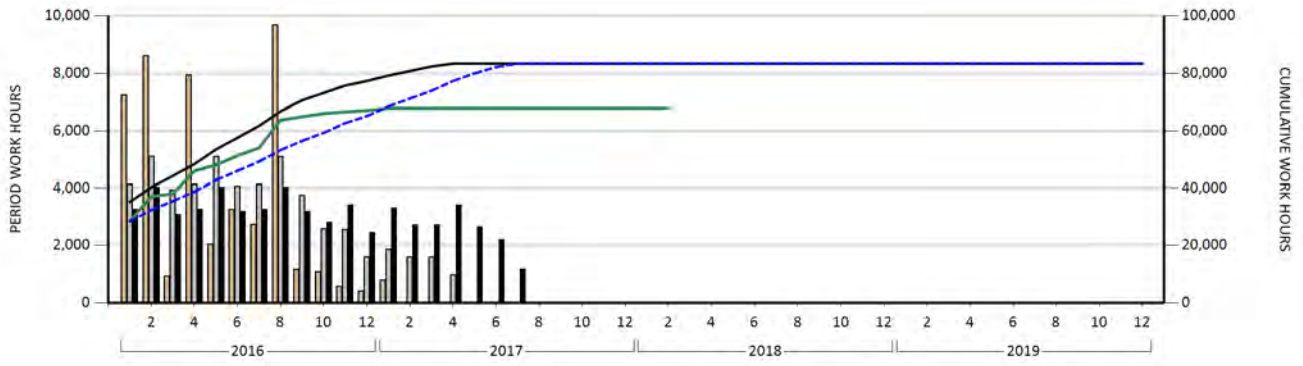
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**92.4%**	**-7.6%**



E - ENGINEERING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**83,447**	**83,447**
Baseline Hours	0	83,447	83,447
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	67,878	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(15,569)	
SPI on Baseline	-	0.81	

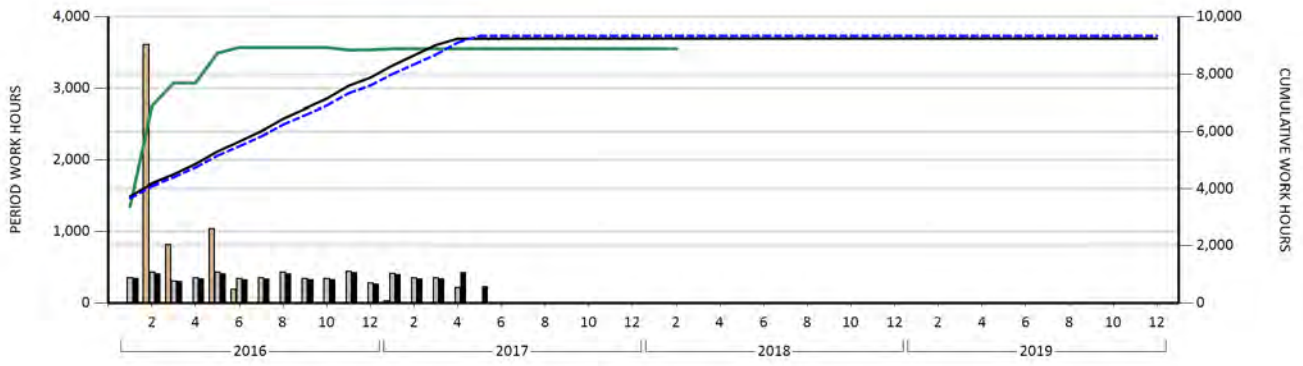
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**81.3%**	**-18.7%**



P - PROCUREMENT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**9,357**	**9,357**
Baseline Hours	0	9,257	9,257
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	8,899	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(358)	
SPI on Baseline	-	0.96	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**96.1%**	**-3.9%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

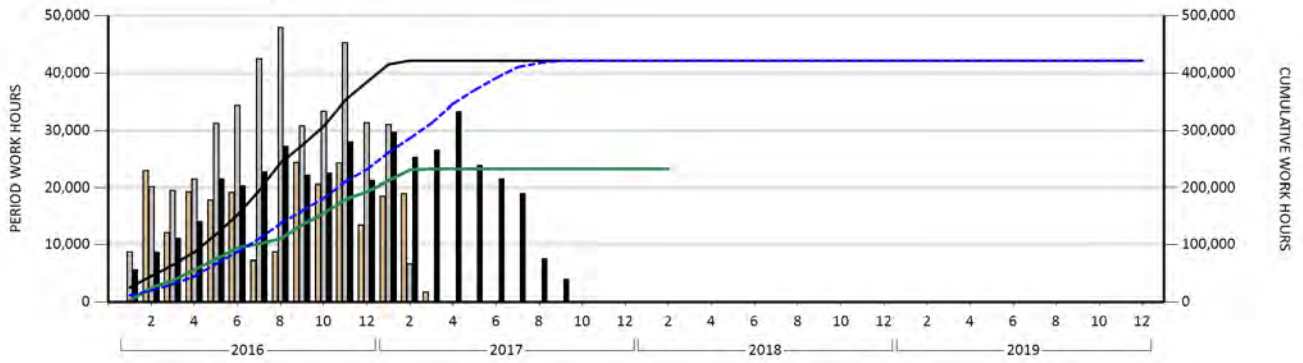
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

C - CONSTRUCTION

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**422,246**	**422,246**
Baseline Hours	0	422,246	422,246
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	232,594	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(189,652)	
SPI on Baseline	-	0.55	

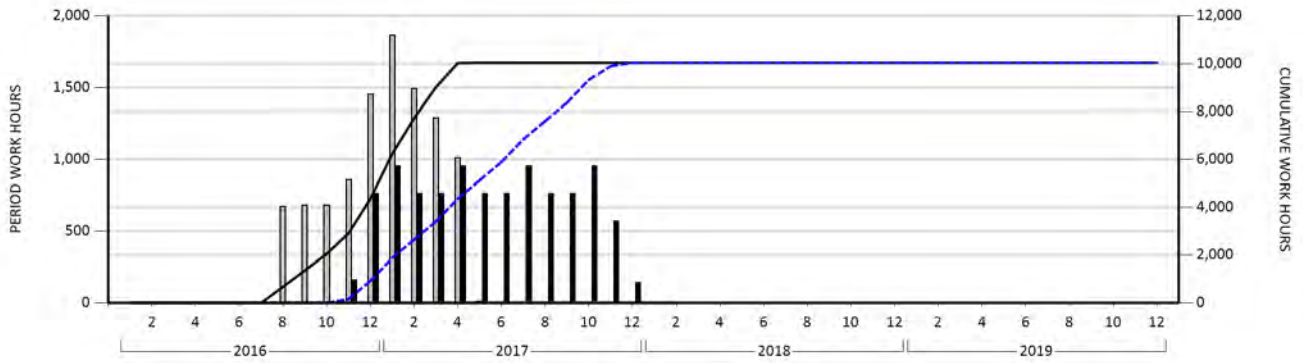
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**55.1%**	**-44.9%**



C - COMMISSIONING

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**0**	**10,053**	**10,053**
Baseline Hours	0	10,053	10,053
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(10,053)	
SPI on Baseline	-	-	

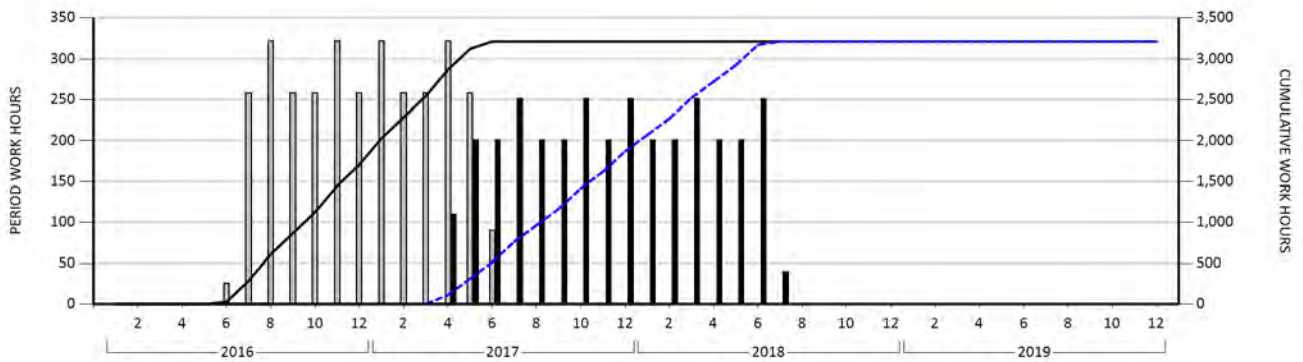
	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



C - CLOSEOUT

P6 VUL Value Units Labor	Last Month	LTD Cumulative	At Completion
Current Budgeted Hours	**201**	**2,271**	**3,216**
Baseline Hours	0	3,216	3,216
Forecast (Recovery)	N/A	N/A	
Earned Hours	0	0	
Actual	N/A	N/A	
Variance (Earned From Baseline)	-	(3,216)	
SPI on Baseline	-	-	

	Planned %	Earned %	Variance
Cumulative Progress	**100.0%**	**0.0%**	**-100.0%**



ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

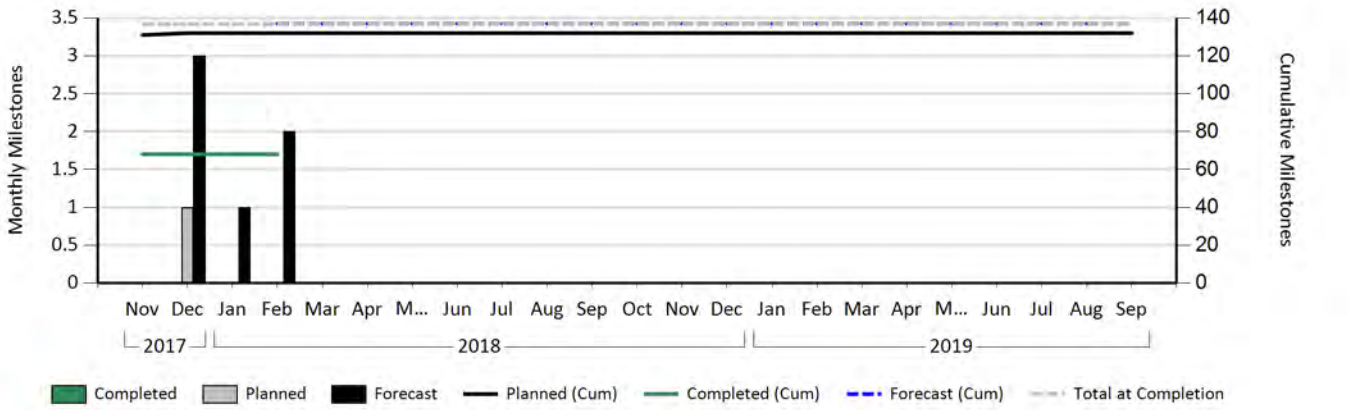
F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Filters Applied:
Program: Nuclear Refurbishment
Unit: U0, U1, U2, U3, U4, UD, UF, UN, US
Table: 120 Day Window
Tier: 3, 4
Type: EPC, LLT, PCA, MED, SOI, CCD, CMS, AFS, RTS, PCO
Status: Active

MILESTONE PERFORMANCE (# MILESTONES)

Milestones with Baseline	**52**
LTD Planned Completion	52
Milestones Planned to Date Completed	30 | 58%
Variance Ahead / (Behind)	(22)
Milestones Completed on Time	10 | 19%
Milestones Forecasting Late	22 | 100%
# of Milestones Completed | Remaining	30 | 22
Milestones with No Baseline	**85**
# of Milestones Completed | Remaining	38 | 47
Total # of Milestones	**137**
# of Milestones Completed | Remaining	68 | 69



Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
Unit F - Facilities & Infrastructure Projects Work								
NR.CP.IN.01.UF.31555 - 31555 - UF - SNC Heavy Water Management Building West Annex Project								
AA611990	Release For Commissioning-EC#120557-Breathing Air	4	CMS		21-Apr-17	0	0	XX
AA30695	Release For Commissioning-EC#121326-ELEC-#96 Elec and I&C for new Instrument/Service Air Compressors	4	CMS		21-Apr-17	0	0	XX
AA30705	Release For Commissioning-EC#120485-ELEC-#54 Misc Electrical Power to Pump Motors & Equip (Active/inactive),	4	CMS		21-Apr-17	0	0	XX
AA30715	Release For Commissioning-EC#127218-ELEC-Cable Duct from SWG53 to D2O/RFRISA buildings	4	CMS		21-Apr-17	0	0	XX
AA30725	Release For Commissioning-EC#120472-ELEC-#56 Electrical Power Supply for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30745	Release For Commissioning-EC#120478-ELEC-#63 MCC Design	4	CMS		21-Apr-17	0	0	XX
AA30755	Release For Commissioning-EC#120479-ELEC-#55 Building Lighting and Electrical Distribution System	4	CMS		21-Apr-17	0	0	XX
AA30765	Release For Commissioning-EC#120475-ELEC-#58 Uninterruptible Power Supply (UPS)	4	CMS		21-Apr-17	0	0	XX
AA30775	Release For Commissioning-EC#120476-ELEC-#59 Grounding System for West Annex	4	CMS		21-Apr-17	0	0	XX
AA30785	Release For Commissioning-EC#120477-ELEC-#60 Cable Support Systems	4	CMS		21-Apr-17	0	0	XX
AA30795	Release For Commissioning-EC#127532-ELEC-Misc building electrical and I&C	4	CMS		21-Apr-17	0	0	XX
AA30805	Release For Commissioning-EC#129058-elec-design-dngs hwmb west annex 120/208v normal/backup power distrib	4	CMS		21-Apr-17	0	0	XX
AA30815	Release For Commissioning-EC#121805-ELEC/I&C-I&C and power for chilled water system	4	CMS		21-Apr-17	0	0	XX
AA30825	Release For Commissioning-EC#121318-ELEC/I&C-#95 (SCI 63830) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA30835	Release For Commissioning-EC#120488-I&C-#68 Storage Tank/Equipment Control System	4	CMS		21-Apr-17	0	0	XX
AA30845	Release For Commissioning-EC#120489-I&C-#69 Storage Tank Level Indicators	4	CMS		21-Apr-17	0	0	XX
AA30855	Release For Commissioning-EC#120491-I&C-#71 (67989) Fixed Gaseous Effluent Radioactivity Monitoring	4	CMS		21-Apr-17	0	0	XX
AA30865	Release For Commissioning-EC#120492-I&C-#74 (62341 & 62330) FAATM and FAAGM	4	CMS		21-Apr-17	0	0	XX
AA30875	Release For Commissioning-EC#120493-I&C-#66 (63860) D2O Leak Detection System (Beetles)	4	CMS		21-Apr-17	0	0	XX

Legend:

✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
AA30885	Release For Commissioning-EC#120351-I&C-#64 (67870) Fire and Smoke Detection System	4	CMS		21-Apr-17	0	0	XX
AA30905	Release For Commissioning-EC#120349-I&C-#73 (60220 & 69040) Telephone/LAN	4	CMS		21-Apr-17	0	0	XX
AA30915	Release For Commissioning-EC#120352-I&C-#65 (60215) Public Address System	4	CMS		21-Apr-17	0	0	XX
AA30925	Release For Commissioning-EC#120481-I&C-#75 (62321) Personnel and Portal Monitors	4	CMS		21-Apr-17	0	0	XX
AA30935	Release For Commissioning-EC#120421-MECH-#46-1 (38110) Tanks/Piping for D2O Supply	4	CMS		21-Apr-17	0	0	XX
AA30945	Release For Commissioning-EC#120422-MECH-#47-2 (38110) Tanks/Piping for TRF Outgoing	4	CMS		21-Apr-17	0	0	XX
AA30955	Release For Commissioning-EC#120423-MECH-#46-2 (38500) Tanks/Piping for Downgraded	4	CMS		21-Apr-17	0	0	XX
AA30965	Release For Commissioning-EC#120424-MECH-#47-1 (38410) Tanks/Piping for D2O Clean Up	4	CMS		21-Apr-17	0	0	XX
AA30975	Release For Commissioning-EC#120523-MECH-#53 Drum Filling/Testing/Cleaning	4	CMS		21-Apr-17	0	0	XX
AA30985	Release For Commissioning-EC#121133-MECH-#33 (75160 & 75110) Instrument Air and Service Air System	4	CMS		21-Apr-17	0	0	XX
AA30995	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		21-Apr-17	0	0	XX
AA31005	Release For Commissioning-EC#121319-MECH-#94 (SCI 38300) DEC for D20 Vapour Recovery	4	CMS		21-Apr-17	0	0	XX
AA31015	Release For Commissioning-EC#120784-MECH-#27 (79710 & 38210) Active Plant Drainage + D2O Liquid Recovery S	4	CMS		21-Apr-17	0	0	XX
AA31025	Release For Commissioning-EC#120643-MECH-#50-2 (SCI 79110) Inactive Plant Drainage	4	CMS		21-Apr-17	0	0	XX
AA31035	Release For Commissioning-EC#120615-MECH-#43 Fire Protection Design (Standpipe & Cabinets)	4	CMS		21-Apr-17	0	0	XX
AA31045	Release For Commissioning-EC#120616-MECH-#42 Sprinkler System	4	CMS		21-Apr-17	0	0	XX
AA31055	Release For Commissioning-EC#121323-MECH-#51 Steam Heating, Condensate, Ventilation	4	CMS		21-Apr-17	0	0	XX
AA31065	Release For Commissioning-EC#120588-MECH-#44 Building Plumbing, Emergency Shower & Eyewash, Sewage, Do	4	CMS		21-Apr-17	0	0	XX
AA1625	Release For Commissioning-HVAC Start-up	4	CMS		21-Apr-17	0	0	XX
AA1618	CCD-HVAC Start-up		CCD		21-Apr-17	0	0	XX
AA30735	Release For Commissioning-EC#120474-ELEC-#57 Back-up Power	4	CMS		21-Apr-17	0	0	XX
AA1615	Release For Commissioning-Electrical TestingDCU4/120670	4	CMS		21-Apr-17	0	0	XX
AA1655	Release For Commissioning-Fire Detection (Alarm) System Testing	4	CMS		21-Apr-17	0	0	XX
AA1665	Release For Commissioning-Mechanical Equipment Start-up	4	CMS		21-Apr-17	0	0	XX
31555SM101	Start of Commissioning (CMS)	3	CMS		09-Jun-17	0	0	XX
RA30988	CCD-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units		CCD		10-Aug-17	0	-338	XX
R1020	Release For Commissioning-EC#121320-MECH-#52 (73870 & 38300) Chilled Water and Air Conditioning Units	4	CMS		10-Aug-17	0	-79	XX
31555FM171	Final AFS - All Commissioning Complete	3	CMF		14-Dec-17	0	0	XX
31555M0150	All Piping and Pumps Installed in Basement	4	FOI	27-Jun-16	17-Jul-17	-385	0	XX
31555M0320	Start Mech/Elec work on West Annex Bldg - EL 107	3	SOI	12-Jul-16	21-Apr-17	-283	0	XX
31555M0170	Detailed Design Complete	3	EDD	25-Jul-16	23-Jun-17	-333	0	XX
31555M0070	Prefab piping/supports installation in existing HWMB complete	4	FOI	04-Aug-16	29-Jun-17	-329	0	XX
31555M0180	All Tie In Completed	4	FOI	04-Aug-16	08-Sep-17	-400	0	XX
A23500	Manufacturing Equipment/Material Completed 100% and Delivered to Site - Control Panels	5	MED	18-Oct-16	21-Apr-17	-185	0	XX
31555M0190	Pipe Chase/ Causeway Civil Complete	4	FOI	24-Oct-16	05-May-17	-193	0	XX
31555M0200	All Design Updated With Vendor Documents and Issued as New Revision	3	EDD	24-Oct-16	19-Jun-17	-238	0	XX
31555M0210	All Piping Prefab Complete	4	FOI	26-Oct-16	27-Apr-17	-183	0	XX
31555M0080	Building Piping Installation Complete	4	FOI	02-Nov-16	17-Aug-17	-288	0	XX
31555M0090	Electrical Installation Complete	4	FOI	16-Nov-16	25-Sep-17	-313	0	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

Activity ID	Milestone Title	Tier	Code	Baseline	Forecast	Variance	Variance to Last Month	Status
A24100	Manufacturing Equipment/Material Completed 100% and Delivered to Site-Vapor Recovery Drier- CCI Thermal	5	MED	29-Nov-16	24-May-17	-176	0	XX
A23800	Manufacturing Equipment/Material Completed 100% and Delievered to Site -Chiller	5	MED	02-Dec-16	06-Jul-17	-216	0	XX
31555M0230	All Electrical on 108 el installed	4	FOI	28-Dec-16	06-Jun-17	-160	0	XX
A27150	Manufacturing Equipment/Material Completed 100% -Class 3 Orifice Plates	5	MED	11-Jan-17	19-Jul-17	-189	0	XX
A27230	Manufacturing Equipment/Material Completed 100% -Class 6 Orifice Plates	5	MED	11-Jan-17	01-Aug-17	-202	0	XX
31555M0330	Construction Substantially Complete (excluding precommissioning)	4	AFS	21-Mar-17	10-Aug-17	-142	0	XX
31555M0120	All Commissioning Complete.Final In Service Declaration Complete	4	CMF	19-Apr-17	14-Dec-17	-239	0	XX
31555PED20	Project Completion (AFS) - JV	4	AFS	19-Apr-17	14-Dec-17	-239	0	XX
31555M0130	Project Close-out Complete	4	PCO	23-May-17	15-Jan-18	-237	0	XX
31555M0240	Final Completion / Project Closeout	4	PCO	23-May-17	23-Feb-18	-276	-35	XX
31555PED30	Project Close out complete	4	PCO	23-May-17	23-Feb-18	-276	-35	XX

Legend:					
✓✓	Completed Early/On Time	-	On Track	X	At Risk
✓	Completed Late			XX	Missed

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
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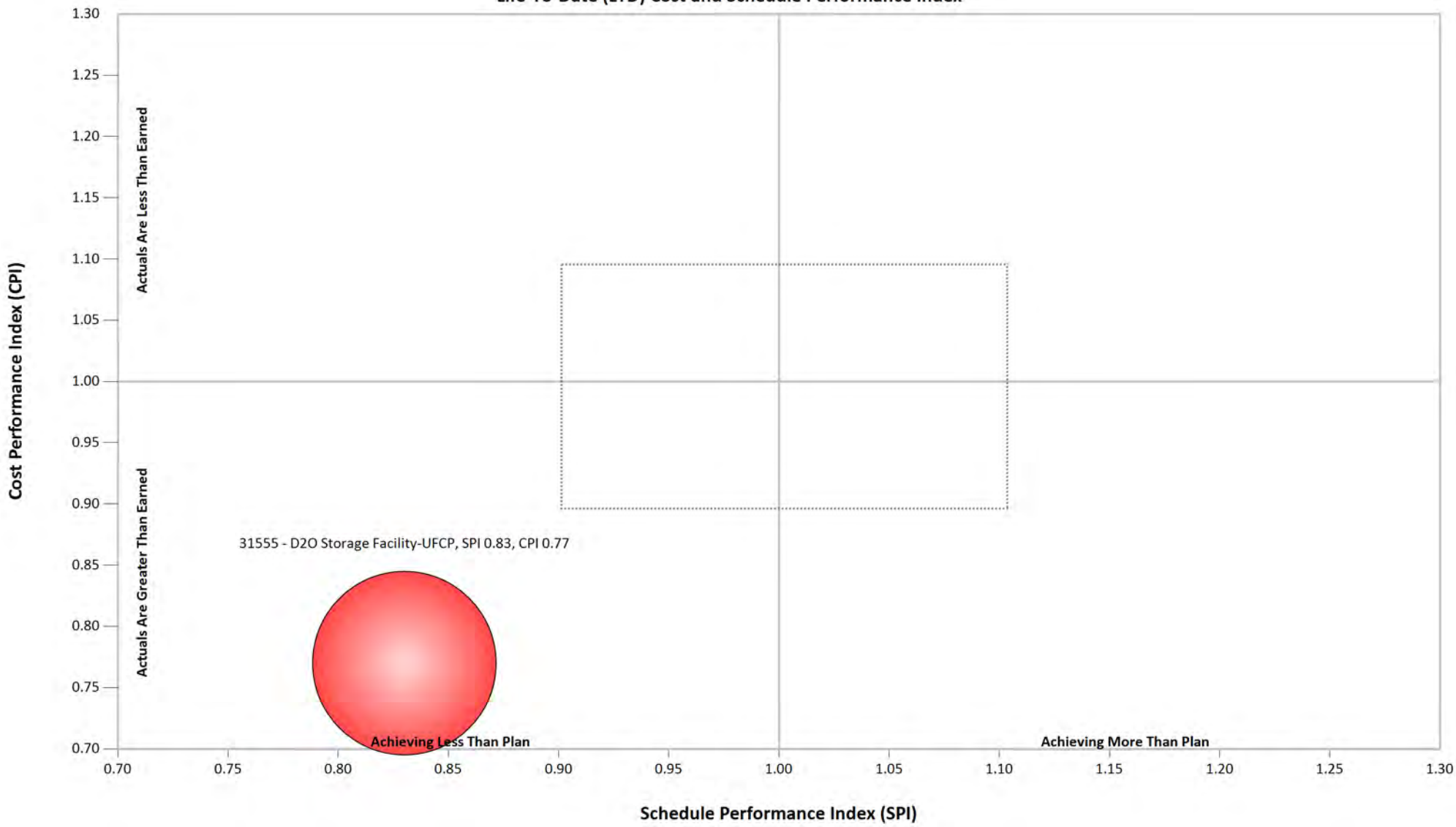
Period Ending: February 2018

Life-To-Date (LTD) Cost and Schedule Performance Index



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

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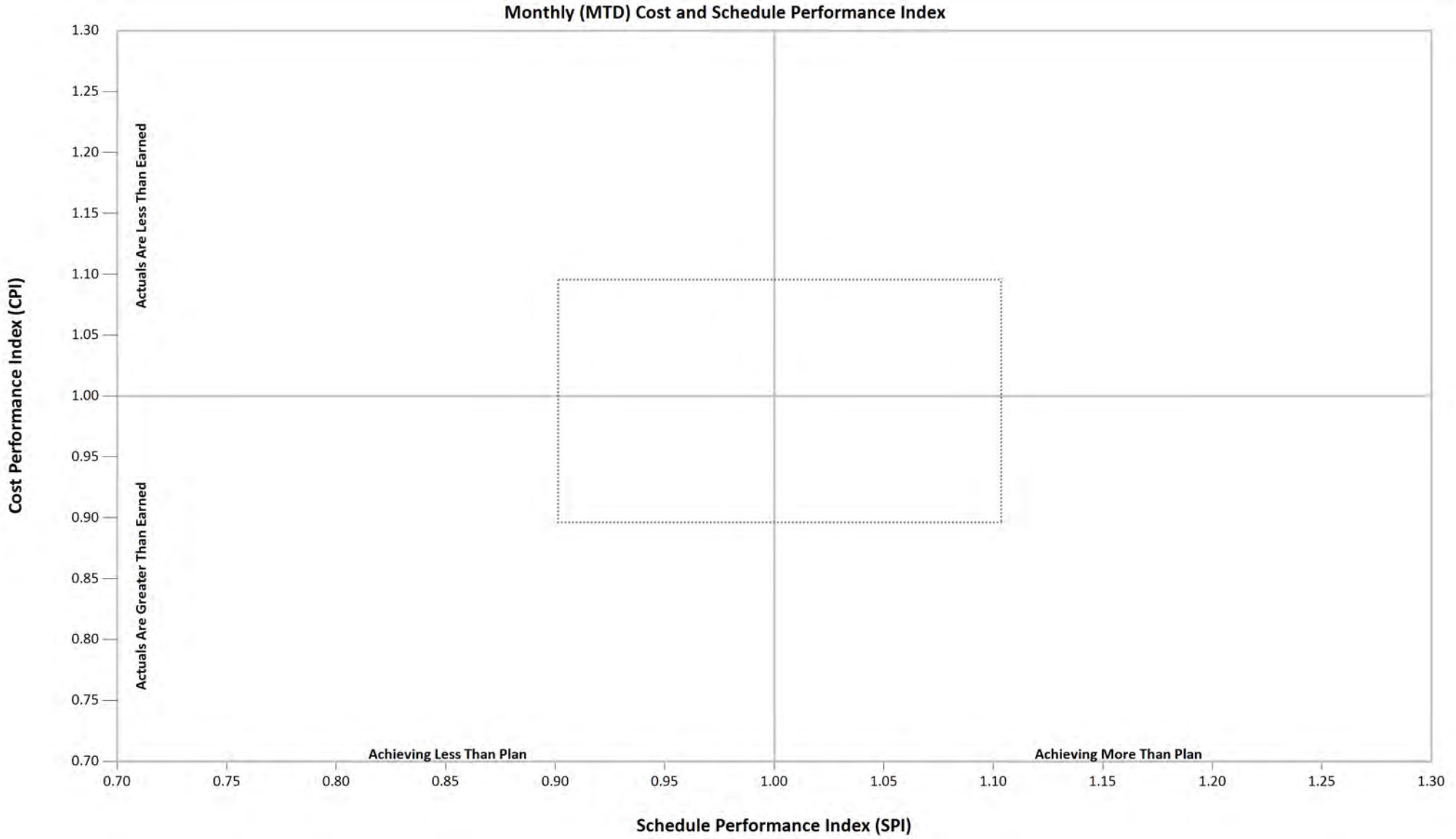
Process Owner: Multiple
Period Ending: February 2018



Legend:	Poor	Moderate	Good	Excellent	Good	Moderate	Last Month's
	< 0.91	0.91 - 0.94	0.95 - 1.00	1.01 - 1.05	1.06 - 1.09	> 1.09	Performance

Note 1: Colours on the chart select the worst performing colour between SPI and CPI values.
Note 2: Bubble Chart Labels: Project, SPI, CPI
Note 3: SPI Based on Cost data

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

		This Period							Cumulative (Life-To-Date)							Life Cycle
		a	*b*	*c*	*d = b - c*	*e = b - a*	*f = b / c*	*g = b / a*	*h*	*i*	*j*	*k = i - j*	*l = i - h*	*m = i / j*	*n = i / h*	*o*
Line #	Description	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)	Earned (EV)	Actual (AC)	Cost Variance	Schedule Variance	CPI[1]	SPI[1]	Plan (CB)
Top Projects Driving Overall SPI and CPI									↓							
1	31555 - D2O Storage Facility-UFCP	0	0	(1,172)	1,172	0	0.00	-	241,132	201,096	262,587	(61,490)	(40,036)	0.77	0.83	241,132
Top Projects Driving SPI Negative Performance													↓			
1	31555 - D2O Storage Facility-UFCP	0	0	(1,172)	1,172	0	0.00	-	241,132	201,096	262,587	(61,490)	(40,036)	0.77	0.83	241,132
Top Projects Driving CPI Negative Performance												↓				
1	31555 - D2O Storage Facility-UFCP	0	0	(1,172)	1,172	0	0.00	-	241,132	201,096	262,587	(61,490)	(40,036)	0.77	0.83	241,132
	Total	**0**	**0**	**(1,172)**	**1,172**	**0**	**0.00**	**-**	**241,132**	**201,096**	**262,587**	**(61,490)**	**(40,036)**	**0.77**	**0.83**	**241,132**

[1] CPI and SPI are calculated on Control Budget Deliverable Based work packages only.

ONTARIO POWER GENERATION

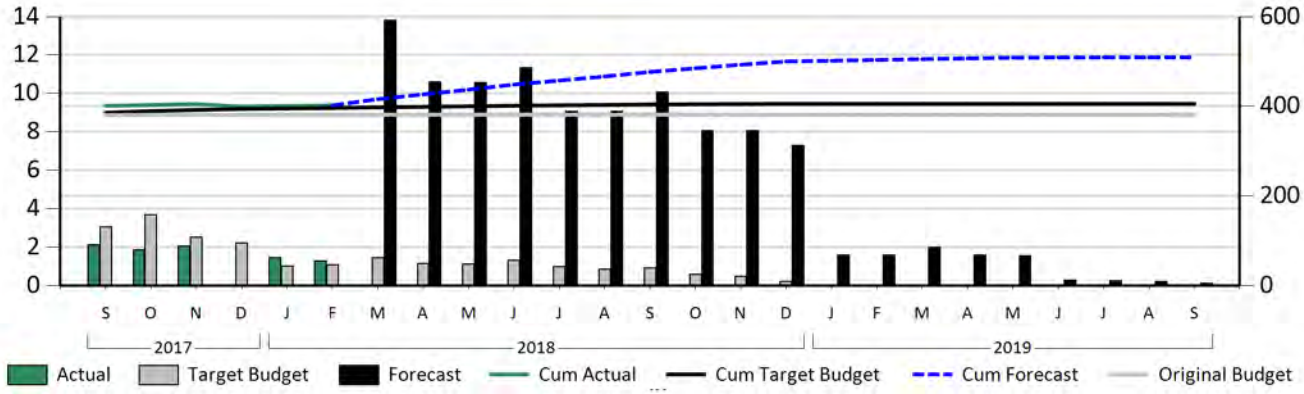
Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

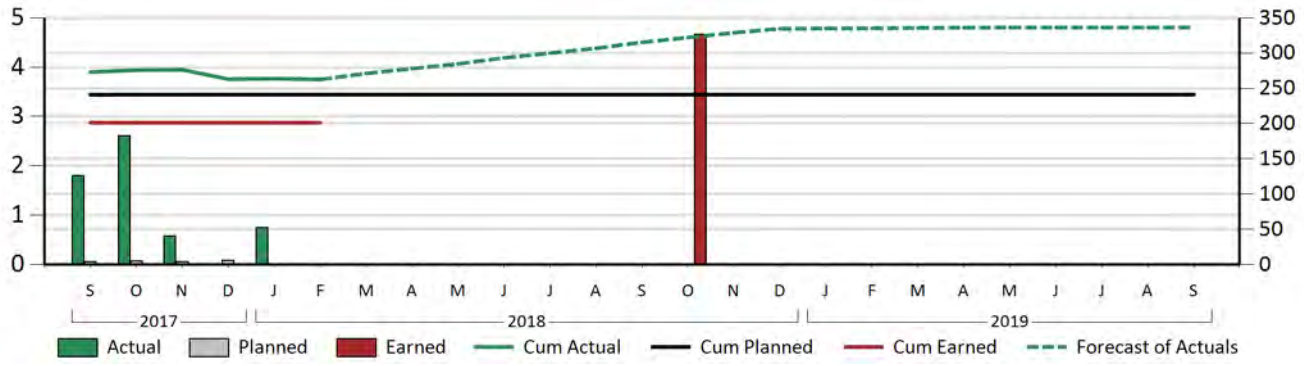
100% = 61% + 39%

COST PERFORMANCE *($ MILLIONS) - ALL WORK PACKAGES*



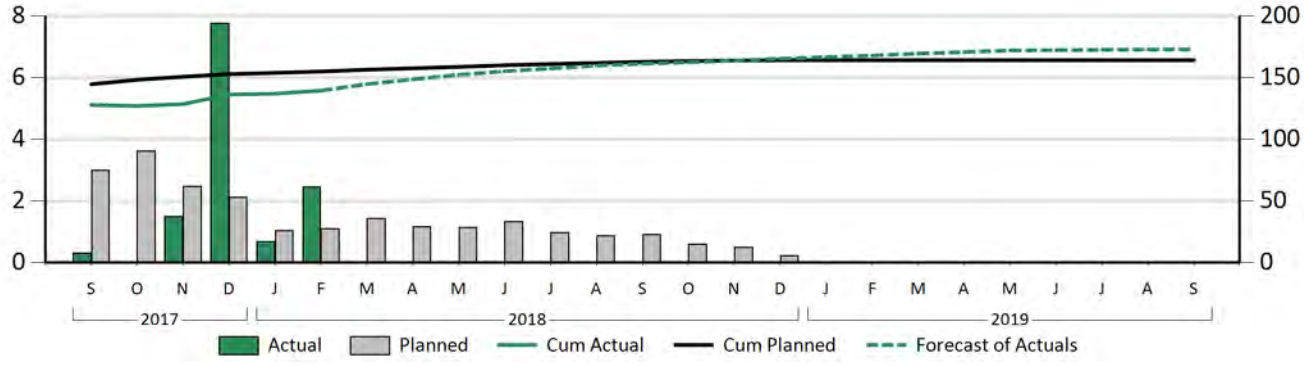
Life-To-Date	
Original Budget	381,174
Target Budget	396,025
Actual	401,929
Variance-to-Target Budget	5,903
% of Target Budget Spent	101%
Funding Released to Projects	380,496

EARNED VALUE MANAGEMENT *($ MILLIONS) - DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	241,132
Earned Value	201,096
Actual	262,587
Variance-to-Planned Value	21,454
Cost Performance Index	0.77
Schedule Performance Index	0.83

COST PERFORMANCE *($ MILLIONS) - NON DELIVERABLE BASED WORK PACKAGES*



Life-To-Date	
Planned Value	154,893
Actual	139,342
Variance-to-Planned Value	(15,551)

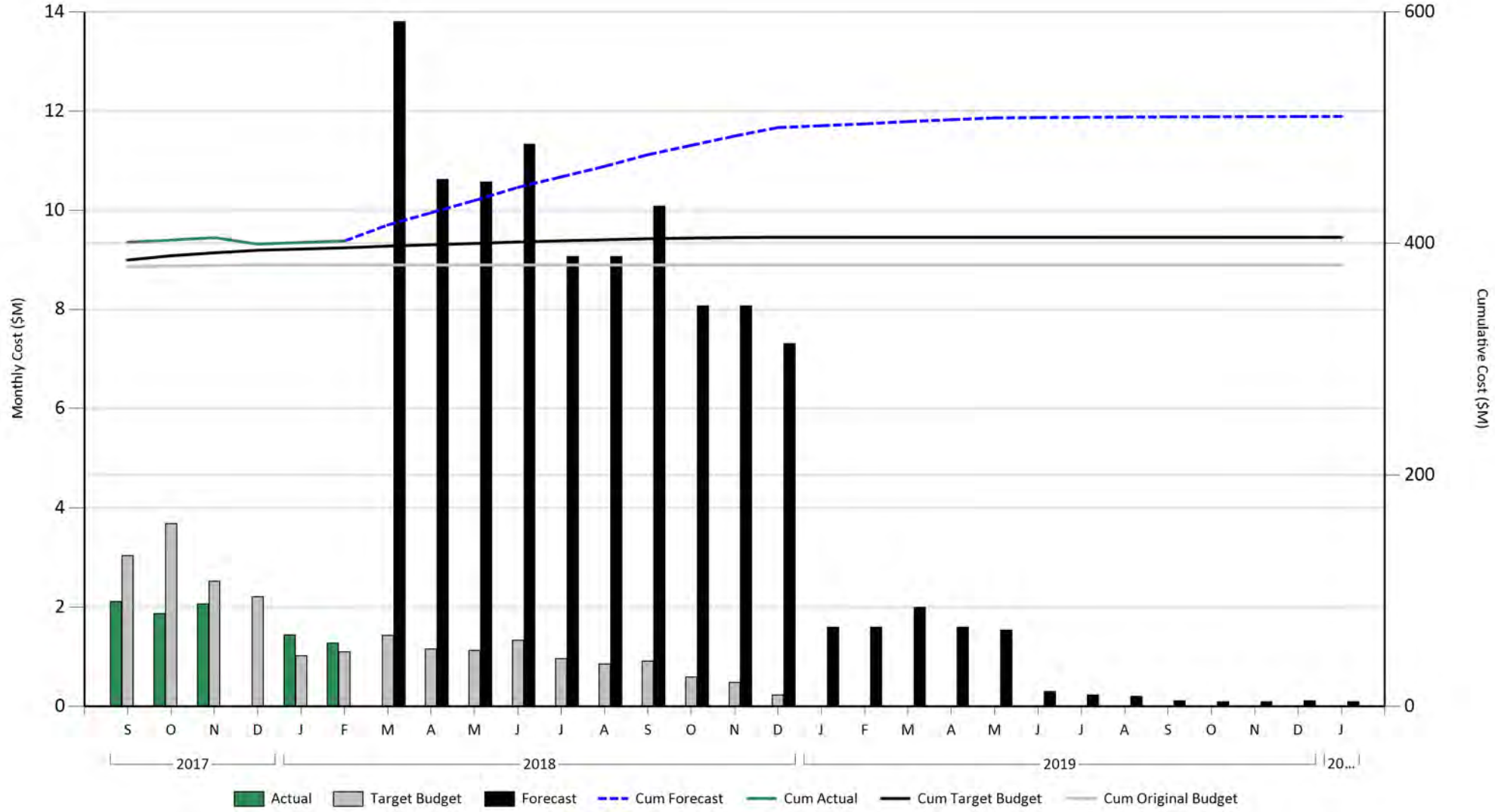
ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

COST CURVE *($ MILLIONS) - Units: U2, U4, US, U1, U3, UD, UF, U0*



Life Cycle Budget		Cumulative (Life-To-Date)			Forecast = Estimate at Completion		
Original Budget	Target Budget	Target Budget	Actual	Cost Variance	ETC	EAC	Var. FromTarget
381,174	405,174	396,025	401,929	5,903	108,084	510,013	104,839

ONTARIO POWER GENERATION

Monthly Project Status Report - Month End February 2018

F&IP - D2O Storage Facility

Report ID: 0106A *Tech Tips*
Report Owner: R. Hall
Process Owner: Multiple
Period Ending: February 2018

		Life Cycle Budget					This Period			Cumulative (Life-To-Date)				Forecast = Estimate at Completion			
		a	*b*	*c = a + b*	*d*	*e = c + d*	*f*	*g*	*h = g - f*	*i*	*j*	*k*	*l = k - j*	*m*	*n = k + m*	*o = n - e*	*p*
Line #	Description	Original Budget	Directed Changes[2]	Control Budget	Non Directed Changes[2]	Target Budget	Target Budget	Actual	Cost Variance	Original Budget	Target Budget	Actual	Cost Variance To Target Budget	ETC	EAC	Variance from Target Budget	Variance to EAC over Period
	3 - Engineering	2,830	967	3,797	-	3,797	-	7	7	2,830	3,797	1,891	(1,906)	-	1,891	(1,906)	7
1	**OPG Design Support in Vendor Project**	**2,830**	**967**	**3,797**	**-**	**3,797**	**-**	**7**	**7**	**2,830**	**3,797**	**1,891**	**(1,906)**	**-**	**1,891**	**(1,906)**	**7**
	0 - Cost Management	44,927	(7,175)	37,752	12,683	50,435	1,104	-	(1,104)	44,927	41,287	24,490	(16,796)	21,675	46,165	(4,270)	5,000
	1 - Project Management	6,562	3,119	9,681	-	9,681	-	75	75	6,562	9,681	11,326	1,645	2,610	13,937	4,255	75
	4 - Procurement	13,940	(7,444)	6,496	-	6,496	-	52	52	13,940	6,496	6,990	494	1,500	8,490	1,994	1,552
	6 - Commissioning	378	244	621	-	621	-	16	16	378	621	278	(344)	5,415	5,692	5,071	16
2	**OPG Non Design Support in Vendor**	**65,806**	**(11,256)**	**54,550**	**12,683**	**67,233**	**1,104**	**143**	**(961)**	**65,806**	**58,085**	**43,084**	**(15,001)**	**31,199**	**74,284**	**7,050**	**6,643**
	0 - Cost Management	1,869	(1,869)	-	-	-	-	-	-	1,869	-	-	-	-	-	-	-
	1 - Project Management	4,388	3,917	8,305	-	8,305	-	1	1	4,388	8,305	8,821	517	-	8,821	517	1
	3 - Engineering	23,314	1,117	24,431	-	24,431	-	130	130	23,314	24,431	24,000	(431)	2,731	26,731	2,300	130
	4 - Procurement	20,263	8,097	28,360	-	28,360	-	-	-	20,263	28,360	28,236	(124)	-	28,236	(124)	-
	5 - Construction	84,180	(8,888)	75,292	-	75,292	-	-	-	84,180	75,292	75,646	354	-	75,646	354	-
	9 - Closeout	375	(2)	374	-	374	-	-	-	375	374	374	-	261	635	261	-
3	**Vendors Managed by Projects and**	**134,390**	**2,372**	**136,761**	**-**	**136,761**	**-**	**131**	**131**	**134,390**	**136,761**	**137,077**	**316**	**2,992**	**140,070**	**3,308**	**131**
	0 - Cost Management	1,306	94	1,401	-	1,401	-	-	-	1,306	1,401	1,401	-	-	1,401	-	-
	5 - Construction	28,198	664	28,862	-	28,862	-	-	-	28,198	28,862	28,862	-	-	28,862	-	-
4	**Ellis Don Under P&M**	**29,504**	**758**	**30,262**	**-**	**30,262**	**-**	**-**	**-**	**29,504**	**30,262**	**30,262**	**-**	**-**	**30,262**	**-**	**-**
	1 - Project Management	121	(1)	120	-	120	-	-	-	121	120	120	-	-	120	-	-
	5 - Construction	6,157	1,365	7,523	-	7,523	-	23	23	6,157	7,523	7,619	97	-	7,619	97	23
5	**ESFOX Under PM**	**6,278**	**1,365**	**7,643**	**-**	**7,643**	**-**	**23**	**23**	**6,278**	**7,643**	**7,739**	**97**	**-**	**7,739**	**97**	**23**
	0 - Cost Management	-	-	-	210	210	-	-	-	-	210	1	(209)	-	1	(209)	-
6	**SNC AECON JV Under P&M**	**-**	**-**	**-**	**210**	**210**	**-**	**-**	**-**	**-**	**210**	**1**	**(209)**	**-**	**1**	**(209)**	**-**
	0 - Cost Management	2,282	922	3,204	1	3,205	-	107	107	2,282	3,205	2,568	(637)	-	2,568	(637)	107
	1 - Project Management	20,870	5,318	26,189	3,022	29,211	-	1,029	1,029	20,870	29,211	31,644	2,433	5,000	36,644	7,433	6,029
	3 - Engineering	15,438	446	15,883	152	16,036	-	249	249	15,438	16,036	25,051	9,015	-	25,051	9,015	249
	4 - Procurement	36,000	(72)	35,929	3,442	39,371	-	7,784	7,784	36,000	39,371	43,298	3,927	-	43,298	3,927	7,784
	5 - Construction	67,245	(816)	66,429	4,489	70,918	-	(7,955)	(7,955)	67,245	70,918	88,286	17,368	68,892	157,178	86,260	(9,230)
	6 - Commissioning	531	(4)	527	-	527	-	-	-	531	527	-	(527)	-	-	(527)	-
	U - Unallocated Cost	-	-	-	-	-	-	(251)	(251)	-	-	(8,983)	(8,983)	-	(8,983)	(8,983)	(251)
7	**SNC AECON for ESMSA under PM**	**142,366**	**5,794**	**148,160**	**11,107**	**159,267**	**-**	**962**	**962**	**142,366**	**159,267**	**181,864**	**22,597**	**73,892**	**255,756**	**96,489**	**4,687**
	3 - Engineering	-	-	-	-	-	-	9	9	-	-	9	9	-	9	9	9
8	**TETRA TECH WEI INC**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**9**	**-**	**-**	**9**	**9**	**-**	**9**	**9**	**9**
	Nuclear Refurbishment	**381,174**	**-**	**381,174**	**24,000**	**405,174**	**1,104**	**1,275**	**171**	**381,174**	**396,025**	**401,929**	**5,903**	**108,084**	**510,013**	**104,839**	**11,500**

Note: [1] All Values Include Interest and Escalation
[2] Direct Changes are PCA's (Project Change Authorization) which are OPG directed changes to scope. Non-Directed Changes are CTP's (Consent To Proceed) which are Contractor forecasts that exceed cost targets.

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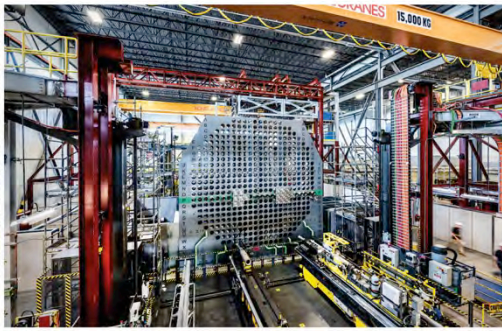
D20 Project Update

June 20th, 2018



Safety
Quality
Schedule
Cost

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BWXT Canada Ltd.
FOX CONSTRUCTORS
SNC·LAVALIN Nuclear
AECON Joint Venture

ONTARIO POWER GENERATION

D20: Safety / Quality

D20 Safety Report: *Week ending June 15th*

D2O WEEKLY SAFETY REPORT										
Job site	Week Ending	Injuries				LTIs	Incidents/damage		Spills	Safety
		Recordable	Non-Recordable	First Aids	Report Only		Equip/tools	Property/material	Environmental	Opportunity
D2O - Aecon	10-Jun-18	0	0	0	0	0	0	0	0	0
Sub-contractors										
Safway	10-Jun-18	0	0	0	0	0	0	0	0	0
Culliton	10-Jun-18	0	0	0	0	0	0	0	0	0
Mammoet	10-Jun-18	0	0	0	0	0	0	0	0	0
Total	10-Jun-18	0	0	0	0	0	0	0	0	0

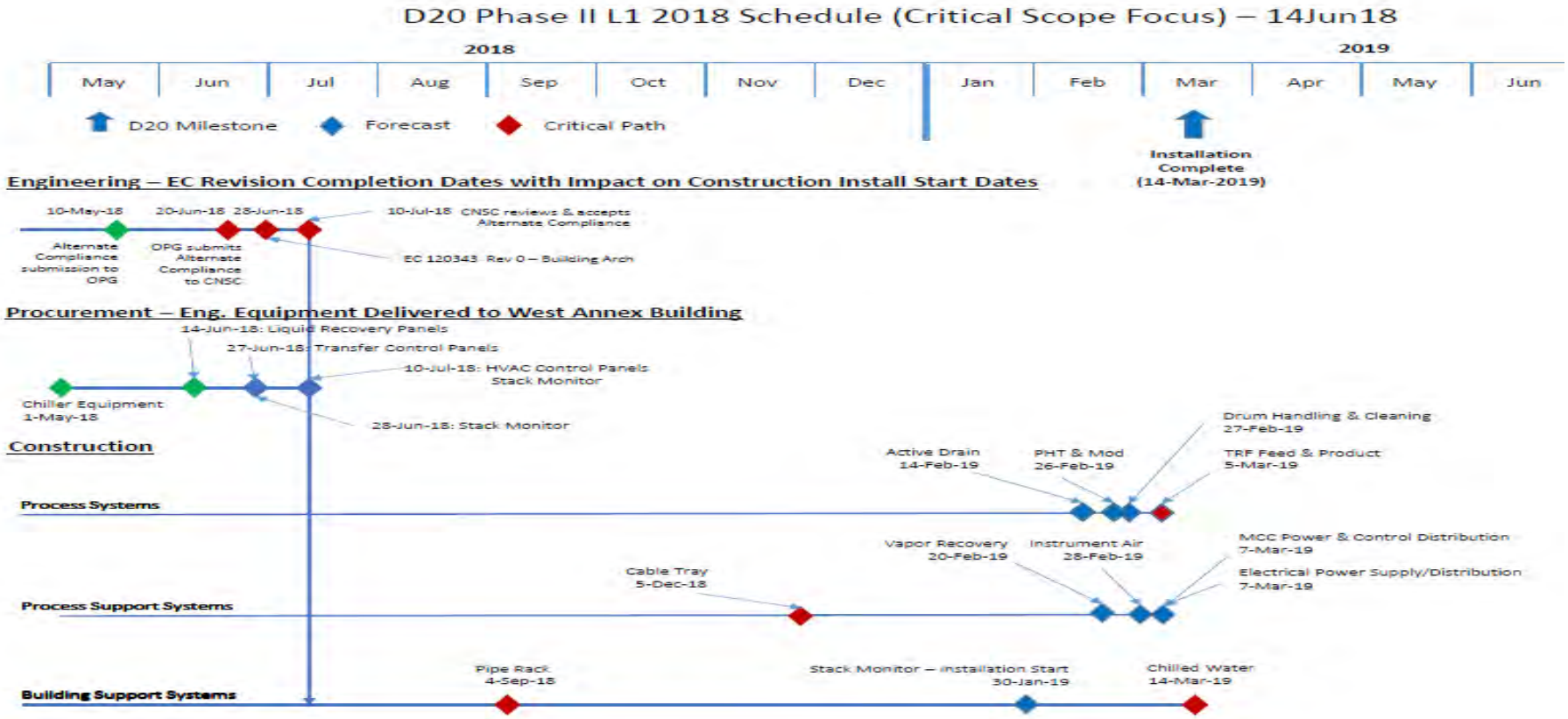
Weekly Incident Summary None to report

QUALITY

	NCR/CORRECTIVE ACTIONS/SCAR/NCAR						
	Initiated		Completed		Backlog		
As at 06/03/18	Week	Last 4 week Avg	Week	Last 4 week Avg	Open	Open Pending Construction Completion	Overdue
NCAR	0	0	0	0	0	0	0
CARs/Proact (CA)	0	0.25	2	0.75	5	0	4
Field NCRs	0	0	2	3.25	90	90	0

ONTARIO POWER GENERATION

Schedule: Key Dates



D20 Project Key Dates-

Construction Completion:	March 2019
Pre / Commissioning Start:	February 2019
Commissioning H20 End:	May 2019
Partial AFS:	Q2 2019

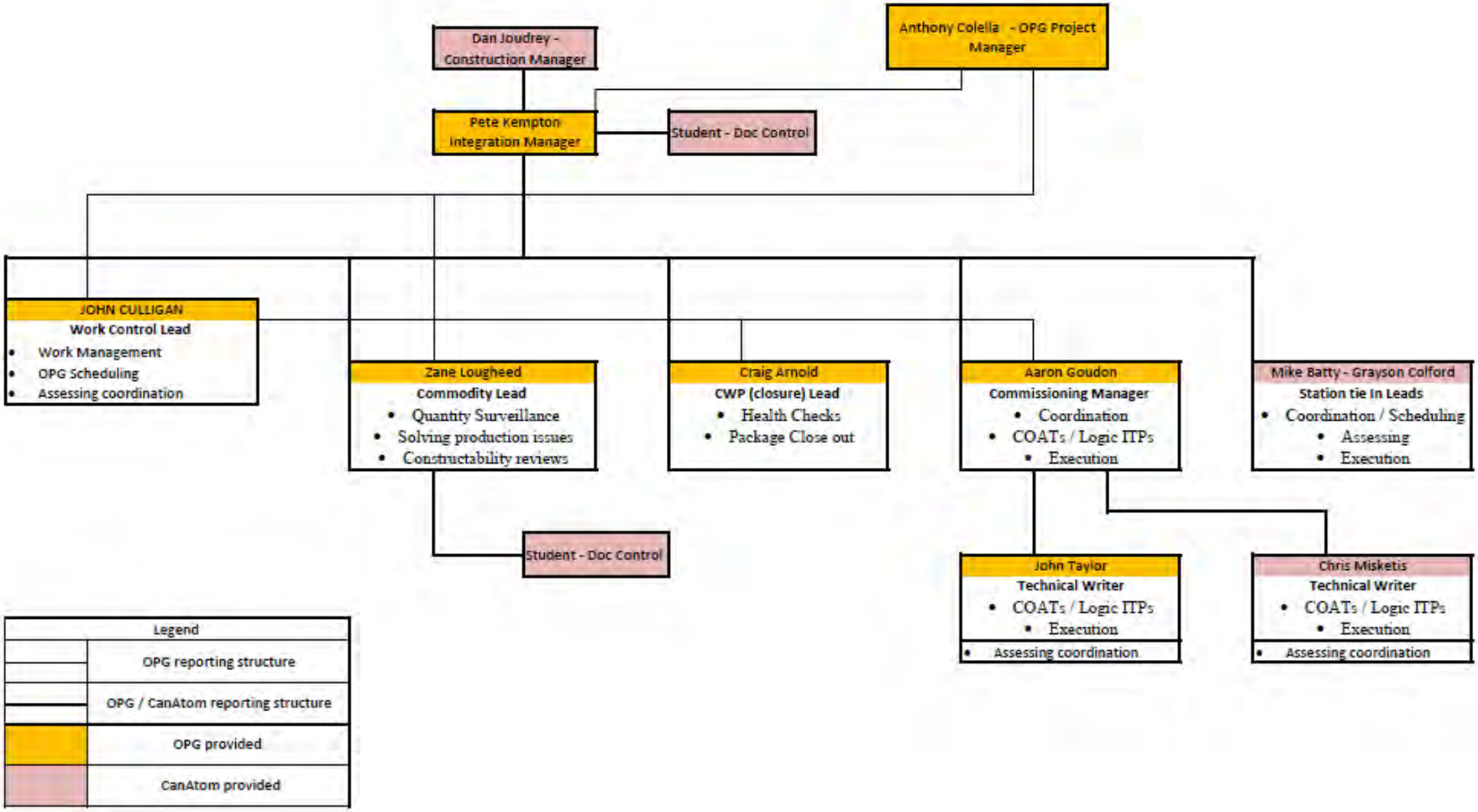
ONTARIO POWER GENERATION

D20 Key Risks

Project Key Risks (June 2018):

- CanAtom Pre-Commissioning / COATs
- CWP Focus: Material readiness / Work Planning
- CanAtom Document Closeout Deliverables Planning (CWP & IPT Quality)

Integrated Team



ONTARIO POWER GENERATION

Schedule: Manpower Ramp-up

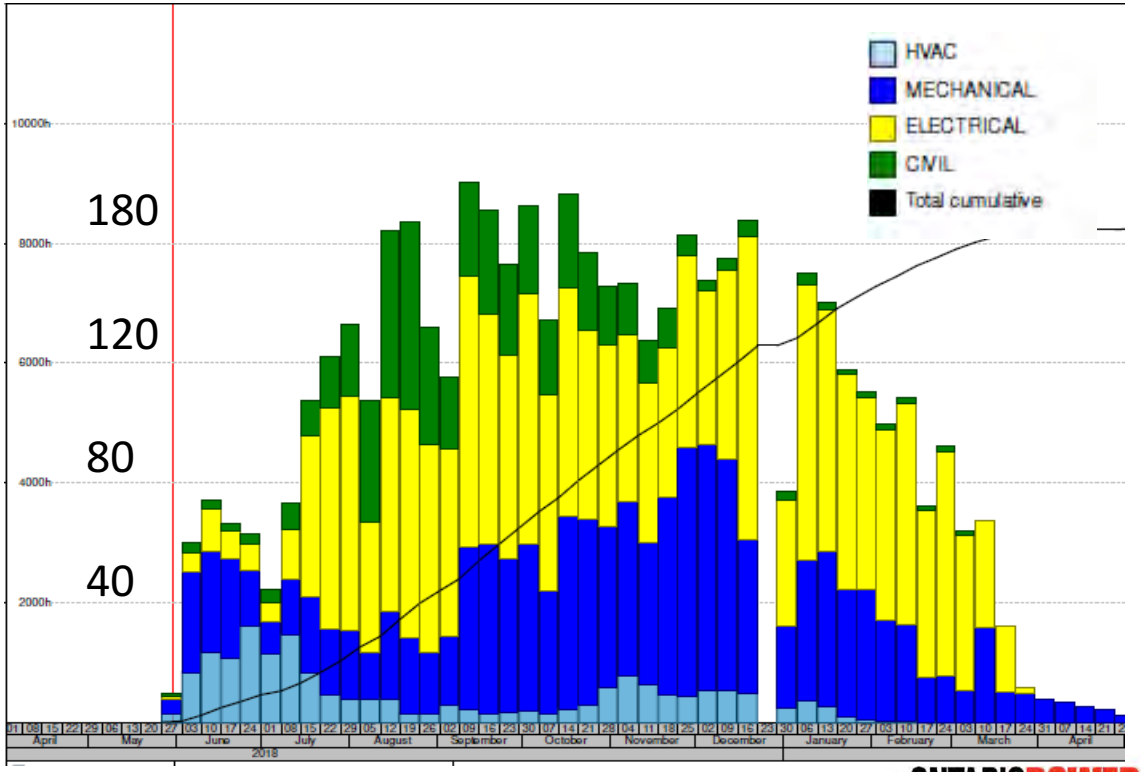
Current Project Direct Manpower: June 19th

PF = PIPEFITTER
E = ELECTRICIAN
MW = MILLWRIGHT
IW = IRONWORKER
OE = OPERATOR ENGINEER
C = CARPENTER
L = LABOURER
BL -BLOCK LAYER
P - PAINTER
SUB = SUBTRADE

DAILY WORK FORCE	PF	E	BL	P	IW	OE	C	L	SUB	TOTAL WORK
Foreman	4	2	0	1	1	0	0	1	2	11
Sub Foreman	7	2	0	0	1	0	0	0	1	11
Journeyman	28	11	1	4	1	1	2	4	5	57
Apprentice	7	2	0	0	0	0	0	0	1	10
Total	46	17	1	5	3	1	2	5	9	89

Key D20 Planning Changes:

- Maximum Building Efficiency Limited to 100 Craft per shift
- Restructured the Schedule: accounted for two shifts @ 5days a week, 10 hours per day (from 4x10's partial one shift)

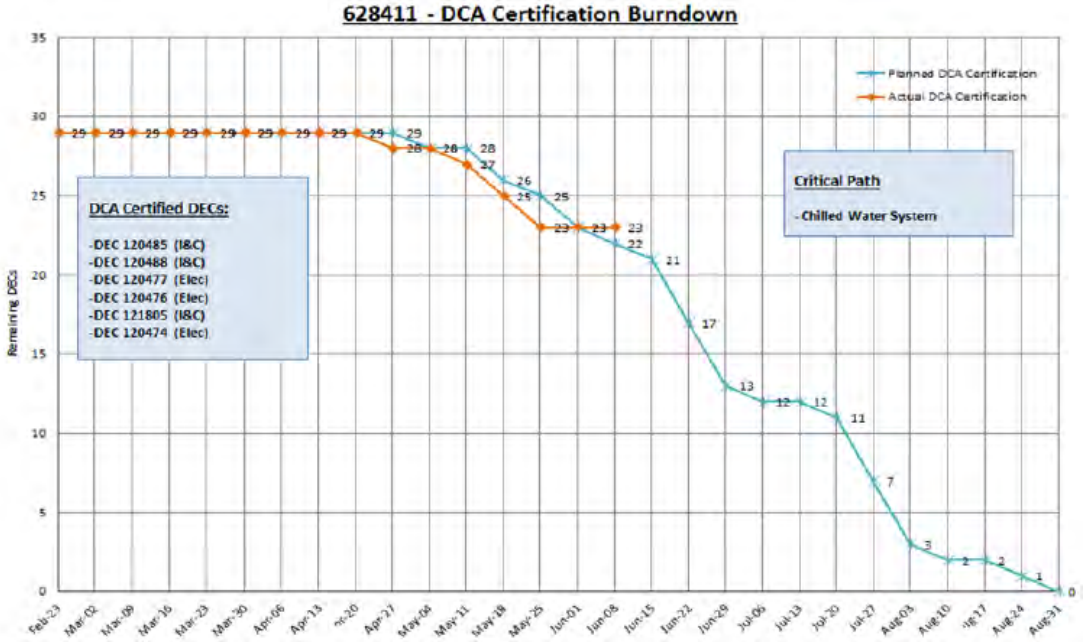


ONTARIO POWER GENERATION

Engineering: EC & CWP Update

D20 Phase 2 Engineering:

- Currently 23 outstanding EC's affecting CWP's
- On schedule for June's Month end EC delivery commitments (bulk of effort)

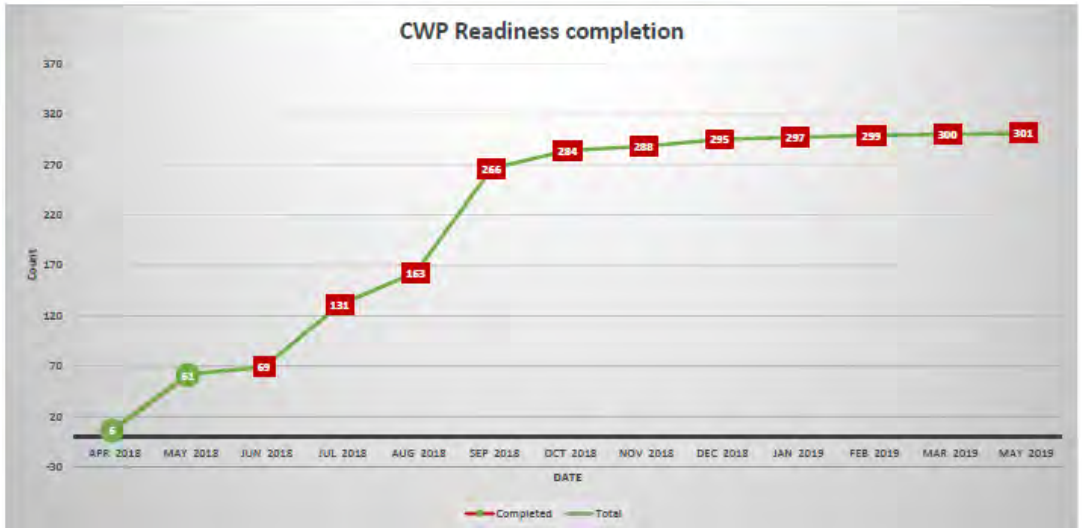


D20 Phase II CWP Readiness for Installation

In Progress - CWPs currently undergoing the readiness process, with an installation start date in the indicated month

Forecast - CWPs that will start the readiness process and be ready for installation start within the indicated month

Completed - CWPs that have completed the readiness process and are currently being installed

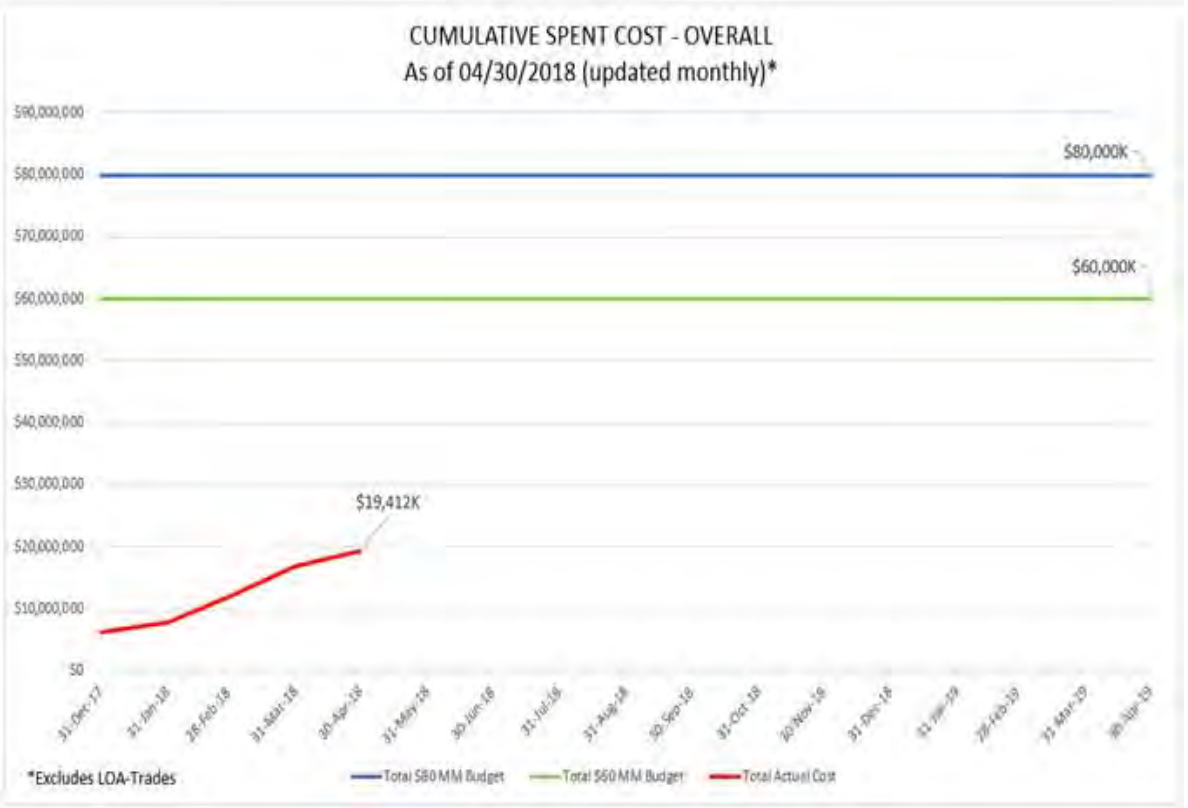


Cost: CanAtom Burn Rate & OPG Spend

D20 Cost Forecast:

- Current Forecast / BCS with Management Reserve: $510M
- Current OPG Internal Spend: $1.3M per month

CanAtom D20 Phase 2 Burn Rate



ONTARIO POWER GENERATION

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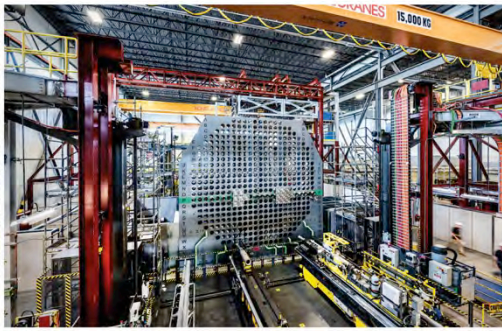
D20 Project Update

Sept 21st, 2018



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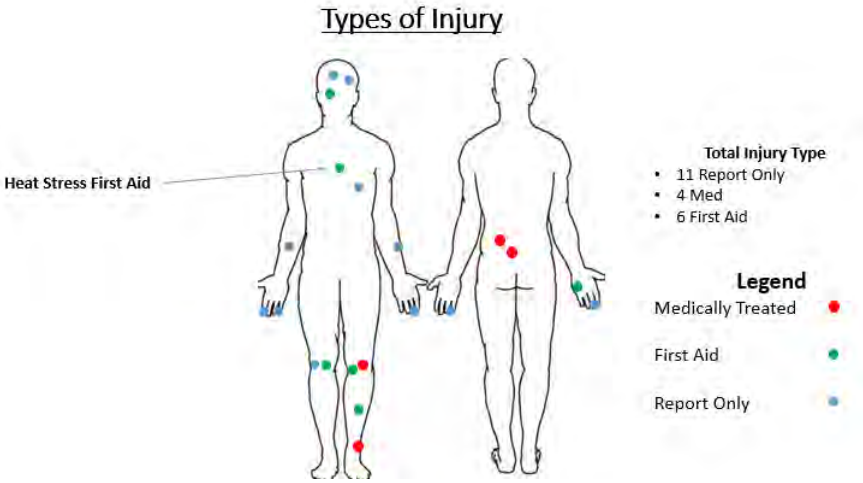
AECON Joint Venture

ONTARIO POWER GENERATION

Safety Trend (August/Sept)

HWMB West Annex (D2O Project) – Safety Snapshot

2017		2018	
Q1 Hours	218,072	Q1 Hours	67,097
Q2 Hours	23,911	Q2 Hours	76,158
Q3 Hours	19,561	Q3 Hours	77,507 (to date)
Q4 Hours	50,168	Q4 Hours	TBD
Total Hours	311,712	Total Hours (To Date)	220,762
Medically Treated Injuries (MTI)	3	Medically Treated Injuries (MTI)	1
2017 TRIF	1.92	2018 TRIF	0.91
2017 Q3-Q4 TRIF	8.6		
*All MTI occurred in Q4			* Projected hours for remainder of 2018 = 200,000 +



- **7 Safety Incidents over the past two months**

ACER	INCIDENT CLASSIFICATION	DATE	INJURY	Cause
ACE-18-14066	Report Only	Aug-15	Muscle Strain (Chest)	Material Handling (Scaffold)
ACE-18-14153	Medically Treated Injury	Aug-22	Back	Slip and Fall Same Level (Pulling Material Cart)
ACE-18-14198	Report Only	Aug-27	Finger	Stuck By (Hammer)
ACE-18-14310	First Aid	Sept-11	Strain/Sprain (Back)	Cable Pull/Overexertion
ACE-18-14373	First Aid	Sept-17	Strain (Elbow)	Overexertion (tie wrap on cable)
ACE-18-14384	Report Only	Sept-17	Back	Material Handling (water cooler jug)
ACE-18-14397	First Aid	Sept-18	Knee	Slip/Strain (Pushing Material Cart)

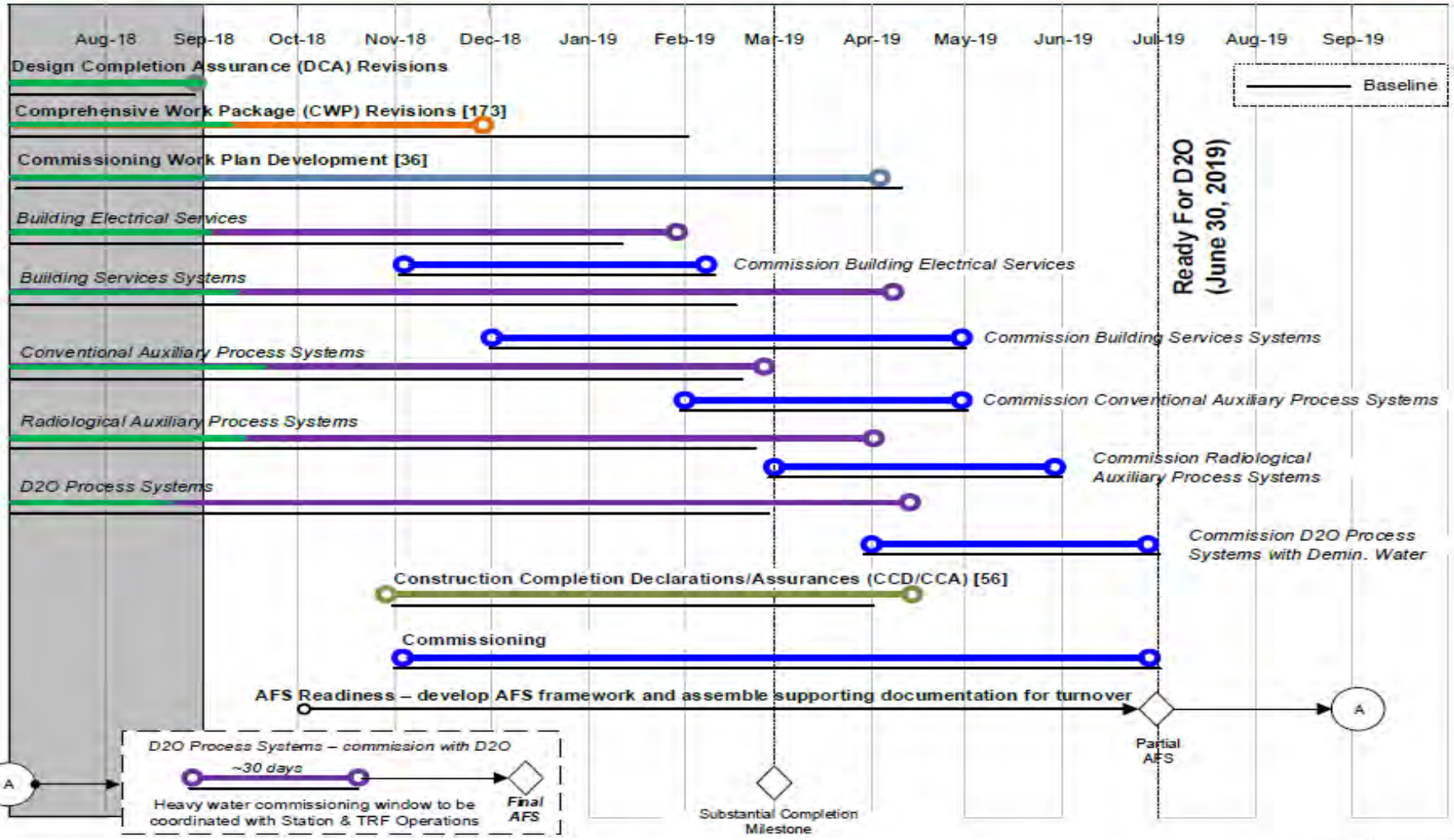
ONTARIO POWER GENERATION

Schedule : Level 0

ONTARIO POWER GENERATION

HWMB West Annex (Project 31555)
Executive Summary

August 2018 - Page 1



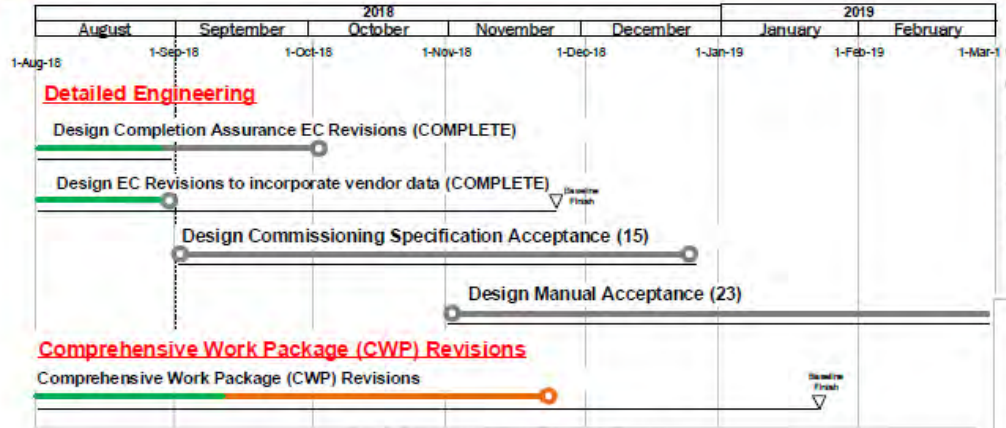
ONTARIO POWER GENERATION

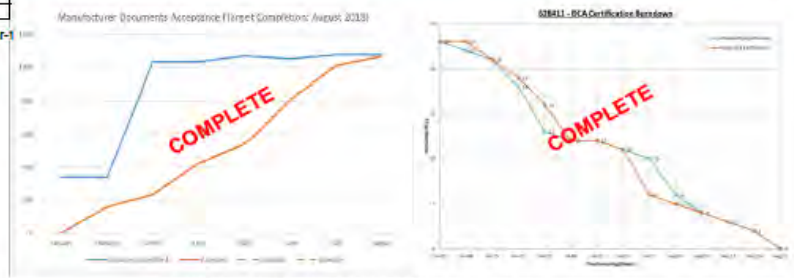
Key Workdown Curves

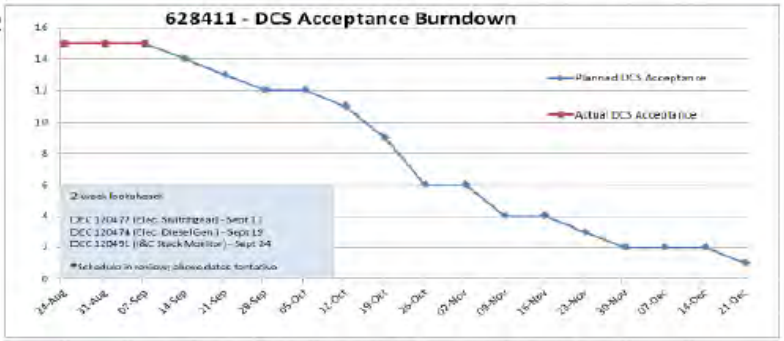
ONTARIO POWER GENERATION

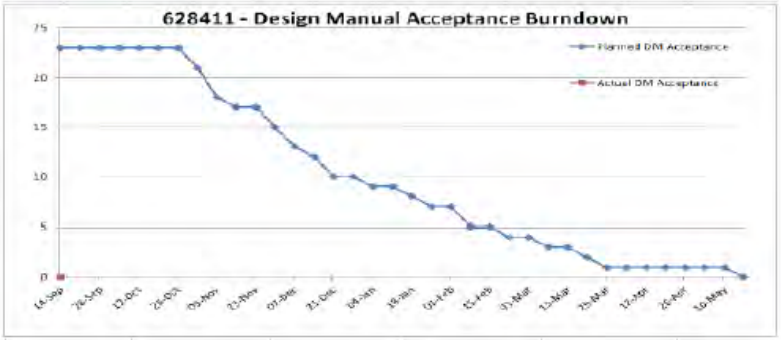
HWMB West Annex (Project 31555)
Engineering/Documentation Summary

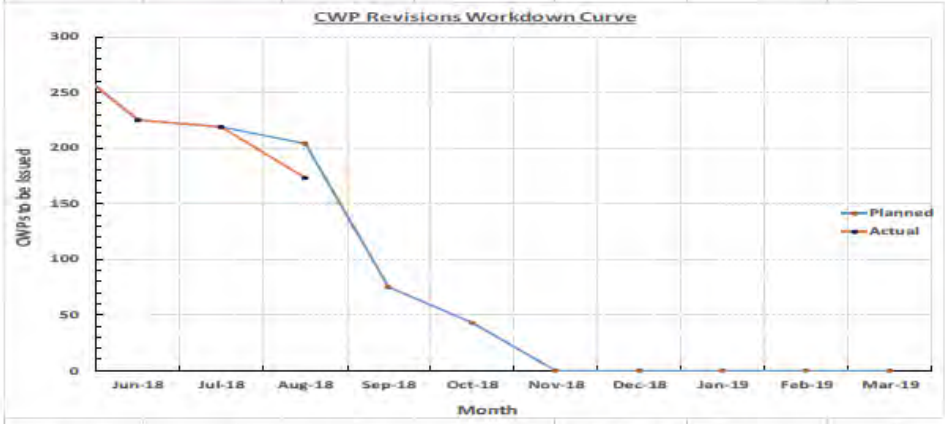
August 2018 - Page 2











Issued CWPs per month

Month	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19
# of CWPs (Planned)	0	60	6	15	98	32	43	0	0	0	0
CWPs remaining (Forecast)	285	225	219	204	75	43	0	0	0	0	0
# of CWPs (Actual)	0	60	6	46	0	0	0	0	0	0	0
CWPs remaining (Actual)	285	225	219	173	173	173	173	173	173	173	173

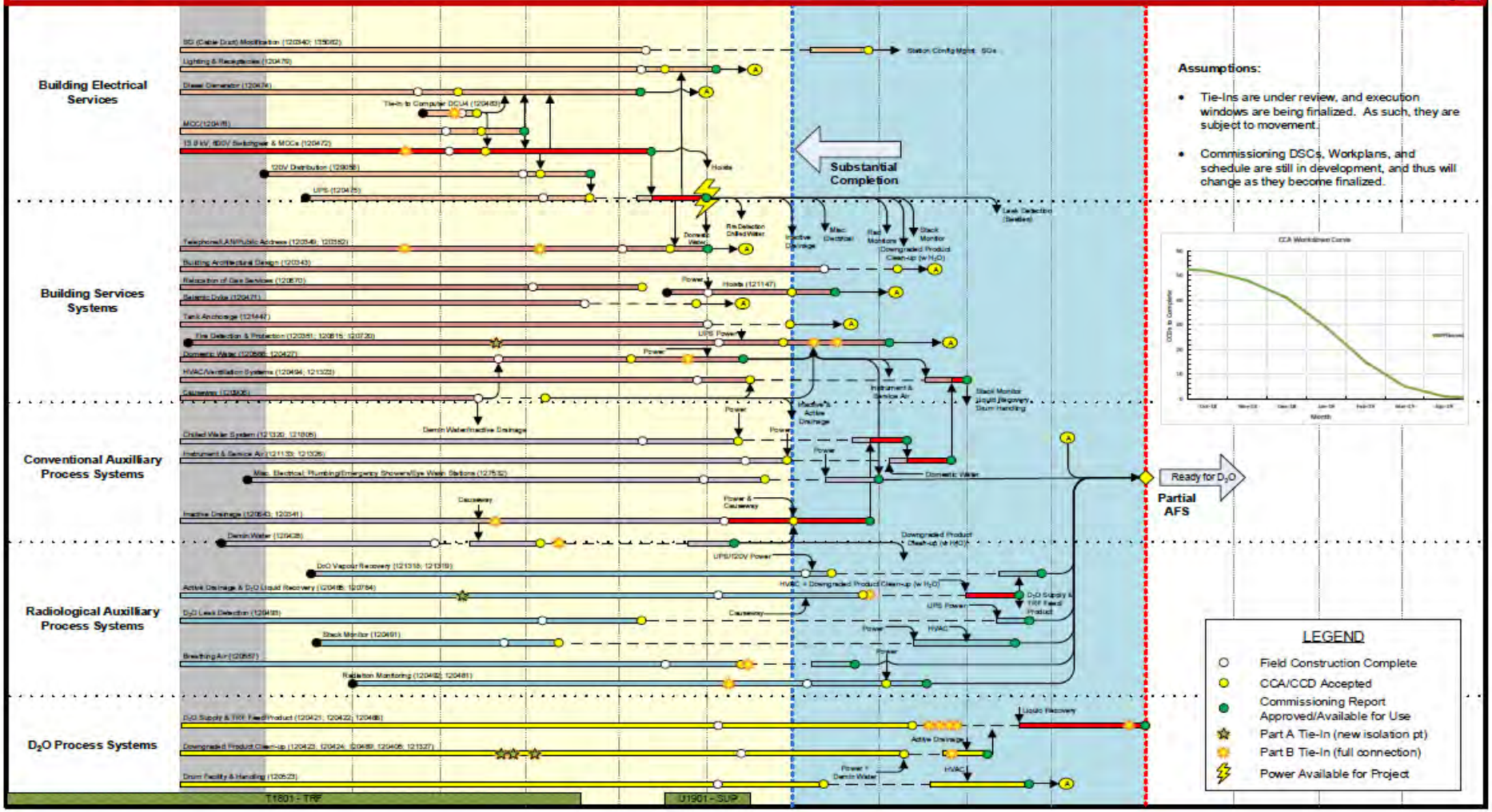
ONTARIO POWER GENERATION

Schedule Level 1 and CCD's

ONTARIO POWER GENERATION

HWMB West Annex (Project 31555)
Overall Level 1

Page 3



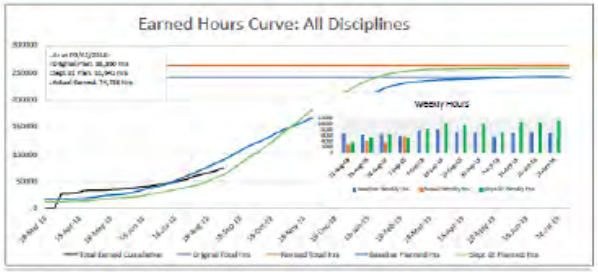
ONTARIO POWER GENERATION

Progression - Commodities

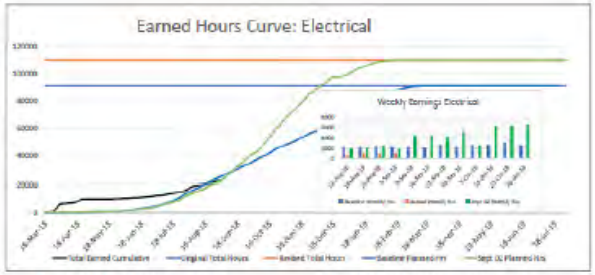
ONTARIO POWER GENERATION

HWMB West Annex (Project 31555)
Commodity Curves

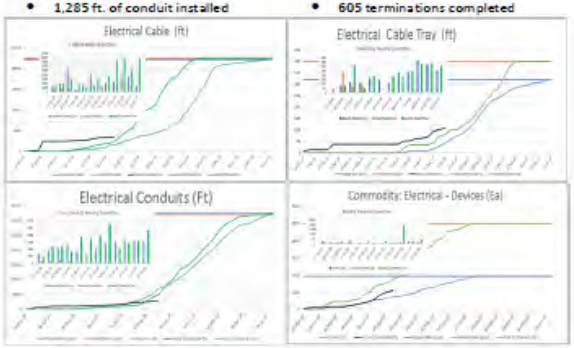
August 2018 - Page 5

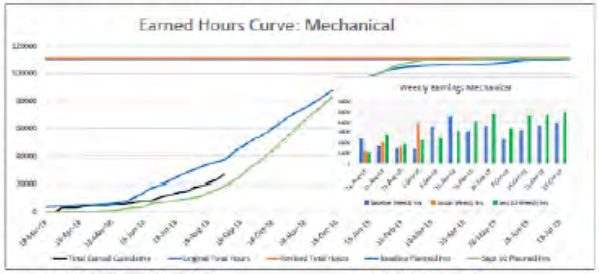


- Currently we have 141 workers on day and 29 workers on night shift.
- At peak there will be 220 construction personnel in the field.

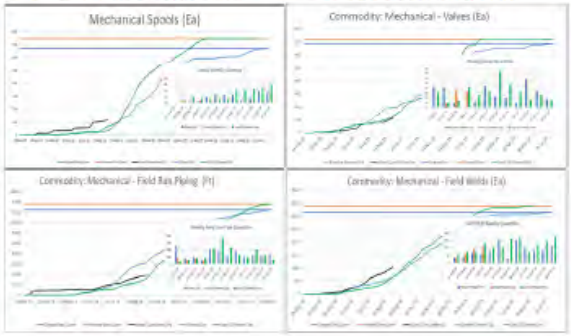


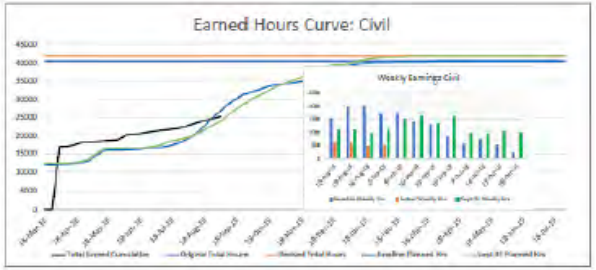
- 3,246 ft. of cable installed
- 1,285 ft. of conduit installed
- 392 ft. of cable tray installed
- 605 terminations completed



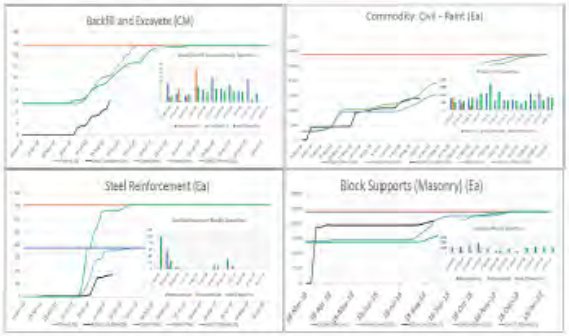


- 54 pipe spools installed
- 662 ft. of field run pipe installed
- 23 valves installed
- 272 field welds completed





- Work continues on block installation and west caison cutting



ONTARIO POWER GENERATION

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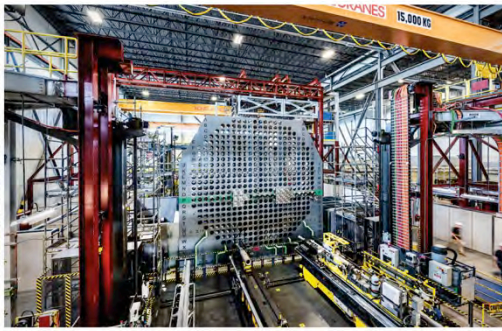
D20 Project Update

March 1st, 2019



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ONTARIO POWER GENERATION

D20 Project: Major Milestones

Milestone No.	Milestone	Milestone Status / Due Date
1	**Total Percent Complete**	95% Total Scope Completed (76% Phase 2 Remaining)
2	**Substantial Construction Completion** (95% Phase 2 Complete & Last CCA Date)	June 27th, 2019
3	**Construction Completion Status**	12 out of 54 Completed
4	**Construction Completion Assurances Packages**	8 out of 54 Completed
5	**Building Energized and Transition to Construction & Operating island**	March 11th, 2019 (Complete)
6	**Ready for D2O**	P75 – September 6th, 2019 P90 – September 27th, 2019
7	**D20 Building Required- U3 PHT/Mod**	March / April 2020

Overall CanAtom Productivity

Overtime Metric							
Category		Cumulative (Ph 2 Inception to Date)	2/3/2019	2/10/2019	2/17/2019	2/24/2019	3/3/2019
PMT/Eng. - Engineering Office	Regular Hours	113,281	1,555	1,628	1,530	1,530	1,415
	Overtime	4,637	170	16	150	150	140
	Ratio	4%	11%	1%	10%	10%	10%
PMT - Site/Construction	Regular Hours	166,838	4,733	2,567	4,440	2,217	3,957
	Overtime	24,487	1,066	651	1,164	552	802
	Ratio	15%	23%	25%	26%	25%	20%
DFL - Site/Construction	Regular Hours	375,361	9,559	9,237	8,610	6,829	8,298
	Overtime	82,165	3,292	2,810	2,863	3,036	3,155
	Ratio	22%	34%	30%	33%	44%	38%
	Weekly Spent Hours		12,851	12,046	11,473	9,865	11,453
	Weekly Earned Hours		6,436	5,326	4,456	4,521	4,754
	CPI		0.50	0.44	0.39	0.46	0.42

Note:
1) Commissioning hours are included in the total spent hours in the OT metrics shown above
2) Hours reported above exclude seconded QC resources (i.e., externally contracted support from Eaton & Schneider Electric)

ONTARIO POWER GENERATION

Main Project Risks & Mitigations

Top Project Risk:

- Schedule slippage leading to Cost growth

Supplementary risks and Mitigations include:

- Ability to complete punch list items to meet commissioning milestones due to focus on Construction Completion
  - *CanAtom assigned dedicated issues manager (Patrick Oliver) to address punch list items*

- Low Craft/Construction Productivity Index - Averaging CPI of 0.44 (realizing increased DFL cost from Q3 2018)
  - *Augmenting CanAtom electrical support with OPG direct hires to increase CPI productivity.*
    (Super attendant Support; Field Engineering Support – 4 Bodies)

- "Available For Service" readiness and sufficient Turnover Documentation (e.g., Flowsheets, CMPs, Equipment Load Verification Status)
  - *Additional resources being obtained to support AFS preparation & turnover*

Mitigating Risk Actions

Supplementary risks and Mitigations (continued):

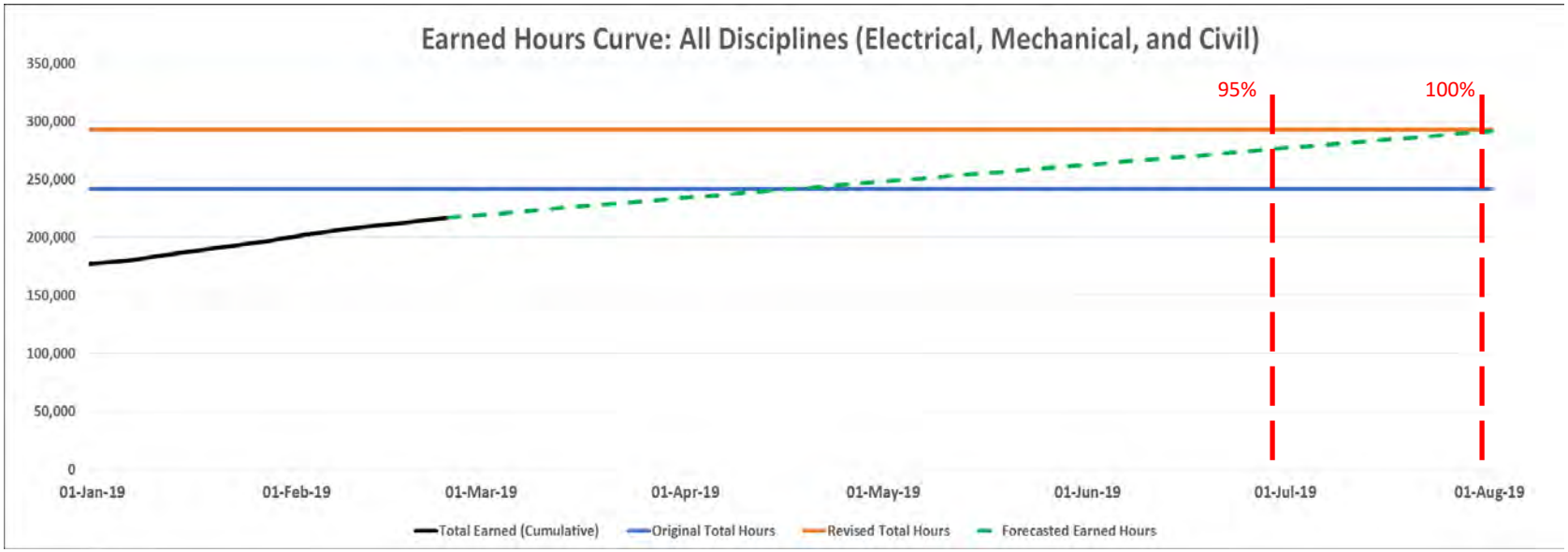
- TRF Operations availability to support remaining Tie-ins due to TRF Outage delays (T1801)
  - *Establishing priority with outage organization*

- OEM/Vendor support of site set-up and checks prior to commissioning.
  - *Purchase Order commitments are in-progress*

- Station Ice Plug crew support for passing isolations
  - *Engaging Pickering iceplug operator support for Iceplug applications for Active Drainage Commissioning*

- Commissioning / Discovery Issues
  - Commissioning milestones are being optimized to remove work scope for PHT, MOD, and TRF Feed/Product Commissioning

Construction Overview



2018 Q4 → 2019 Q1 Project Progression:

- Total D2O Construction Hours Remaining to Earn:
  70,300 Hours (Approximately **3,500 Hrs** Earned Weekly across all disciplines)

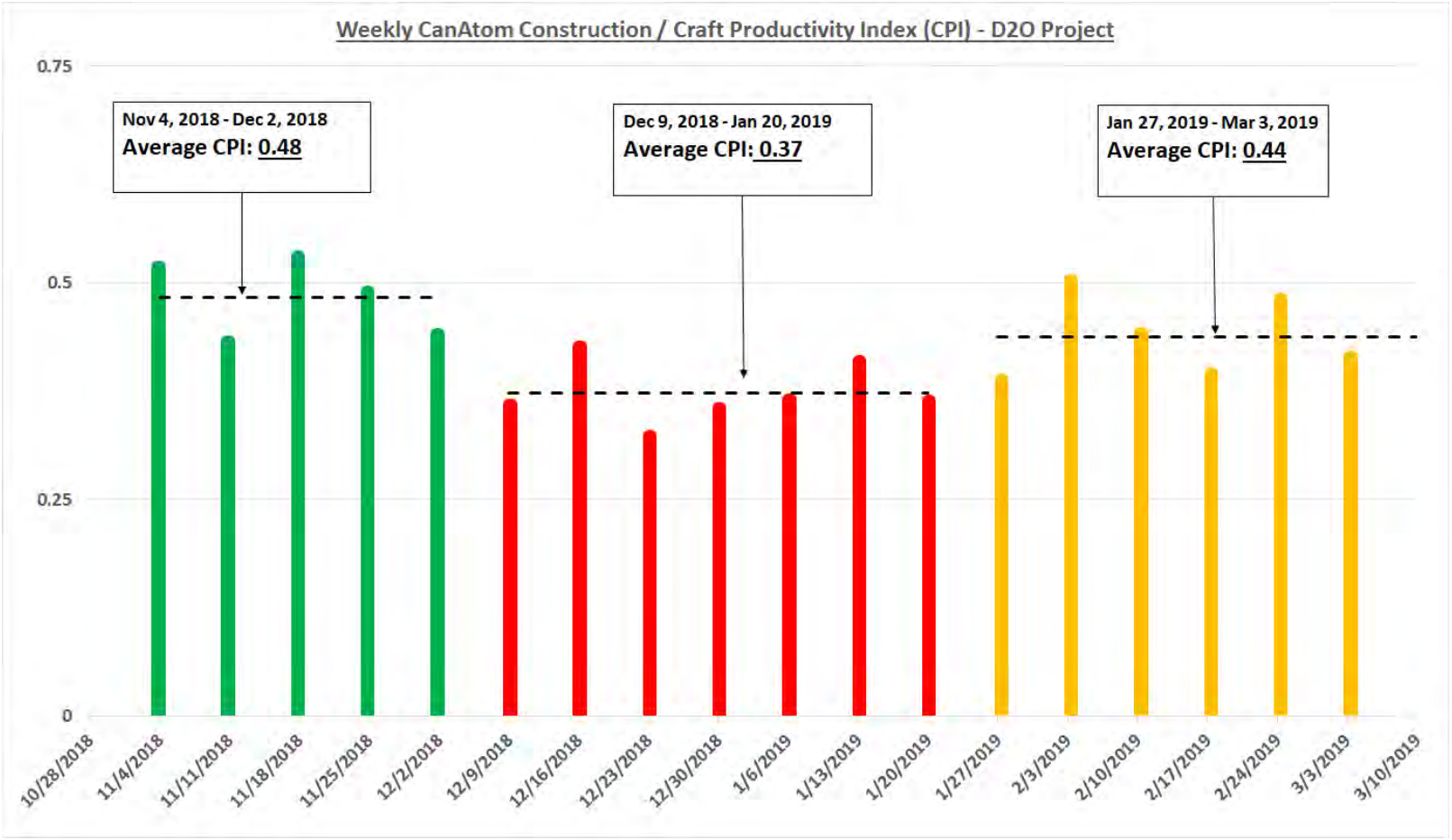
  Target Construction Completion Date – 17 Weeks:
  Late July 2019

- Electrical Hours Remaining to Earn:
  31,400 Hours (19,000 Hours Earned Q1 / 28,000 Hours Added to Electrical Scope)

- Mechanical Hours Remaining to Earn: remaining
  29,400 Hours (15,000 Hours Earned Q1 / 13,500 Hours Added to Mechanical Scope)

ONTARIO POWER GENERATION

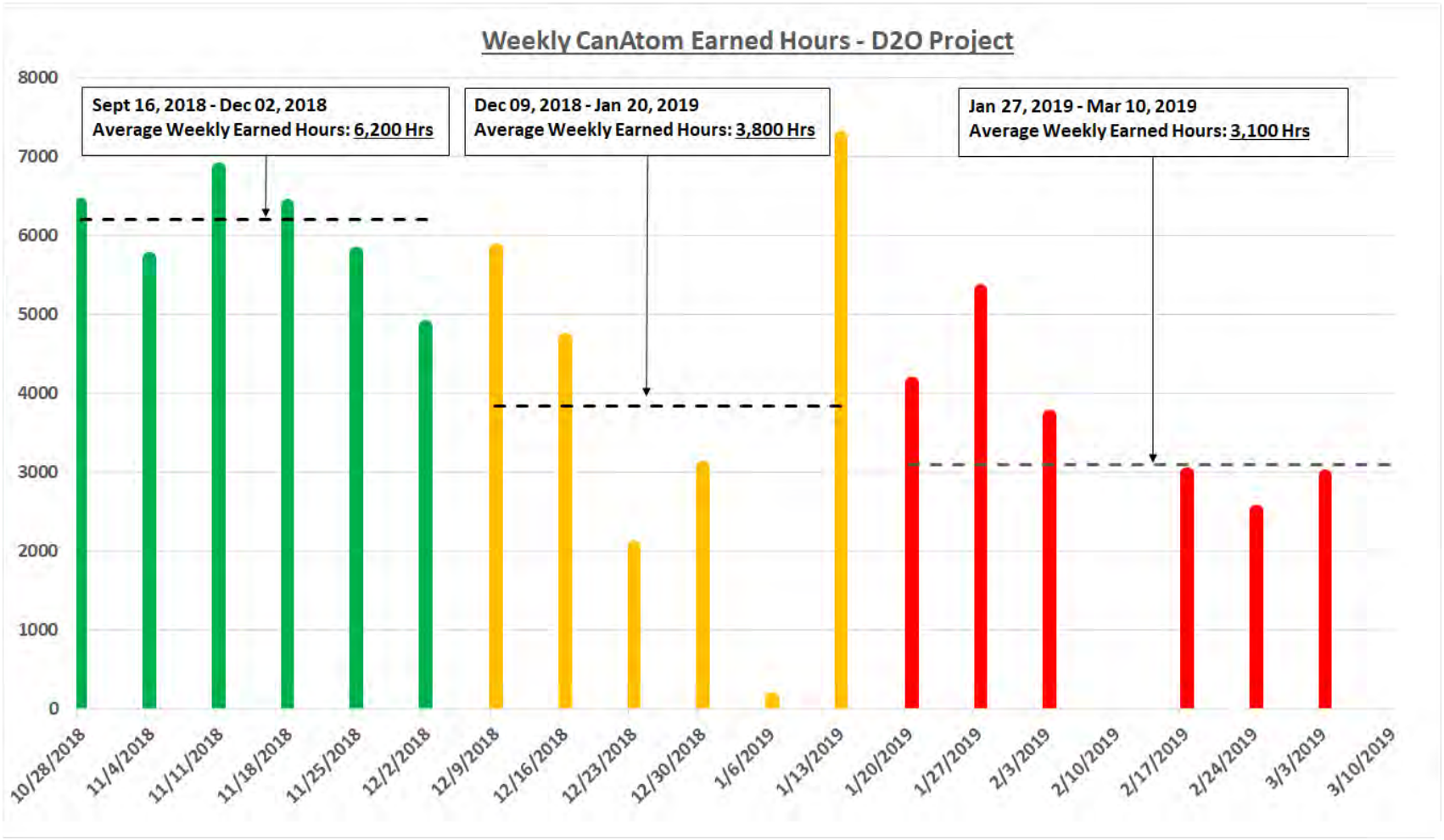
Construction & Commissioning Productivity



Current CanAtom Average CPI: **0.44**

ONTARIO POWER GENERATION

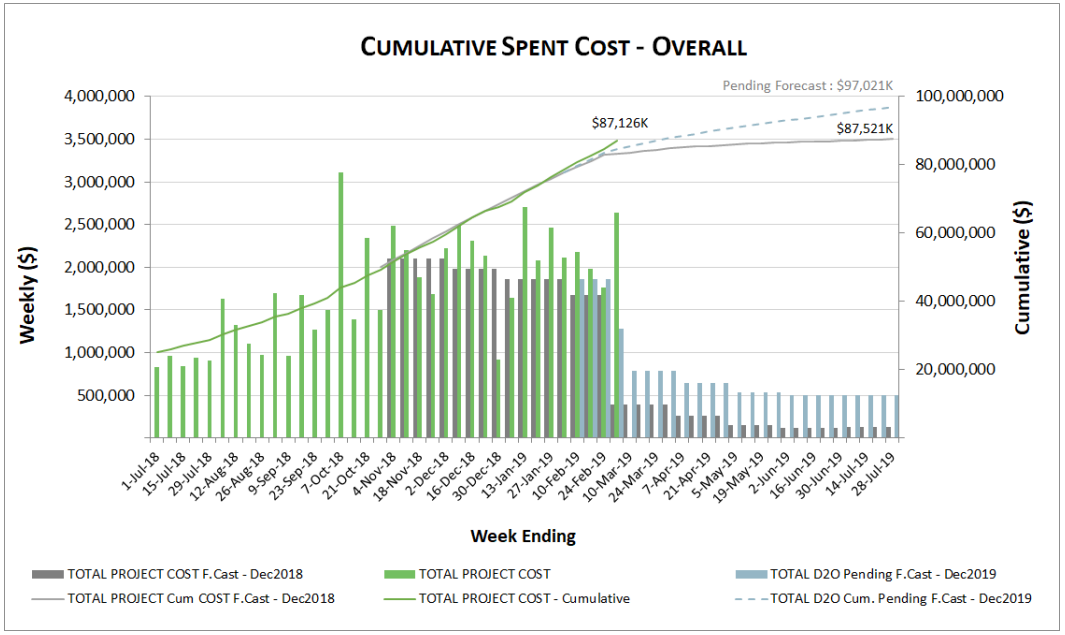
Construction Productivity



Current CanAtom Construction Weekly Hours Earned: **~3,500 Hours / Week**

ONTARIO POWER GENERATION

CanAtom & OPG Shared Financials



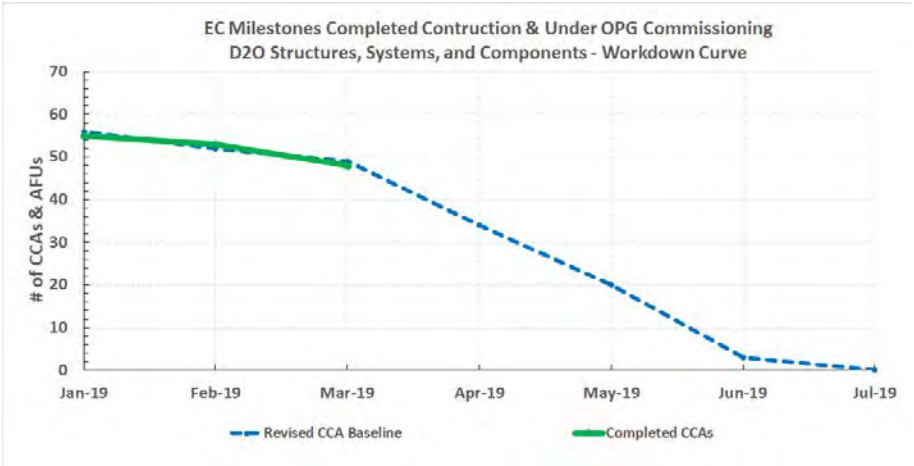
Current Spend to date:
$87M
(End of February 2019)

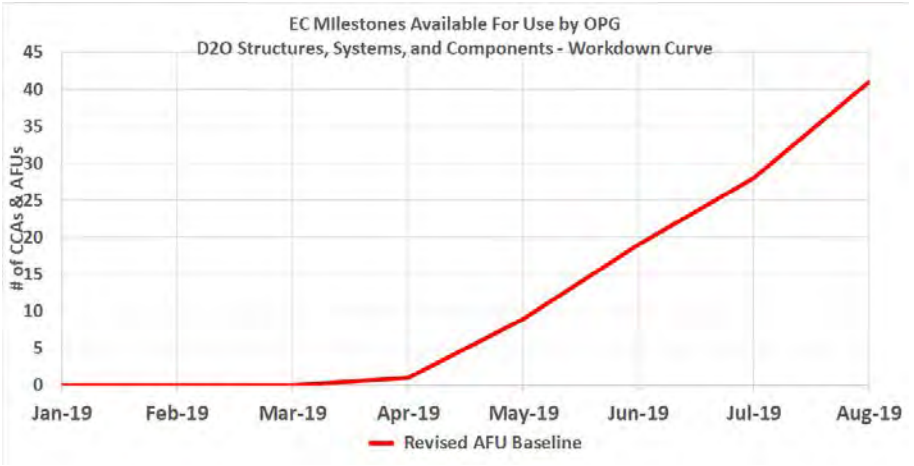
Burn rate Forecast at $95M:
Mid-Late April /19
(Guaranteed Maximum Price)

Forecast at CanAtom Completion:
End of June for Construction + PMT for Closeout Initiatives
($97M + ~$30M Remaining = **$127M**)

ONTARIO POWER GENERATION

Construction & Commissioning CC/AFU Progress





Construction & Commissioning KPI's:

- 48 out of 58 Construction Completion Milestones remaining
  - 5 CCAs Fully Completed:

    1) Tie-in to PHT 2) Tie-in to MOD 3) Tie-in to Upgrader 4) Relocation of Gas Service Instrumentation 5) Relocation of Underground Inactive Drainage

  - Systems pending Punchlist Reference "A" Actions:

    1) Diesel Generator 2) 120V Distribution 3) 13.8 kV Switchgear 4) MCCs 5) Demin Water 6) UPS

- 41 Remaining "Available For Use" (AFU) Sign-offs by OPG remaining
  - 3 AFUs in target for March 2019:

    13.8 kV Switchgear, 13.8 kV and 600 V Switchgear, Motor Control Centers

EL 87.0 "Basement"

EL 100.0
"Main Floor: Drum Handling"

EL 107.8 "Equipment Floor"

ONTARIO POWER GENERATION

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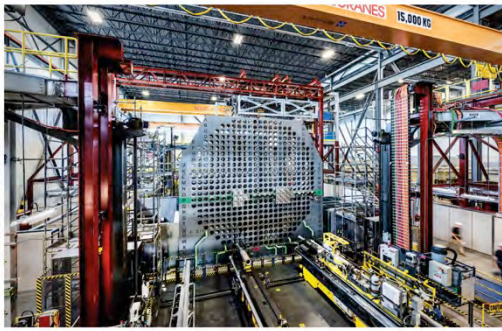
D2O ESTEECO Update

June 28th, 2019



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ONTARIO POWER GENERATION

D20 Project: Major Milestones

Milestone No.	Milestone	Milestone Status / Due Date
1	**Total Percent Complete**	97% Total Scope Completed (90% Phase 2 Completed)
2	**Substantial Construction Completion**	July 31 (HVAC, Chilled Water) August 21 (Remaining Processes / Critical Systems) Sept 14 (Non-Critical Systems)
3	**Construction Completion Assurances Packages**	33 out of 58 Completed
4	**Ready for D2O**	October 14, 2019
5	**D20 Building Required for U3 PHT/Mod**	April / May 2020

Safety Snapshot

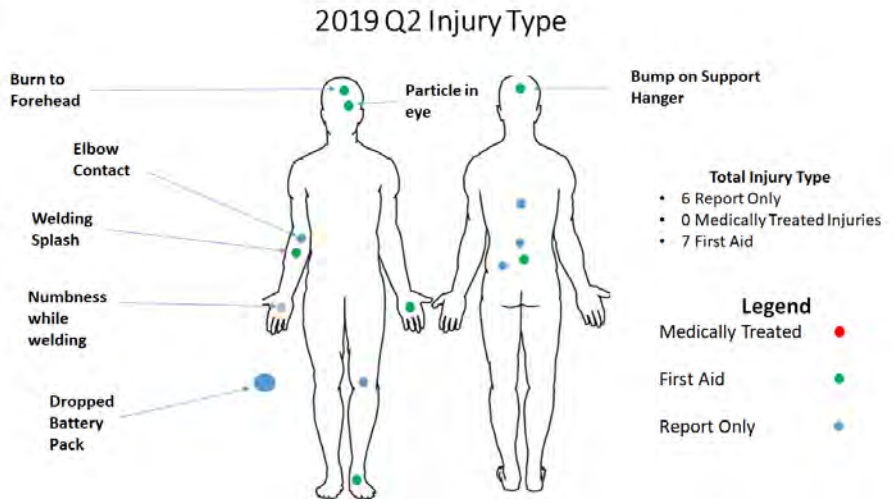
Safety Opportunities

1. Body Dynamics (Head Bumps, Strained Extremities)
2. Material Handling (Pinch Points, Sharp Objects)

Safety Summary

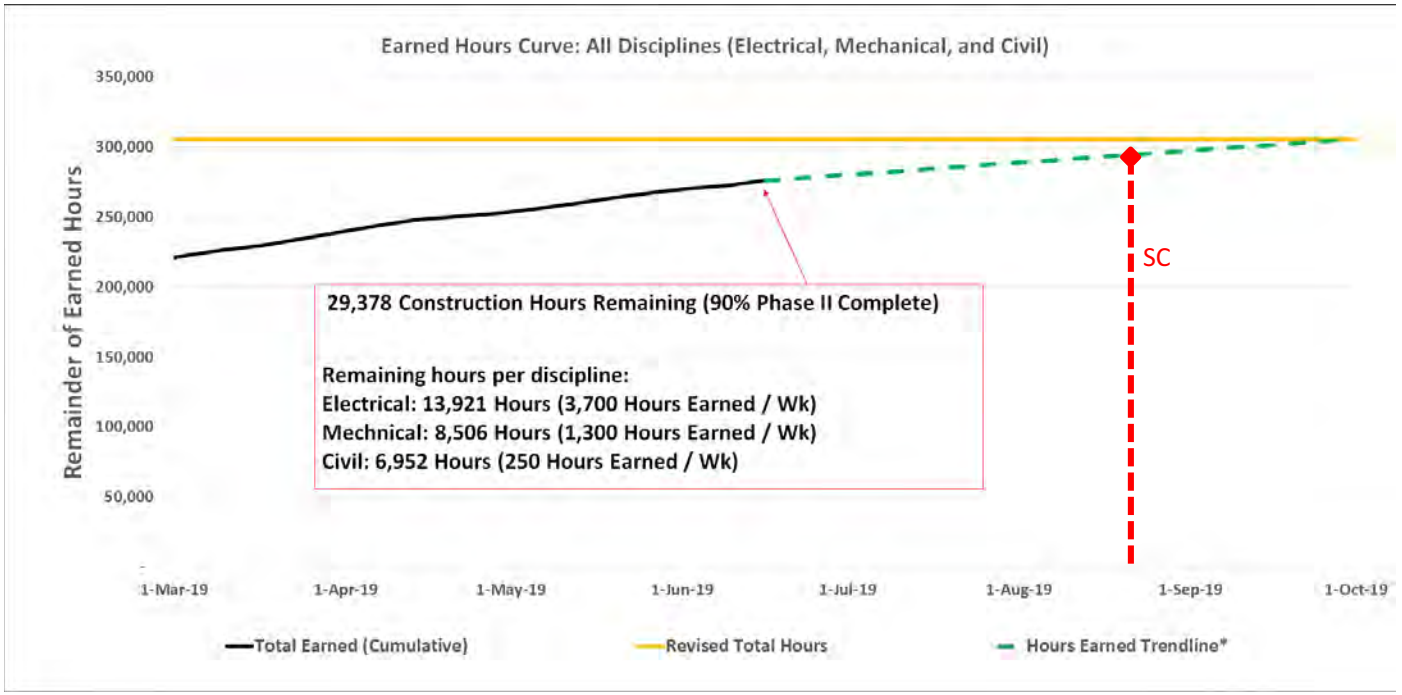
2017		2018		2019	
Q1 Hours	218,072	Q1 Hours	67,097	Q1 Hours	230,946
Q2 Hours	23,911	Q2 Hours	76,158	Q2 Hours	201,508
Q3 Hours	19,561	Q3 Hours	137,896	Q3 Hours	TBD
Q4 Hours	50,168	Q4 Hours	221,840	Q4 Hours	TBD
Total Hours	311,712	Total Hours	502,991	Total Hours	432,454
Medically Treated Injuries (MTI)	3	Medically Treated Injuries (MTI)	2	Medically Treated Injuries (MTI)	1
2017 TRIF	1.92	2018 TRIF	0.80	2019 TRIF	0.46

2019 Q2 Injury Type



ONTARIO POWER GENERATION

Construction Overview

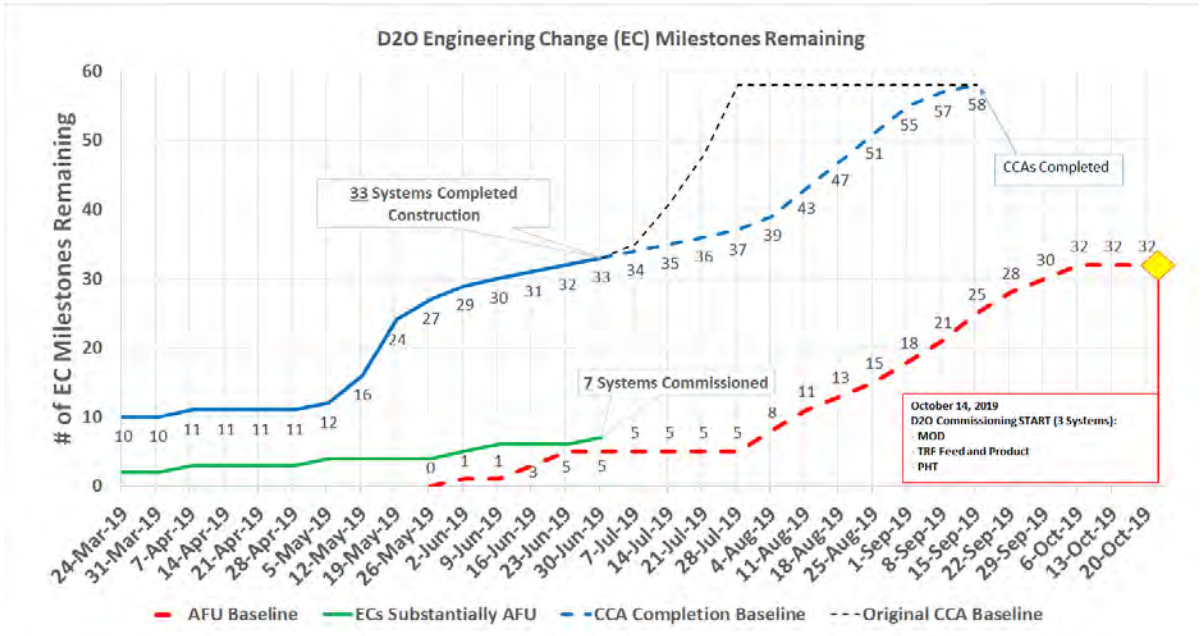


2019 Q2 Project Progress:

- Total D2O Construction Hours Remaining to Earn: **29,378 Hours**
- Electrical Hours Remaining to Earn: **13,921 Hours**
- Mechanical Hours Remaining to Earn: **8,506 Hours**
- Civil Hours Remaining to Earn: **6,952 Hours**

ONTARIO POWER GENERATION

Construction & Commissioning Milestones



End of Week	Current Target Completion Count
W.E June 7	2 **(2 Completed)**
W.E June 14	2 **(2 Completed)**
W.E June 21	2 **(1/2 Completed)**
W.E June 28	6
Total for June	12 (5/12 Completed)
Total for July	28

Construction KPIs:

- **<u>33</u> out of <u>58</u> CCA Milestones Completed ECs Completed (June to Date):**
  1) 121133: Instrument and Service Air
  2) 121146: Maintenance Platform for Tanks
  3) 120340: Electrical Relocates for Standby Generator
  4) 121327: D2O Cleanup System IX1 & IX2 Modification
  5) 120481: Personnel and Portable Monitors

Commissioning KPIs:

- **7/32 Completed "Available For Use" (AFU) Milestones:**
  1) 13.8 kV & 600 V Switchgear (120472)
  2) Motor Control Centers (120478)
  3) 120V Distribution (129058)
  4) UPS (120475)
  5) Diesel Generator (120474)
  6) Demineralized Water (120428)
  7) Breathing Air System (120557)

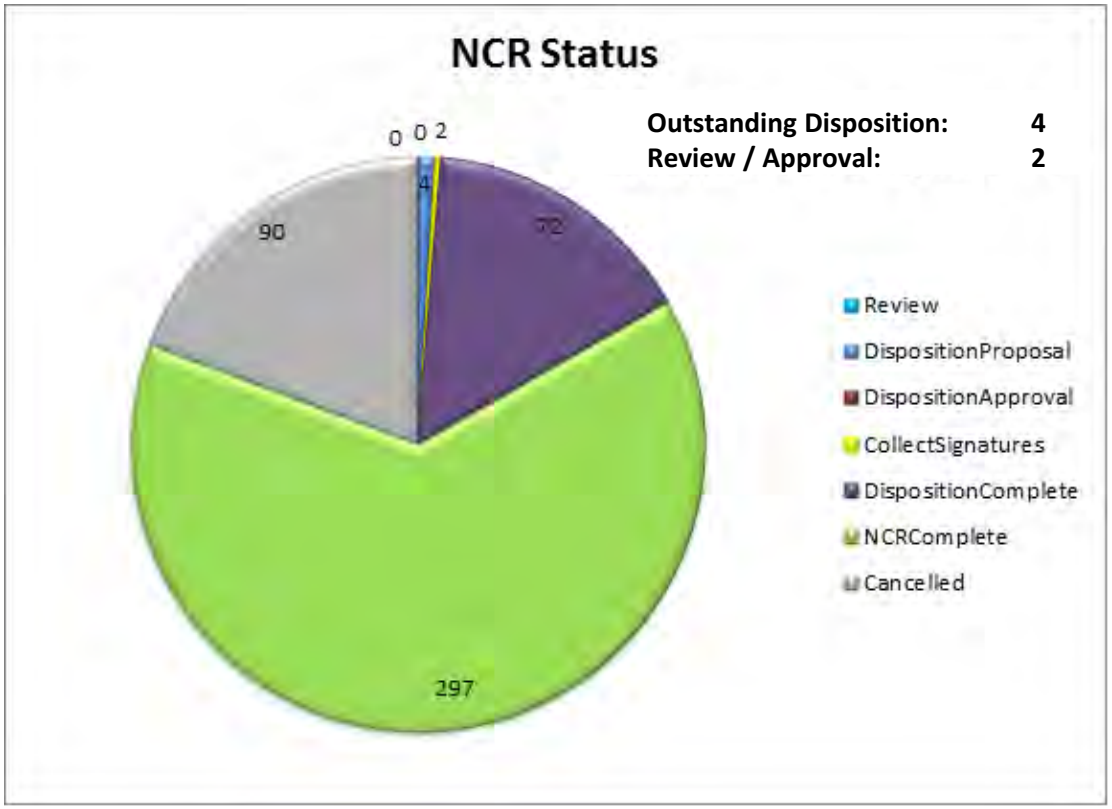
Critical Systems Overview

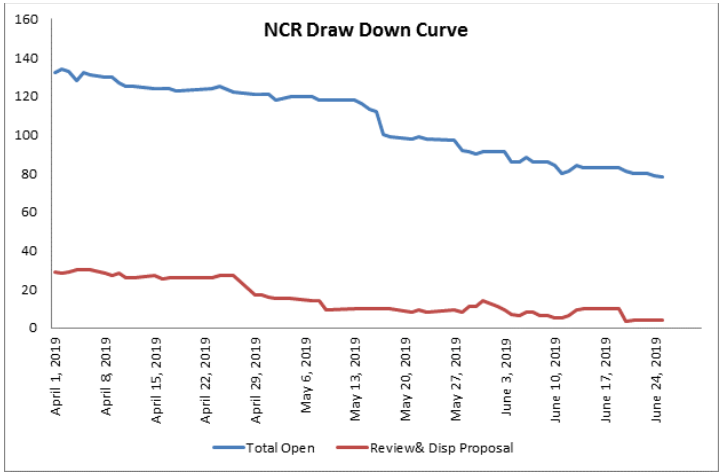
System	% Complete	Remaining work split by discipline		Top two remaining commodities by discipline	
		Electrical	Mechanical	Electrical	Mechanical
PHT, MOD, HX (120421)	95%	0%	100%	N/A	1. 4 Spools 2. 87 Tie-in Field Welds
HVAC (120494, 121323)	66%	78%	22%	1. 2,595 Ft of Conduit 2. 23,095 Ft of Cable	1. 16 Spools 2. 90 Field Welds
Vapor Recovery (121318, 121319)	62%	26%	74%	1. 1,755 Ft of Cable 2. 1,000 Terminations	1. 66 Spools 2. 10 Field Welds
Chilled Water (121320, 121805)	94%	71%	29%	1. 270 Ft of Cable 2. 448 Terminations	1. 0 Spools 2. 30 Field Welds

ONTARIO POWER GENERATION

Raised Adverse Conditions

CanAtom Non-Conformance Records (NCR)





ONTARIO POWER GENERATION

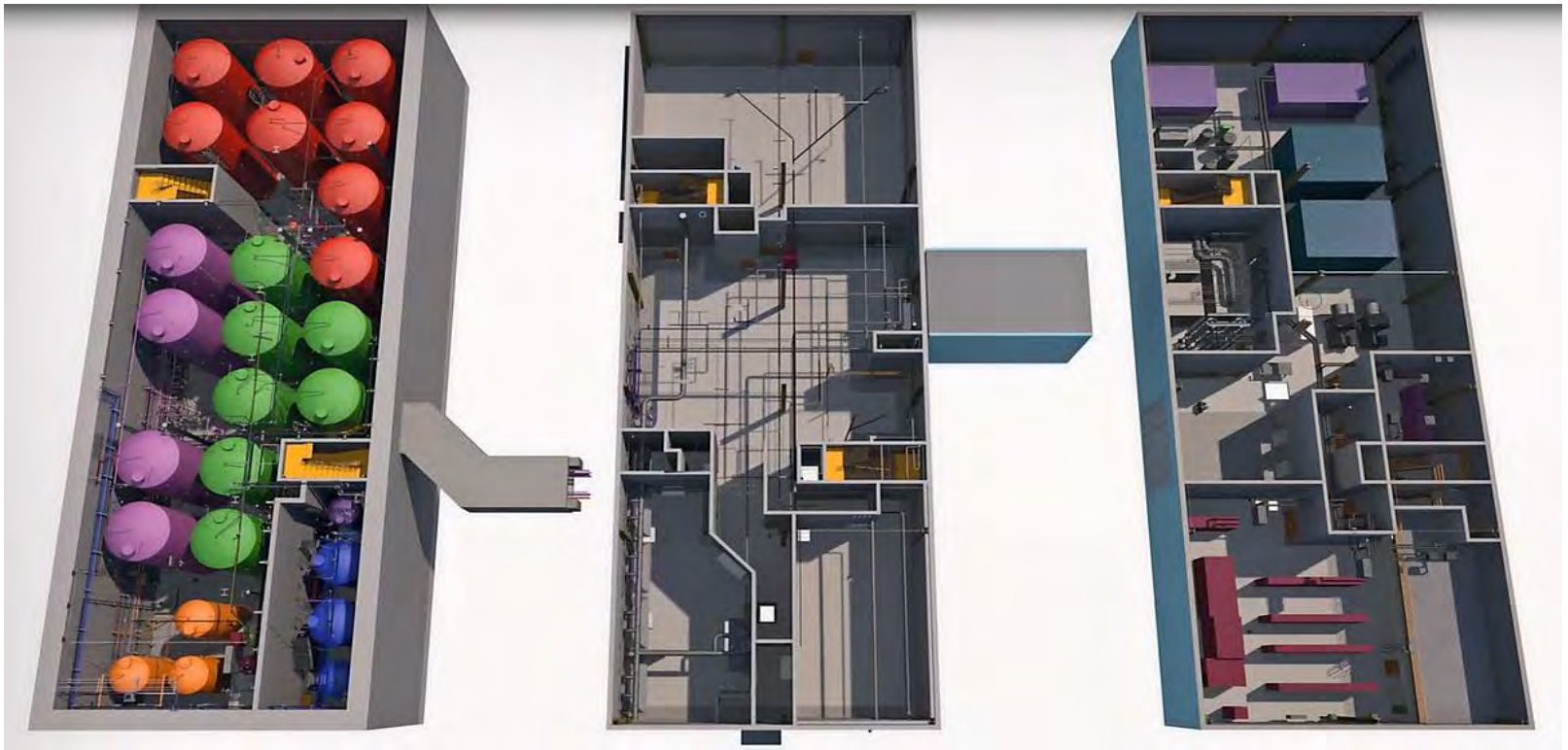
Main Project Risks & Mitigations

Top Project Risk:

- Schedule slippage leading to Cost growth

Supplementary Risks and Mitigations:

- Operational Pressure Tests – 12% Complete out of 60 Pressure Tests
  - *CWP Review and Operational Pressure Test look-ahead team being added*
  - *Additional QC Support being organized to support execution*
- Mechanical Productivity: Pipefitters – Mechanical Operations current in Critical Path
  - *Execution meetings with Pipefitters and Local are being organized*
- PMT Burnout – Final Push to Completion
  - *Insuring proper support for key positions are being utilized*
  - *Reorganizing key roles to expedite final project milestones*
- Ability to complete punch list items to meet commissioning milestones due to focus on Construction Completion
  - *CanAtom assigned dedicated issues manager to address punch list items*
- "Available For Service" readiness and sufficient Turnover Documentation (e.g., Flowsheets, CMPs, Equipment Load Verification Status)
  - *Additional resources being obtained to support AFS preparation & turnover*



EL 87.0 "Basement"

EL 100.0
"Main Floor: Drum Handling"

EL 107.8 "Equipment Floor"

ONTARIO POWER GENERATION

D2O ESTEECO Update

August 9th, 2019

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D20 Project: Major Milestones

Milestone No.	Milestone	Milestone Status / Due Date
1	**Total Percent Complete**	97% Total Scope Completed
2	**Critical Substantial Construction Completion Dates**	~~August 16~~ ~~(Chilled Water System)~~ (Complete) September 10 (HVAC/Effluent Exhaust System) September 15 (Vapour Recovery System) October 10 (Tanks/Piping for PHT & MOD)
3	**Construction Completion Assurances Packages**	39 out of 58 Completed
4	**Ready for D2O**	November 30, 2019
5	**D20 Building Required for U3 PHT/Mod**	April / July 2020

Safety Snapshot

Safety Opportunities

1. Body Dynamics (Head Bumps, Strained Extremities)
2. Material Handling (Pinch Points, Sharp Objects)

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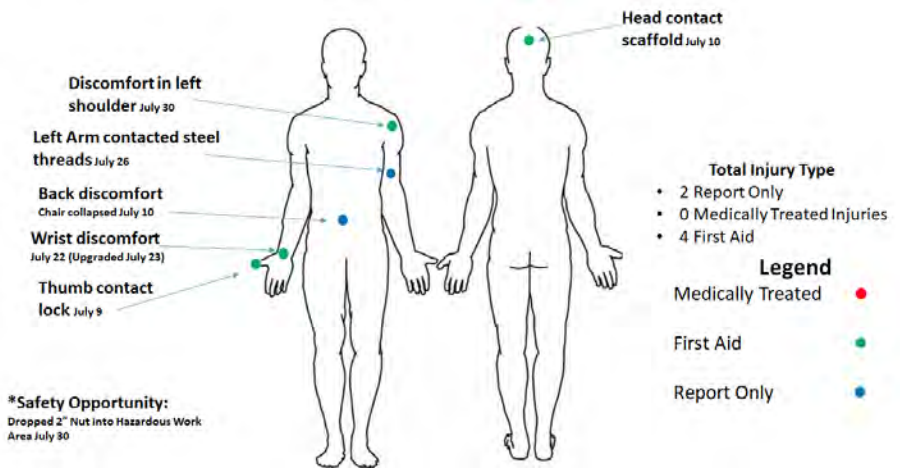
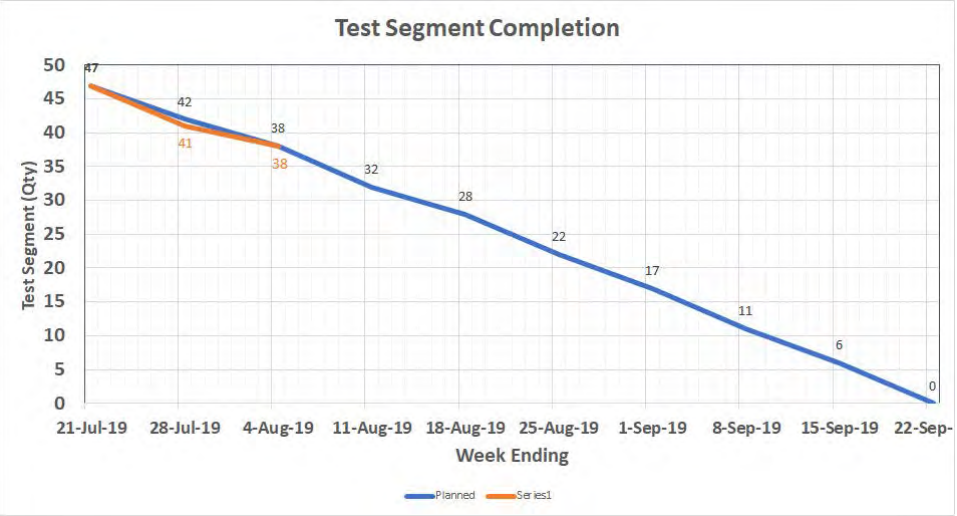
2017 TRIF	1.92	2018 TRIF	0.80	2019 TRIF	0.75

2019 Q3 Injury Type

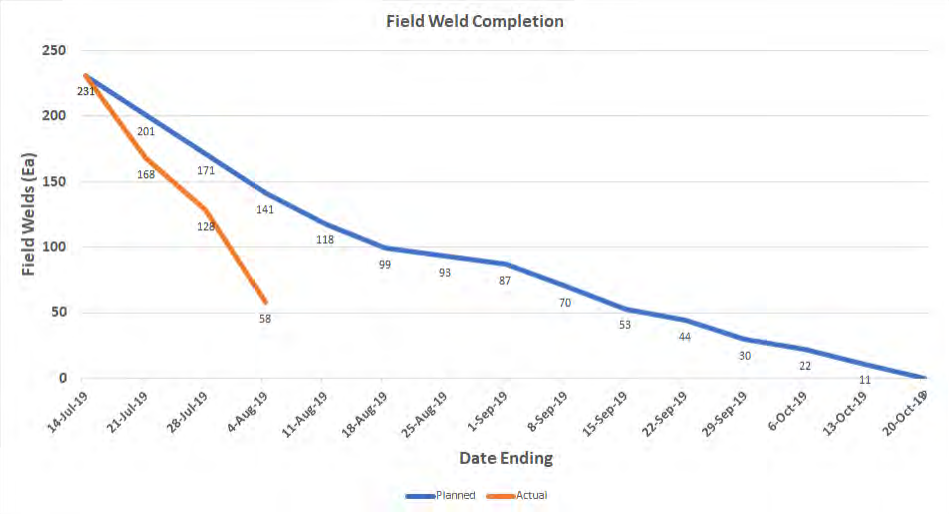


Construction Overview

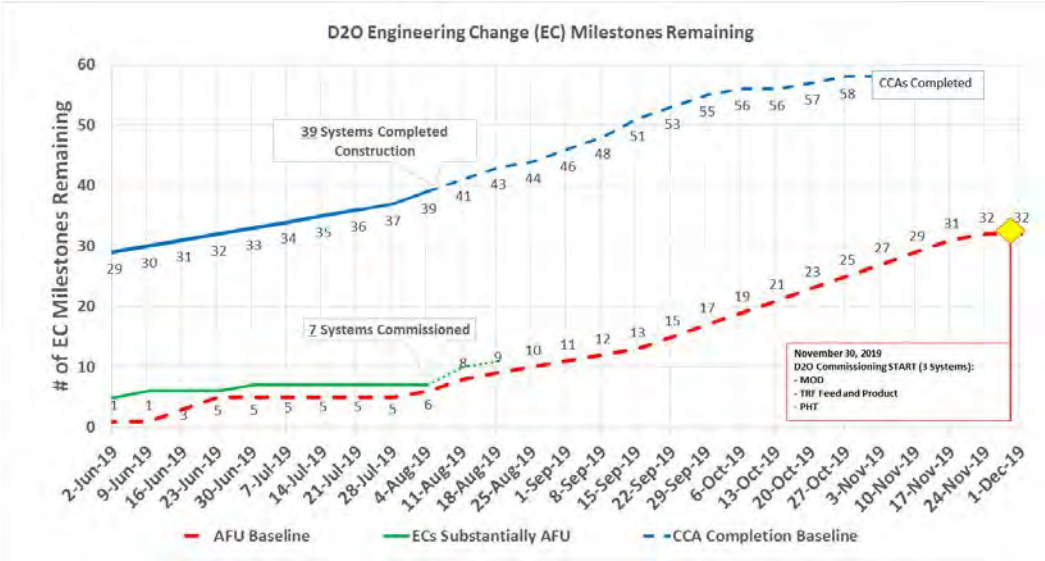
Remaining Pressure Tests



Remaining Field Welds



Construction & Commissioning Milestones



End of Month	Current Target Construction KPIs
August	2/6 Complete
September	9
October	6
Total Remaining	19

Construction KPIs:

- **<u>39</u> out of <u>58</u> CCA Milestones Completed**

  ECs Completed (August to Date):

  1) I&C and Power for Chilled Water System (121805)
  2) Mechanical for Chilled Water System (121320)

Commissioning KPIs:

- **7/32 Completed "Available For Use" (AFU) Milestones:**
  1) 13.8 kV & 600 V Switchgear (120472)
  2) Motor Control Centers (120478)
  3) 120V Distribution (129058)
  4) UPS (120475)
  5) Diesel Generator (120474)
  6) Demineralized Water (120428)
  7) Breathing Air System (120557)
- **Pending:**
  1) Inactive / Active Drainage (120643; 120485)
  2) Fire Protection (120615)
  3) Domestic Water (120588)

Construction Overview

Top Project Risk:

- Schedule slippage leading to Cost growth

- "Available For Service" readiness and sufficient Turnover Documentation (e.g., Flowsheets, CMPs, Equipment Load Verification Status, Commissioning Reports)
  - *Additional resources being obtained to support AFS preparation & turnover*

Supplementary Risks and Mitigations:

- Operational Pressure Tests
  - *CWP Review and Operational Pressure Test look-ahead team added*
  - *Additional QC Support being organized to support execution*

- Mechanical Productivity: Pipefitters – Mechanical Operations current in Critical Path
  - *Execution meetings with Pipefitters and Local are organized*

- PMT Burnout – Final Push to Completion
  - *Insuring proper support for key positions are being utilized*
  - *Reorganizing key roles to expedite final project milestones*

EL 87.0 "Basement"

EL 100.0 "Main Floor: Drum Handling"

EL 107.8 "Equipment Floor"

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D2O Project Update

January 10, 2020

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Safety Snapshot

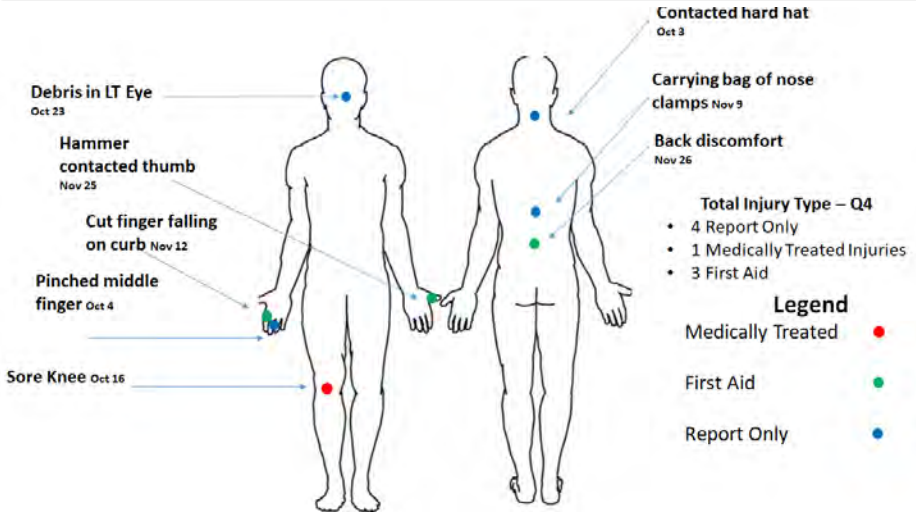
Safety Opportunities

1. Body Dynamics (Head Bumps, Strained Extremities)
2. Material Handling (Pinch Points, Sharp Objects)
3. Slip prevention with winter freeze/thaw weather

Safety Summary

2017		2018		2019	
Q1 Hours	218,072	Q1 Hours	67,097	Q1 Hours	230,946
Q2 Hours	23,911	Q2 Hours	76,158	Q2 Hours	226,921
Q3 Hours	19,561	Q3 Hours	137,896	Q3 Hours	170,374
Q4 Hours	50,168	Q4 Hours	221,840	Q4 Hours	113,176
Total Hours	311,712	Total Hours	502,991	Total Hours	741,417
Medically Treated Injuries (MTI)	3	Medically Treated Injuries (MTI)	2	Medically Treated Injuries (MTI)	3
2017 TRIF	1.92	2018 TRIF	0.80	2019 TRIF	0.81

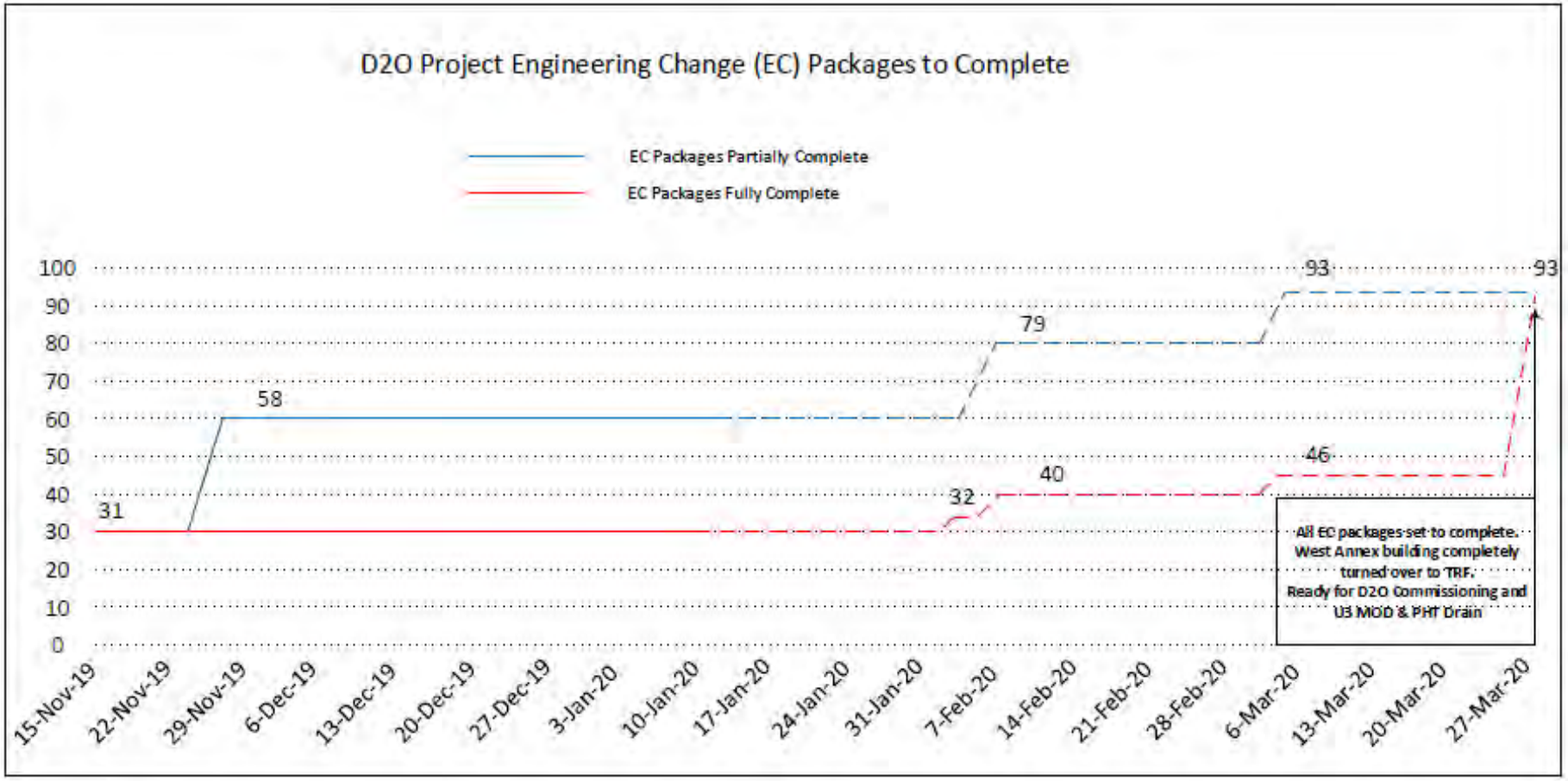
2019 Q4 Injury Type



D2O Project: Major Milestones

No.	Milestone	Milestone Status / Due Date
1	**Key Meetings / AFS**	~~Partial AFS #1 – Nov 27~~ (Completed) ~~REIS – Dec 1~~ (Completed) Partial AFS #2 – Feb 5 Senior Information (SIM) Meeting – March 2 Partial AFS #3 – March 4 Operational Decision Making (ODM) – March 16 Handover to TRF – March 26
2	**AFU**	23 of 32 AFU Packages Complete - Representing 36 of 71 EC's associated with an AFU - 93 EC's total - AFU completions are scheduled to support Partial AFS #2 and #3.
3	**D2O Building Required for U3 PHT/Mod**	August / October 2020

D2O Project: EC AFS Completion



D2O Project: Operational Pressure Tests (OPT)

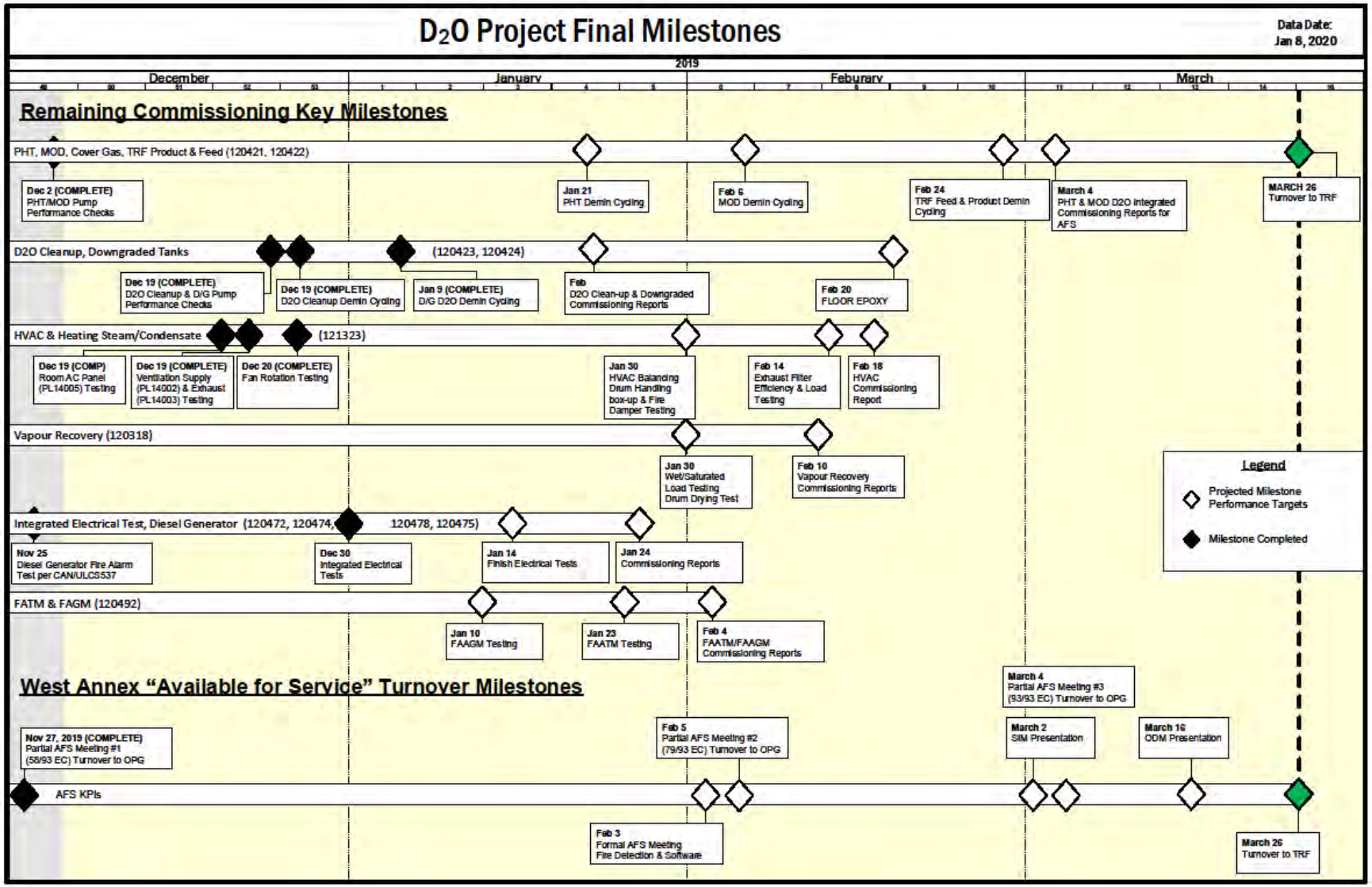
- 12 OPT's remaining (see Table)
- Completion dates are being aligned with CWP completion schedule and requirements
- OPT activities have an assigned CanAtom Manager to drive completion and is tracked via daily meeting.
- OPG working collaboratively and continuously to assist.

EC	Description
120421	PHT, Mod & Cover Gas
120422	TRF & Product Feed
120423	Downgrader
120424	Cleanup
120523	Drum Handling
120588	Domestic Water
120643	Inactive Drainage
120784	Active Drainage
121133	Instrument and Service Air
121319	Vapour Recovery
121320	Chilled Water
121323	Steam and Condensate

D2O Project: CanAtom Remaining Work

- Support of OPG-led Commissioning
- Completion of OPT's and CWP's in support of the February and March AFS's
- Completion of Flooring Epoxy – 89-m and 100-m elevations
- Installation new Electrical System Protection to address phase protection issue
- Final Clean-up and Demobilization from Site

D2O Project: Overview



D2O Project: "Ensure Clean" Program

Tanks/Systems with Station Chemistry specification achieved:

- Downgraded tanks and associated pipework, pumps, suction and discharge headers, transfer lines between systems and to the HWMB.
- The Clean-up Tanks and associated pipework, pumps, suction and discharge headers, transfer lines between systems and to the HWMB.
- PHT tanks 14/15/16/17/18/19

Station Chemistry spec confirmation outstanding:

- PHT Tanks 20 and 21
- Moderator tanks and associated pipework
- Feed & Product tanks and associated pipework

87-m Elevation (Basement) – Key Activities

- PHT, Mod, Feed, Product Commissioning
  - PHT, Mod, Feed & Product Demin Water Cycling
- Leak Detection (Beetles) testing
- Floor Epoxy
- Final Clean-up

100-m Elevation (Main Floor) – Key Activities

- Ventilation supply & exhaust testing
- Carbon filter loading and Efficiency Test
- HVAC Balancing & Box-up testing
- FAAGM and FAATM Testing
- Hoists testing & in-service
- Floor Epoxy
- Whole Body and Hand & Foot Monitors placement and testing
- Drum Handling – install scales and tooling testing
- Final clean-up

107-m Elevation (Equipment Floor) – Key Activities

- Chilled Water – final adjustments
- Vapour Recovery – Drum Wet Testing and Balancing
- Stack Monitoring – final gas flow testing and measurements
- Diesel Generator – final electrical testing with loads
- Final Clean-up

Project Risks and Mitigation

- "Available For Service" readiness and sufficient Turnover Documentation (e.g., Flowsheets, CMPs, Equipment Load Verification Status, Commissioning Reports)
  - *Resources are identified and supporting AFS preparation & turnover*
  - *Historical EC packages are being reviewed and closed-out*

- Preventative Maintenance and Scheduling
  - *— 21 of 74 Approved or Pending Approval*
  - *— 37 of 74 Submitted by the Project and Under Review*
  - *— 16 of 74 Not Submitted – Target Jan 17*

- Risk of power outage causing damage to electrical systems and loads
  - Engineering solution on phase imbalance trip is progressing
  - Only leave critical equipment powered

- TRF Outage impact on start of D2O commissioning
  - Project is coordinating closely with TRF

- FME System Events
  - Enhanced boroscoping inspection of tank and piping internals
  - This risk is now significantly reduced.

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D2O Project Update

February 7, 2020

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Safety Opportunities

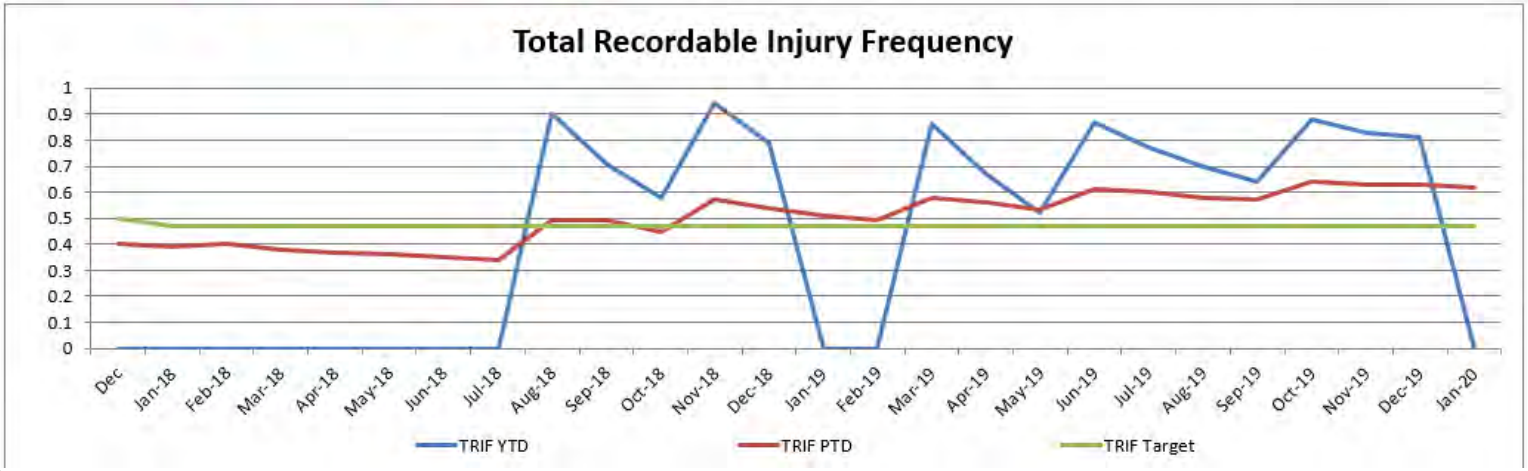
1. Material Handling (Report only – sore wrist while moving concrete weight on pallet jack)
2. Slip prevention with winter freeze/thaw weather

Safety Summary

Safety Metrics	*PTD*	*Period*	*YTD*
Total Hrs. Worked	2,252,191	16,748	16,748
LTI #	0	0	0
TRIF (target <0.47)	0.62	0	0.00
TRIF Monthly Trend			
EHS Opp	105	0	
BBO	3,525	8	

How do you calculate recordable frequency rate?

The OSHA **Recordable** Incident **Rate** (or Incident **Rate**) is **calculated** by multiplying the number of **recordable** cases by 200,000, and then dividing that number by the number of labor hours at the company. The Lost Time Case **Rate** is a similar **calculation**, only it uses the number of cases that contained lost work days.



Safety Snapshot (cont'd)

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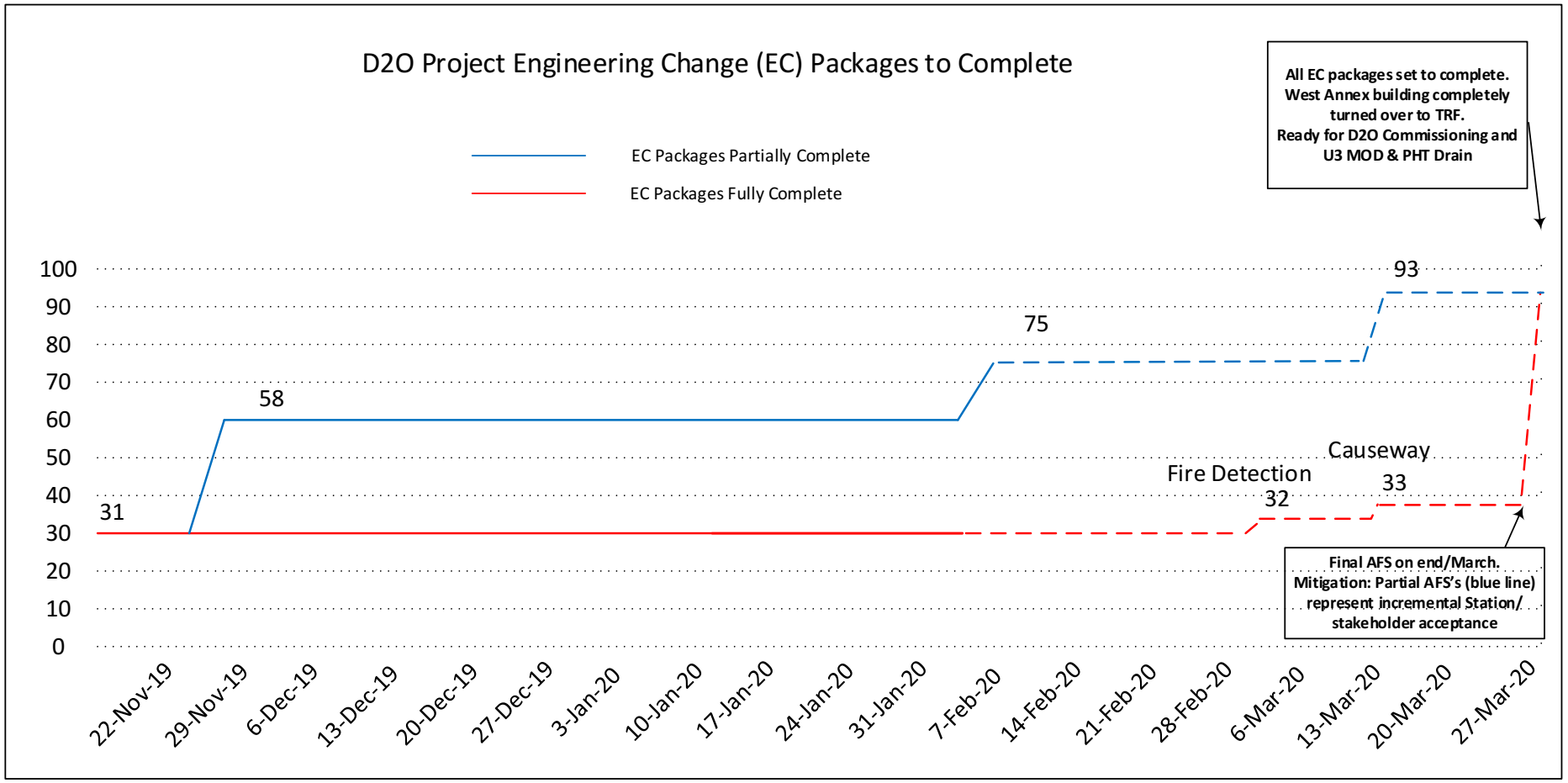
Medically Treated Injuries (MTI)	3	Medically Treated Injuries (MTI)	2	Medically Treated Injuries (MTI)	3
2017 TRIF	1.92	2018 TRIF	0.80	2019 TRIF	0.81

Safety - Environmental

- On Jan 28, it was discovered that Chiller RFU3 had a slow leak of refrigerant. 160 kg of R134a Refrigerant was lost over approximately 6 weeks through the stack to the environment
- No personnel were at any risk
- All reporting was done per Ministry requirements
- Root cause is suspected slow leak into an internal closed water circuit; investigation ongoing
- Mitigating actions are in place (operator rounds and routine leak checks)

RFU3 showing rupture disks and indicators

No.	Milestone	Milestone Status / Due Date
1	**Key Meetings / AFS**	~~Partial AFS #1 – Nov 27~~ (Completed) ~~REIS – Dec 1~~ (Completed) Partial AFS #2 – Feb 5 (Completed) Senior Information (SIM) Meeting – March 2 Partial AFS #3 – March 11 Operational Decision Making (ODM) – March 16 Handover to TRF – March 26
2	**AFU**	25 of 32 AFU Packages Complete. - TCD for completion 2/21/2020 - Remainder associated with Partial AFS #3
3	**D2O Building Required for U3 PHT/Mod**	August / October 2020


D2O Project Engineering Change (EC) Packages to Complete
All EC packages set to complete.
West Annex building completely turned over to TRF.
Ready for D2O Commissioning and U3 MOD & PHT Drain
EC Packages Partially Complete
EC Packages Fully Complete
100
90
80
70
60
50
40
30
20
10
0
31
58
75
93
Fire Detection
32
Causeway
33
Final AFS on end/March.
Mitigation: Partial AFS's (blue line) represent incremental Station/ stakeholder acceptance
22-Nov-19
29-Nov-19
6-Dec-19
13-Dec-19
20-Dec-19
27-Dec-19
3-Jan-20
10-Jan-20
17-Jan-20
24-Jan-20
31-Jan-20
7-Feb-20
14-Feb-20
21-Feb-20
28-Feb-20
6-Mar-20
13-Mar-20
20-Mar-20
27-Mar-20

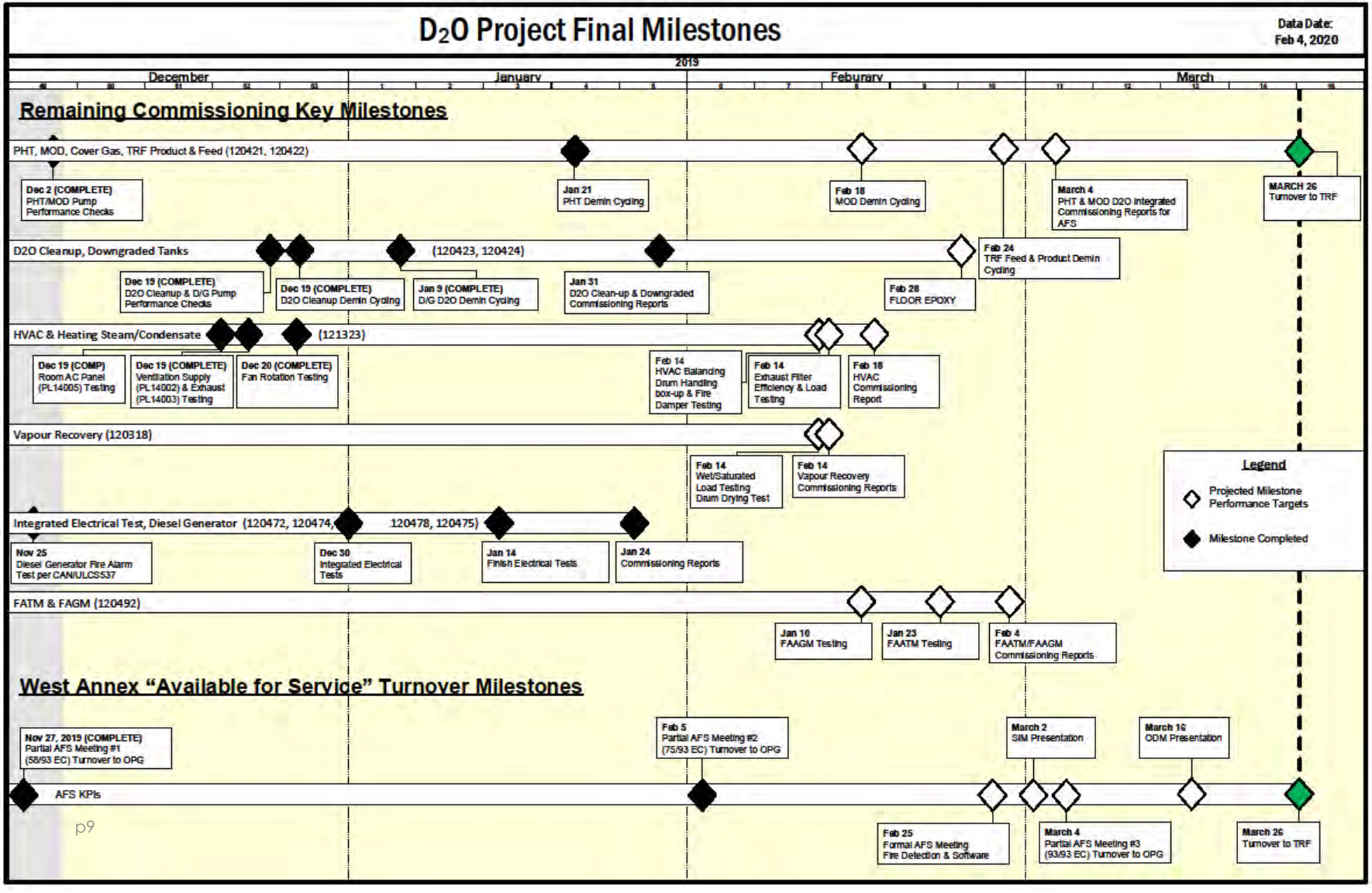
- 12 OPT's remaining (see Table)
- Change in strategy after consultation with TSSA:
- 4 Non-D2O containing systems OPT shall be completed by CanAtom
  - IA/SA (PAFS #2)
  - Chilled Water, Domestic Water Steam & Condensate (PAFS #3)

EC	Description
120421	PHT, Mod & Cover Gas
120422	TRF & Product Feed
120423	Downgrader
120424	Cleanup
120523	Drum Handling
120588	Domestic Water
120643	Inactive Drainage
120784	Active Drainage
121133	Instrument and Service Air
121319	Vapour Recovery
121320	Chilled Water
121323	Steam and Condensate

- Remaining 8 D2O containing systems to be tested by OPG with D2O post-March 16 when TRF transfers Heavy Water
- Risk is LOW, welds passed QC and radiography

- Support of OPG-led Commissioning
- Completion of OPT's and CWP's in support of the February and March AFS's
- Completion of Flooring Epoxy – 89-m and 100-m elevations (photo at right)
- Installation new Electrical System Protection to address phase protection issue
- Support of OPG-led OPT with Heavy Water (low probability of support required)
- Final Clean-up and Demobilization from Site

Photo: Section of epoxy complete 100 el


D2O Project Final Milestones
Data Date: Feb 4, 2020
2019
December
January
Feburary
March
Remaining Commissioning Key Milestones
PHT, MOD, Cover Gas, TRF Product & Feed (120421, 120422)
Dec 2 (COMPLETE) PHT/MOD Pump Performance Checks
Jan 21 PHT Demin Cycling
Feb 18 MOD Demin Cycling
March 4 PHT & MOD D2O Integrated Commissioning Reports for AFS
MARCH 26 Turnover to TRF
D2O Cleanup, Downgraded Tanks (120423, 120424)
Dec 19 (COMPLETE) D2O Cleanup & D/G Pump Performance Checks
Dec 19 (COMPLETE) D2O Cleanup Demin Cycling
Jan 9 (COMPLETE) D/G D2O Demin Cycling
Jan 31 D2O Clean-up & Downgraded Commissioning Reports
Feb 24 TRF Feed & Product Demin Cycling
Feb 28 FLOOR EPOXY
HVAC & Heating Steam/Condensate (121323)
Dec 19 (COMP) Room AC Panel (PL14005) Testing
Dec 19 (COMPLETE) Ventilation Supply (PL14002) & Exhaust (PL14003) Testing
Dec 20 (COMPLETE) Fan Rotation Testing
Feb 14 HVAC Balancing Drum Handling box-up & Fire Damper Testing
Feb 14 Exhaust Filter Efficiency & Load Testing
Feb 18 HVAC Commissioning Report
Vapour Recovery (120318)
Feb 14 Wet/Saturated Load Testing Drum Drying Test
Feb 14 Vapour Recovery Commissioning Reports
Legend
Projected Milestone Performance Targets
Milestone Completed
Integrated Electrical Test, Diesel Generator (120472, 120474, 120478, 120475)
Nov 25 Diesel Generator Fire Alarm Test per CAN/ULCS537
Dec 30 Integrated Electrical Tests
Jan 14 Finish Electrical Tests
Jan 24 Commissioning Reports
FATM & FAGM (120492)
Jan 16 FAAGM Testing
Jan 23 FAATM Testing
Feb 4 FAATM/FAAGM Commissioning Reports
West Annex "Available for Service" Turnover Milestones
Nov 27, 2019 (COMPLETE) Partial AFS Meeting #1 (58/93 EC) Turnover to OPG
Feb 5 Partial AFS Meeting #2 (75/93 EC) Turnover to OPG
March 2 SIM Presentation
March 16 ODM Presentation
AFS KPIs
Feb 25 Formal AFS Meeting Fire Detection & Software
March 4 Partial AFS Meeting #3 (93/93 EC) Turnover to OPG
March 26 Turnover to TRF

The Risk for D2O systems foreign material / chemistry risk is nearly retired. Flushing and chemistry results exceeding spec have been achieved for:

- Downgraded tanks and associated pipework, pumps, suction and discharge headers, transfer lines between systems and to the HWMB.
- The Clean-up Tanks and associated pipework, pumps, suction and discharge headers, transfer lines between systems and to the HWMB.
- All PHT and Mod tanks and pipework
- Feed & Product tanks and pipework

What's left: Final pressurized flushing of the Moderator suction/discharge headers. Blow down all lines of Demin water using instrument air cover gas.

87-m Elevation (Basement) – Key Activities

- Floor Epoxy
- Flushing Moderator headers
- Final Clean-up

100-m Elevation (Main Floor) – Key Activities

- Carbon filter efficiency testing
- HVAC Balancing & Box-up testing
- FAAGM and FAATM Testing
- 1 Hoist remaining to test
- Floor Epoxy
- Whole Body and Hand & Foot Monitors placement and testing
- Drum Handling – install scales and tooling testing.
- Final clean-up

107-m Elevation (Equipment Floor) – Key Activities

- Chilled Water – repair RFU3 rupture disk and restart
- Vapour Recovery – Drum Wet Testing and Balancing
- Stack Monitoring – final gas flow testing and measurements
- Final Clean-up

- TSSA Support for CWP closeout due to competing priorities (RFR etc). OPG is assisting CanAtom to align TSSA support.

- "Available For Service" readiness and sufficient Turnover Documentation (e.g., Flowsheets, CMPs, Equipment Load Verification Status, Commissioning Reports)
  - *Resources are identified and supporting AFS preparation & turnover*
  - *Historical EC packages are being reviewed and closed-out*

- Risk of power outage causing damage to electrical systems and loads
  - Engineering solution on phase imbalance trip is progressing
  - Only leave critical equipment powered

- TRF Outage impact on start of D2O commissioning
  - Project is coordinating closely with TRF

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Refiled: 2021-05-28
EB-2020-0290
Exhibit L-D2-02-CME-019
Attachment 32, Page 1 of 31

Report to Nuclear Oversight Committee

3rd Quarter 2014

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

August 13, 2014

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of July 31, 2014.

Pursuant to the Project's Assurance Plan approved by the Audit & Finance Committee, BMcD/Modus has also prepared independent reports documenting the DR Team's status as well as further recommendations for improvement. This quarter we have issued the following Assurance Reports: 1) OPG Operating Experience and Lessons Learned Practices and Procedures; and 2) Schedule Management Practices and Procedures. We continue to meet monthly with the Refurbishment Project Executive Team ("RPET") and weekly with the DR Team's Management Systems Oversight group to discuss our reports to NOC and our Assurance Reports in order to clarify any recommendations and engage in discussion of appropriate OPG management actions. The DR Team continues to provide its cooperation and transparency to our oversight efforts. We are also coordinating our efforts with Internal Audit so that we meet our assurance commitments in an efficient and effective manner.

Attached to this report are summaries we have provided regarding key aspects of the DR Project's current status:

- Attachment A is the updated quarterly summary of the Project Risks with annotations regarding the DR Team's actions with respect to these risks since our May 13, 2014 report;
- Attachment B is a summary of the current status of the recommendations and observations from our Initial Project Assessment of August 13, 2013 ("Initial Assessment). Here, we summarize the DR Team's progress in responding to the issues identified in our Initial Assessment so that the NOC can evaluate the velocity of the DR Project's progress since last year.

The following is a brief summary of the DR Project's most significant developments over the last quarter.

A. Campus Plan Performance Update

The Campus Plan Projects, and in particular the D2O Storage Facility and Auxiliary Heat System Building ("AHS") remain significant risks to the overall Refurbishment Project. Leadership of Projects & Modifications ("P&M") has again changed, which adds to the overall risk of these and possibly other Campus Plan Projects not meeting schedule and/ or budget requirements. In our May 13, 2014 NOC report, we highlighted some management practices that increased the risk associated with these projects under P&M's prior leadership. Management has taken action to address these issues, as discussed in the June 26, 2014 Supplementary Board Meeting, and those initiatives are continuing, as well as changes in the organization's leadership. What bears monitoring with another leadership change is whether the P&M team reverts to its prior ineffective practices or whether the team has incorporated the difficult lessons from the prior two years. Where beneficial to the projects, the initiatives started under prior leadership to streamline the work's execution, increase the contractors' accountability and move P&M to actively manage the work should continue under the new leadership team.

While many of the Campus Plan Projects appear to be on course, select projects are showing evidence of cost growth and schedule degradation. Each of the Campus Plan Projects need to undergo a full reforecast so that the scope, schedule, cost estimate and risks are re-examined, and lessons emanating from the recent D2O Storage estimating effort should be incorporated into these reviews. This work should be completed so the 4d Cost Estimate (the current DR Project estimate that will be included in the 2015-2017 Business Plan Binder) accurately reflects the potential cost and risk associated with the Campus Plan Projects. We describe the most challenging aspects of the Campus Plan Projects below.

- **D2O Storage Facility**

D2O Storage is currently projected to complete on January 18, 2017, though P&M has established a target date of August 31, 2016 based on an aggressive acceleration plan. Completion of this facility remains a direct threat to the Refurbishment Project's October 2016 breaker open date because this facility is required for storage of the heavy water that must be drained from Unit 2 in order to begin that unit's refurbishment. Importantly, the August 31, 2016 target date assumes acceleration of the work utilizing two 50 hour/week shifts with significant overtime, and that materials needed for installation will seamlessly arrive just-in-time for installation. In short, this is a very compressed schedule with no apparent margin for error.

Black & McDonald's efforts over the last three months to produce a reliable Class 2 Estimate for D2O Storage have resulted in an improved estimate for half of the remaining work, though Black & McDonald did not provide OPG with the opportunity to vet estimates of work by its third tier construction and first tier engineering subcontractors. As a result, the cost estimate for D2O Storage remains uncertain. Moreover, it is unclear whether Black & McDonald and its subcontractors have performed, let alone included in their plans, either value engineering or constructability reviews as requested by P&M. As a result, it is unclear at this time whether the current cost estimate is accurate which also calls into question whether Black & McDonald and its subcontractors have a reliable detailed schedule for the work, as the estimate and schedule go hand-in-hand. It is our understanding that DR Team Management has chosen not to advance the D2O Storage estimate to the Board at this time, which, based on its status, is appropriate. However, the urgency of finalizing the cost estimate, driving to a reasonable scope and schedule and maintaining progress of the ongoing work cannot be understated.

- **Auxiliary Heat Steam**

The AHS project is also on a tight schedule to meet its April 3, 2015 milestone, the start of the station's Vacuum Building Outage ("VBO"). AHS is currently scheduled to be completed on March 26, 2015, four weeks later than planned. The contractor has presented additional costs to OPG that could use most or all of the contingency for the Project; these costs were not anticipated at the time the last AHS estimate was presented and approved by the Board. These changes, as well as additional engineering costs, need to be challenged by P&M's project management team. In addition, the value engineering proposal requested by P&M for streamlining the steam line connection to the plant has thus far not yielded the expected cost savings. The DR Team is looking at potential mitigation plans to shorten the commissioning timelines and other means to meet the needs for heat during the VBO. The team should examine all reasonable mitigation options in light of how tight this schedule is and the likelihood that costs will increase in pursuing an aggressive acceleration of the work.

- **Contractor Performance**

[redacted]

B. RQE Preparation

The DR Team is currently developing the basis of the 4d Cost Estimate which will be an important step in the progression to next October's Release Quality Estimate ("RQE"). As we discussed in our Initial Assessment, by this time, the DR

Project's maturity will have increased; thus, there is an expectation of commensurate quality of the 4d Cost Estimate, with tighter certainty bands around estimated direct costs of the work. The DR Team accepted our recommendation that the 4d Cost Estimate be a "dress rehearsal" for RQE such that management and the Board can see the progression of the estimate as well as the gaps that need to be addressed in the coming year. In this regard, the DR Team should identify and explain in detail each of the variances from the 4c Cost Estimate so that they can be appropriately assessed. The RFR, Turbine Generator, Steam Generator and Fuel Handling project estimates have matured significantly and should form the basis for understanding the DR Project's core elements. BOP and other services-related work are less mature, meaning that they may require the greatest amount of review and vetting, particularly with respect to risks, estimate accuracy and contingency. We expressed some concern last year regarding the timing of the cost review efforts associated with the 4c Cost Estimate, which occurred largely in the summer vacation season, and we have those same concerns with this year's estimating process. Management remains committed to the $10B cost of the DR Project and the veracity of its commitment may result in some future difficult choices that are best made with full understanding of all available options.

C. Retube & Feeder Replacement Project

Because of its size and importance to the overall DR Project, execution of RFR remains the DR Project's most notable risk. Fortunately, the ongoing management effort by the DR Team and SNC/Aecon has moved RFR forward, and the issues we previously reported regarding tooling, development of the Class 3 Estimate and meeting the target price for the Definition Phase have been largely mitigated. SNC/Aecon's Class 3 Estimate has been approved by OPG and the tooling fabrication and delivery is on schedule except for the RT Platform. Detailed engineering is currently tracking behind the target schedule, and if not mitigated, SNC/Aecon's estimating effort could be compressed as a result. SNC/Aecon has rolled-out its plan for developing the Class 2 Estimate which will form the basis for the target price negotiation for the Execution Phase. Limited tool testing has commenced in the Mock-Up and preparations for the remainder are well underway with an expected completion of March 30, 2015.

SNC/Aecon's Class 3 Estimate forms a sizeable portion of the overall program budget, and the vetting of that estimate that was concluded in June 2014 should provide the Board with confidence that this segment of the Project's direct costs are well defined within the prescribed limitations of a Class 3 estimate. With the advent of the 4d Cost Estimate, the DR Team should take SNC/Aecon up on its earlier commitment to provide its view of contingency needed for the RFR Project. In addition, the DR Team should consider how it will incorporate potential changes to contract incentives and disincentives into the 4d Cost Estimate because this will represent a large component of the DR Project's overall cost.

D. Balance of Plant

In last year's Initial Assessment, BMcD/Modus identified the risk that the BOP work would be late in starting and maturing due to the sub-competitive bidding process for each individual project that was required at that time. The BOP scope was also under intense review at that time by the Blue Ribbon Panel that vetted the needs for the work that had been defined at the time. One year later, the BOP scope has been reduced but multiple contracts for the work that remains in Refurbishment's scope have been delayed. It appears that BOP has a reasonable path forward with most of the work, though the DR Team remains appropriately concerned regarding the engineering teams under the ESMSA contractors. Currently, approximately 10% of detailed BOP engineering is forecasted to complete after the team's target of May 2015, and where these delays persist, there could be an impact to the quality of those affected portions of the Project's cost estimate at RQE, the development of the detailed schedule and work planning.

E. Engineering

Engineering risks have been front and center in the DR Team's plans and in our reporting of the Project from the outset. Last year, the DR Team's focus was on completion of the scope defining Modification Definition Packages ("MDP's"), and we saw as a risk maintaining enough schedule float to allow for the vendors' transition to the detailed design phase. Many of the anticipated risks have materialized: while the MDP's were completed on time, some confusion regarding the scope OPG desired remained as the vendors continued to interpret OPG's design intent as conservatively as possible. Some corrections were initiated but valuable time was lost in the process that has compressed the detailed

design period. With the work moving to detailed design and with increased visibility to the issues that have impacted the engineering process, the DR Team is attending to problems that have surfaced, including: forecasting engineering performance, efficiently managing the work and arriving at final decisions more readily and quickly.

As noted in our 2Q 2014 Report, the DR Team has made a significant shift in engineering strategy and is now directly managing and supervising the engineering service providers. The engineering team is also pursuing how to recover some of the lost time and confirm vendors' commitments to meet target dates. In the Engineering section of this Report we revisit three aspects of the engineering effort, identifying the progress being made and the major concerns that remain for each: ongoing engineering initiatives; scope definition and management; and engineering metrics.

II. Campus Plan Update

A. Overview

P&M's management of the Campus Plan Projects continues to be under review by the DR Team. There are projects that remain a risk to the DR Project's schedule (particularly D2O Storage) and scope definition of smaller Campus projects may continue to reduce management reserve and contingency without additional action. In our 2Q 2014 Report, we focused on many of the concerning management issues that we believe led to the current cost and schedule overruns for these Campus Plan Projects. In our Supplemental Report to the NOC of June 26, 2014, we attempted to characterize the impact of these overruns. While the cost increases were significant on a percentage basis, the current trends in the cost growth should be containable within the Project's remaining management reserve, thus preserving over $2B of contingency for the overall Project's working cost estimate.

Over this same period, our team has monitored the progress with the D2O Storage estimate and re-examined and updated our assessment of the other Campus Plan Projects, some of which appear to be on course, others which may require course correction. Below we focus on certain of the Campus Plan Projects that appear to present most of the risks at this time. In addition to D2O Storage and Auxiliary Heat System ("AHS"), some Campus Plan Projects that have received partial funding but are not through their full execution releases are showing early signs of potential scope creep and schedule issues that bear watching.

B. Ongoing Campus Plan Project Risk

1. Schedule and Cost Development

P&M has continued to develop and update the project schedules for the Campus Plan Projects though many of these schedules still have significant defects. In our 1Q 2014 Report, we recommended that P&M in conjunction with the Refurbishment team, Operations & Maintenance and other needed stakeholders perform a schedule "back pass" for the Campus Plan Projects to confirm that: (1) the projected latest possible completion dates for the various projects fit within the overall program's plan; (2) there are no severe resource constraints; (3) back end activities (commissioning and start-up) are provided adequate time; and 4) a realistic sequence of critical and near critical path activities using the late start and late finish dates has been established. Unfortunately, the quality of the current vendor supplied level 3 detailed schedules precludes the team from developing a meaningful back pass review at this time.

With respect to cost growth, the most notable project remains D2O Storage though there are other Campus Plan Projects that are showing signs of upward budget pressure. We recommended in past reports that P&M reforecast each of the Campus Plan Projects because the past practices in budget formation have proven to be inadequate. P&M intends to hold challenge meetings on each of the Campus Plan Projects in advance of the 4d Cost Estimate that should delve into the underpinnings of each project's cost and schedule. Equally important is whether there is evidence that lessons learned from the Campus Plan Projects have been internalized and resultant management actions are effective at mitigating these impacts and providing control and discipline to these projects' management.

(a) D2O Storage

The D2O Storage project's cost estimate and schedule remain very much in flux at this time. Since our 2Q 2014 Report, despite the ongoing efforts of Black & McDonald, Faithful + Gould (the DR Project's estimating team) and the P&M team, the project estimate for D2O Storage has continued to increase, adding approximately 25% in estimated cost since that report. Importantly, the estimate was not deemed by OPG management to be of sufficient quality for presentation to the NOC for the upcoming Board meeting. Approximately half of the D2O Storage estimate has not been vetted by OPG at this time because Black & McDonald had not provided the portions of its estimate related to fixed-price contract work by its third tier construction and first tier engineering subcontractors. Moreover, the status of the value engineering and constructability reviews P&M requested Black & McDonald to perform is uncertain. As such, the issues with the accuracy of the current cost estimate call into question whether Black & McDonald and its subcontractors have a reliable detailed schedule for the work, as the estimate and schedule go hand-in-hand.

The current target date in the DR Project's schedule for D2O Storage Available For Service date is August 31, 2016, which is 110 days late in meeting the DR Project's optimal schedule date of April 15, 2016. This August schedule target assumes an acceleration plan that shaves 4 ½ months off a current projected completion of January 18, 2017 that was derived without acceleration. Black & McDonald's acceleration plan embeds productivity and performance risk, and even if successful the resultant August 31, 2016 date may prove to be a challenge for OPG to support Unit 2's Breaker Open of October 15, 2016.

There is also continued risk in the D2O Storage schedule until final detailed engineering is completed and all of the potential value engineering and design simplification measures are finalized. Black & McDonald's design subcontractor RCM Technologies ("RCMT") reports that its work is over 80% complete, though this estimate is suspect in that there are more than 20% of the design packages outstanding and RCMT projects a design completion date of February 19, 2015. The DR Team has examined the earning rules used and determined that RCMT's calculation of earned value was not aligned with OPG's; this alignment is in process. Any changes to the building could further delay engineering such that it may not be possible to simplify the design and still meet schedule. RCMT has also stated that it is out of funding for engineering under the current release.

The D2O Storage schedule suffers from the same transparency issues from Black & McDonald's subcontractors as the cost estimate. Black & McDonald's subcontractor Ellis Don's schedule for the concrete and civil construction cannot be verified against its cost estimates because its sub-contractors' pricing is based on fixed-prices that Black & McDonald has thus far refused to provide to OPG. Also, procurement activities need to be scheduled and verified with some level of confidence that currently cannot be associated with RCMT's efforts.

In our experience, a successful acceleration plan of this magnitude must be well-planned and coordinated, and the schedule for the work needs to be reliable with full buy-in from all needed stakeholders and contractors. There are currently a number of challenges with the D2O Storage project that will bear on the confidence in the schedule, regardless of which completion date becomes the target. As of this writing, P&M's new leadership is considering the next steps for D2O Storage.

(b) Auxiliary Heat

The current March 26, 2015 Available For Service date for AHS is virtually at the start of the Vacuum Building Outage ("VBO"). As with the D2O Storage above, the contractor (ES Fox) has incorporated acceleration in the form of a two shift schedule for piping and electrical work beginning in August of 2014. This acceleration of the work provides no float or cushion for the VBO, which is a critical milestone. ES Fox recognizes that this schedule is very tight and has little room for failure or delay. ES Fox has raised concerns with the pace of OPG's design approvals and final acceptance of vendor drawings, which could further risk the timeliness of the schedule. OPG has embedded Resident Engineers with the Hatch/Sargent & Lundy ("H/SL") design team to respond to issues through the completion of AHS engineering.

The P&M team is evaluating ways of mitigating the potential delays to meeting the VBO milestone, including shortening commissioning and start-up. The DR Team has committed to maintaining operation of the existing construction boilers and using temporary boilers to augment the steam capacity of the existing facility if necessary. Given that ES Fox's acceleration plan has significant risk associated with it, developing a "plan B" mitigation for the VBO is advisable.

From a cost perspective, ES Fox was asked to provide an estimate regarding a simplified design of the steam line connection from the AHS to the plant, replacing the original design of an underground concrete tunnel with an overhead pipe rack; however, that request was later changed to have them review a simplified under-the-roadway design. ES Fox claims that this change would have no positive impact on the Project's budget, and that it would need time it no longer has to examine different design alternatives. These changes and the costs and schedule savings associated with them need to be evaluated, though this provides a key lesson that value engineering should be performed as early as possible. In addition, it is also our understanding that ES Fox has presented additional engineering costs, scope and delay costs that P&M needs to disposition. These should be vetted so that the budget risk for this project (that has already received full funding approval) can be assessed. At this time, these changes would absorb the remaining contingency for the project.

(c) Emergency Power Generator #3

The new Emergency Power Generator #3 ("EPG3") is a Safety Improvement Opportunity ("SIO") project that P&M is managing for Refurbishment. ES Fox was selected as the contractor for the work. The project went through Gate 3A for partial funding in November 2013. The current estimate at completion for EPG3 shows the cost is projected grow by another 25% is growing as it is being prepared for the full-funding release at Gate 3B.

Issues that have resulted in cost increases to other Campus Plan Projects are also impacting EPG3, including soil conditions and scope identification during the design process. These changes are adding cost to what was believed to be one of the more straight-forward Campus Plan Projects. Nonetheless, given the issues on the earlier Campus Plan Projects, these changes were reasonably foreseeable. P&M's most recent reports for the EPG3's Estimate at Completion ("EAC") continued to show the project being on or under the Gate 3A estimate. However, ES Fox has provided contract change requests as part of its regular executive updates that date to the 1Q of 2014 which have not all been dispositioned or included in the EAC. These change requests are for: (1) Work that the sole-sourced sub-vendor from whom ES Fox is procuring the stock emergency power generator has refused to modify the stock unit it is supplying, including seismic qualification and controls for the unit; this work has to be performed by others; (2) Shoring and dewatering due to unexpected soil conditions that have been common to the rest of the Campus Plan Projects in the protected area; and, (3) Increased size of air handling units on seismically qualified foundation pads; among other changes. If approved, these changes in their current form would add approximately 25% to the project cost. However, we understand that of this amount, a significant proportion should not be proposed change orders but monetized risk items that should be carried in lieu of a portion of the project's contingency. All of these proposed changes need to be thoroughly vetted, as some appear to have been estimated at a very high level (Class 5) and may be duplicative of other changes sought on different Campus Plan Projects. It is our understanding that the Engineering team is currently challenging the underlying scope of these requested changes to the extent there are remaining questions.

The EPG3 schedule currently included in the DR Project's schedule network needs attention. The original Available for Service date for EPG3 is September 17, 2015. The completion of detailed engineering is projecting to finish December 9, 2014, which is a push of approximately three months since March 2014. The schedule was just rebaselined and still shows multiple concurrent critical paths and potential logic that could drive the completion to be significantly later if not corrected. In addition, there is overlap of construction work and commissioning that may not be possible. The final engineering completion dates need confirmation so that the potential risk to downstream procurement activities can be properly evaluated.

Based on these trends, this project that was reported to be relatively straightforward has been subjected to increased costs and schedule delays. This project would benefit from a thorough drill-down with the contractor and the project

management team and a full reforecast of the cost and schedule before its next gate so that the basis for the changes in scope can be identified and challenged, and the planning and execution sequence can be confirmed. In addition, to the extent the contractor has provided monetized risk items, these need to be properly accounted in the project's request for contingency at the next gate.

(d) Containment Filter Venting System

The Containment Filter Venting System is another SIO project that addresses a potential need to release steam from containment under extreme conditions where the station would be subjected to a complete loss of power. The scope of the project was initially addressed in an MDR that was released to ES Fox with preliminary assumptions regarding the size of the venting system that ES Fox and H/SL were required to validate.

As the design matured, additional decay heat studies were performed, ultimately resulting in the current design path in which the required filter system is substantially larger than initially assumed. Because the filter system was significantly larger than originally assumed, the size of the supporting structure for this duct system also had to be increased. Cost growth for these changes is under review but believed to be on the order of 18-30% over the early project estimate that is embedded in the current 4c Cost Estimate. This cost growth appears to be justifiable due to the increased scope, though the estimates for this additional cost should be vetted to ensure they are appropriate and properly priced.

The current schedule for CFVS forecasts a completion date of March 25, 2016. This work was originally contemplated to complete on November 17, 2015. The detailed level 3 schedule suffers from many of the same logic issues and poor critical path definition as noted for EPG3. These issues, as well as the potential cost growth, need to be addressed as soon as possible.

2. Risk Management Progress

In our 2Q 2014 Report, we identified that P&M was not utilizing the risk management process in an effective manner, and was merely using risk as a "check-the-box" activity as a prerequisite to obtaining funding for the work. The Refurbishment risk management team has been deployed to help P&M restructure its risk program, and risks are being collected and are now visible on the Project's risk register. However, there is some remaining confusion with the P&M team regarding on-going risk management. The DR Team is in the process of consolidating the risk management program under the Refurbishment organization, utilizing the same processes for risk identification and management with strong scrutiny by the DR Risk Oversight Committee. This should clear up any remaining inconsistencies.

3. Vendor Performance Issues

As noted, [redacted]

It is also worth noting that three of the four Campus Plan Projects that we have identified above as having concerns are being performed by ES Fox. While there is no evidence that we have seen that questions ES Fox's safety or quality record, and their team has thus far been very responsive to addressing any issues OPG has raised, the scope creep and cost increases evident in EPG3 and CFVS indicate that P&M should be just as vigilant in managing ES Fox's work. Any lessons from Campus Plan Projects should also be understood by the Refurbishment BOP team, who is using ES Fox for multiple scopes of work. P&M and Refurbishment BOP project managers need to vet ES Fox's estimating methodology, including how ES Fox is using factors for productivity, estimating project management team size and engineering costs, among other things.

III. RQE Preparation

A. 4d Cost Estimate

The DR Team is currently preparing the 4d Cost Estimate, the last of the planned Definition Phase funding releases that will be requested prior to RQE. The DR Team should see the 4d Cost Estimate as a "dress rehearsal" for RQE, as the DR Project will have substantially matured over the intervening year. We recommended that the DR Team get an earlier start on the development of the 4d Cost Estimate so that appropriate vetting of the various component cost estimates can be performed and have a detailed schedule of vetting activities with visibility to the team. Further, in past reports and at the advent of this effort, we provided the DR Team with more granular recommendations for different aspects of the 4d Cost Estimate development.

To date, there are certain portions of the cost estimate that have followed along their expected paths. The DR Team completed the development, vetting and approval of the RFR Class 3 Estimate in the spring of 2014, and while the review period was significantly compressed, we witnessed good cooperation between SNC/Aecon and OPG that facilitated OPG's approval of the estimate on schedule in June 2014. The resultant estimate (excluding fee, contingency and incentives) increases SNC/Aecon's Class 4 Estimate by more than 20%, though this increase was anticipated and the 4c Cost Estimate carried sizeable contingency for estimating accuracy. Other elements of the 4d Cost Estimate, including the Turbine Generator, Steam Generator, Defueling and Fuel Handling work are proceeding down similar paths with submitted vendor cost estimates that the DR Team must now characterize. In all, these project bundles account for approximately 70-75% of the DR Project's expected direct cost, and 50% of the overall Project cost, excluding contingency, interest and inflation.

The challenges between now and the completion of the 4d Cost Estimate appear to reside largely in the following major areas:

- **Project Bundles**: BOP, Shutdown/Layup, Specialized Projects and Support Facilities bundles which currently do not have the same level of maturity as the other bundles;
- **Functional Costs**: DR management directed the DR Team to "projectize" functional costs, in particular engineering and planning, so that costs that can be attributed to a specific bundle are properly expressed. In addition, Operations & Maintenance's cost estimate needs sufficient justification;
- **Campus Plan Projects**: as discussed; and
- **Contingency and Management Reserve:** the DR Team must monetize the contingency for all of the DR Project's direct costs, including RFR, which by contract, does not have to be provided by the RFR contractor until next year.

In our recommendations to the DR Team, we have stressed the need for a bottoms-up approach to developing the 4d Cost Estimate, meaning that the DR Team vets and understands the underpinnings and assumptions of each of the cost components within the estimate. The DR Team currently has embedded in its processes project gate reviews and the Options Review Board, which are opportunities for such vetting; though there are major cost components that, as of the issuance of the estimate, will have not been subjected to such a detailed review that will require additional effort in order to be better understood. In our view, a bottoms-up review should root-out uncertainties and misunderstandings that may exist within the DR Team, as it is better to know those now when there is time to manage them, rather than wait until just before RQE. In addition, such a review may highlight a resolution path for decisions on cutting costs that may be needed in order to preserve the DR Project's overall economics.

The remaining work for 4d Cost Estimate is sizeable and will be very time consuming. Our team will be closely monitoring the DR Team's activities and has asked for detailed vetting sessions in late September and mid-October so that we may inform the NOC and the DR Team of our view of the 4d Cost Estimate's overall quality.

B. Risks to RQE Development

The DR Team's goal for RQE is to have virtually all of the DR Project's costs within a Class 2 accuracy band (with a range of -15% to +20%). The AACE guidelines on which OPG has based its progression of estimates refers to a Class 2 Estimate as a project's "Control Budget" which is commonly used in the industry to signify that the scope and planning of the work have sufficiently matured so as to be the basis for comparing cost trends until the project's completion. The application of the Class 2 range when combined with OPG's commitment to hold the DR Project's overall cost to $10B would imply a need for retention of approximately $2.0B in contingency at RQE.

The 4d Cost Estimate should be a leading indicator of the risks that the DR Team is likely to encounter in development of the RQE. In addition to the 4d Cost Estimate deadline of November 13, 2014, there are other key milestones that must be maintained so that the intended accuracy of RQE is commensurate with a Class 2 designation.

Program Integrated Master Schedule (PIMS) Milestone	Date
Refurbishment Outage Planning Organization Defined Health of Scope 4 Achieved	15-October-14
Unit 2 Long Lead Materials Identified	15-November-14
IIP Approved by CNSC	31-December-14
Vacuum Building Outage (Start)	3-April-15
Detailed Engineering Complete	1-May-15[1]
RFR Class 2 Estimate from SNC/Aecon	15-June-15

At this time, the RQE predecessor milestone with the most associated risk is completion of detailed engineering by May 15, 2015. A project is subject to variability and uncertainty in cost and schedule until its scope is frozen and detailed engineering is completed. As we observed with the Campus Plan Projects, developing a budget from immature scope and engineering definition can result in significant cost overruns. Thus, the DR Team was correct in highlighting the importance of this milestone and there is strong awareness within the team of the consequences of missing this date. The Project bundles that are currently most at risk for missing the detailed engineering milestones are the same that are lagging behind for the 4d Cost Estimate—BOP, Shutdown/Layup and Specialized Projects—and those projects are utilizing the ESMSA contractors who have thus far failed to meet significant engineering milestones. The collaborative approach the DR Team initiated should help increase the efficiency of engineering work although the DR Team needs to perfect its metrics for measuring engineering so that this progress can be accurately tracked. In addition, while not among the above milestones, project planning and assessing needs to be sufficiently advanced to support a fully developed RQE.

IV. Major Projects – Summary of Key Risks

A. Retube & Feeder Replacement

1. Tooling Fabrication

The tooling program achieved completion of a major milestone in July with Tooling Detailed Design Complete. Although the milestone was achieved two weeks late, SNC/Aecon's tooling recovery plan is on track to recover the schedule by September 2014 with a few minor exceptions, including:

- **RT Platforms:** Rolls Royce and its sub-contractor have continued to struggle to maintain committed delivery dates for the RT Platforms. However, a recent commercial agreement between Rolls Royce and its subcontractor to provide additional resources, overtime payments, and equipment should help to stabilize the

[1] This is a "stretch goal" for the DR Team. The actual PIMS milestone is August 10, 2015, though this date is recognized to be too late to support RQE.

delivery date, which is currently projected to be the third week in September 2014, approximately four weeks behind the recovery schedule. SNC/Aecon has initiated a contingency plan to mitigate these delivery delays, working from fixed scaffolding in the Mock-Up until the moveable RT Platform is delivered.

- **ATS/CANDU Tools:** Several tools being developed by SNC/Aecon's suppliers ATS and CANDU are threatening to miss the Prototype Complete and Qualification Complete milestones, precursors to Tool Performance Guarantee ("TPG") testing in the Mock-Up. However, the DR Team believes that the impact of missing these milestones is minor and can be acceptably mitigated. The Class 3 Estimate currently uses TPG values that were negotiated in the contract that will be replaced for Class 2 by actual measured times from activities tested in the Mock-Up. The testing activities are currently scheduled in series, and if required, many tools could be tested in parallel, therefore reducing the total duration required without consequence to the schedule. This is particularly relevant for the CANDU tools which are much smaller, less complex, and mostly hand tools.

  For the larger, complex ATS tools, the DR Team believes it is more important for the tools to be proven through rigorous durability testing than through TPG testing. This is because TPG testing will only test five operation cycles, whereas durability testing will test potentially hundreds of cycles of the machine. In addition, the results of durability testing could be used in the case the TPG tests on the Mock-Up could not be completed. Finally, there is the ability to parallel path some of the TPG tests, as described above.

ATS has committed to complete the durability tests to OPG's satisfaction prior to TPG testing. This will give OPG confidence that the risk to critical path delays during the Execution Phase caused by defective tooling will be reduced. At this time, it appears that the TPG testing can be completed on the Mock-Up per the Schedule.

2. Engineering and Procurement Status

[redacted]

Another noted risk is that SNC/Aecon's delay to its procurement activities could complicate the purchasing and delivery of owner-supplied materials. SNC/Aecon's project manager has stated that they now face an aggressive schedule to complete procurements over the months of July and August. Some of the procurements will be made prior to the final certification of the design by the CNSC, although the DR Team believes this is a small risk due to the fact that the RFR engineering is replicated from the existing plant records, so there is no associated modification work.

3. Class 3 Estimate and Class 2 Estimate Recommendations

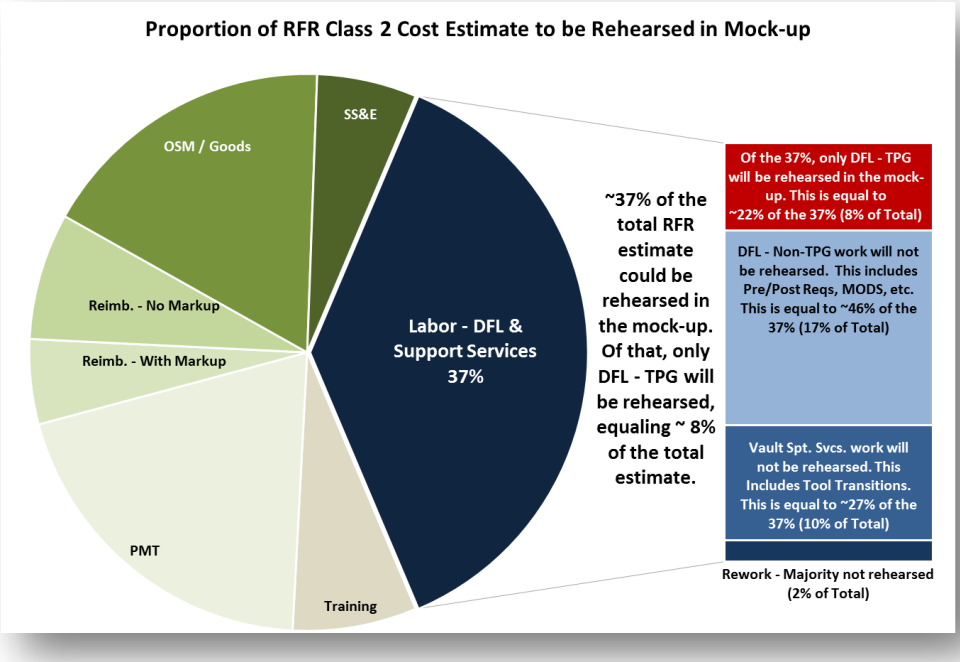
As discussed above, The SNC/Aecon Class 3 Estimate for RFR was accepted by OPG on June 15th, 2014 per the contract milestone date. Overall, the estimate, excluding contingency and fee increased from the Class 4 Estimate by over 20%. This level of growth in the estimate was expected because SNC/Aecon's Class 4 Estimate was by contract based on a "perfect" CANDU refurbishment stripped of all possible and reasonable inefficiencies, while the Class 3 Estimate was the first Darlington-specific estimate representing a reasonable and achievable plan. The estimate will be subject to further refinement in Class 2.

The Class 3 Estimate effort with SNC/Aecon yielded several key lessons learned to be incorporated for a successful Class 2 (as well as for the remaining estimating effort for the DR Project's other projects). Specific to SNC/Aecon, the official review period for the Class 3 Estimate was only about a month long, and in our view, will need to be much longer for

Class 2. The next estimate will not only be more detailed, requiring more time to review, but the number of interested stakeholders will increase with Class 2. The DR Team is taking an appropriately hands-on approach to the Class 2 development process, using a dedicated estimating team to work shoulder-to-shoulder with SNC/Aecon.

Also, given the amount of time that will be required for review by all interested parties, it is important advance as many of the estimating activities forward in the schedule as possible. The critical path to completion of the Class 2 Estimate currently runs through engineering, and as mentioned above, engineering has generated a bow wave of work requiring a concerted effort in order to meet the December 2014 engineering complete milestone. If engineering is actually holding up the estimating work, this could push development of many of the precursor components of the construction work packages to January 2015, leaving only about 2-3 months to assess the results, incorporate tested TPG times from the Mock-Up, develop the estimate report and Execution Phase schedule. This could result in a very compressed time-frame and will require a significant number of resources, tight coordination, and rigorous quality control. Given that this final engineering work is duplication of the existing design, the OPG RFR team intends to challenge whether engineering completion is a true predecessor to detailed estimating work, which would give SNC/Aecon more time to complete its estimating activities.

Finally, SNC/Aecon is currently planning to only use the Mock-Up to establish measured times associated with the TPG prior to Class 2. We see this as a potential risk to the quality of the Class 2 Estimate. The other work such as support functions, transitions, staging of materials, and the movement of tools and equipment within the confined spaces of the RFR are not currently planned to be rehearsed or tested in the Mock-Up as part of the Class 2 Estimate or even prior to negotiating the Target Price and Schedule. This means that SNC/Aecon will populate its estimate with unrehearsed times for this work, depriving OPG of a significant benefit of the Mock-Up. As shown in the chart below, this "untested work" represents a significant portion of SNC/Aecon's Class 2 Estimate for direct work:



As shown above, 37% of the total estimate value is work that could be rehearsed in the Mock-Up. However, SNC/Aecon's current plan is to rehearse only 8%. Without testing this work in the Mock-Up prior to the Class 2 Estimate through rehearsals, time motion studies, and the like, the accuracy of the final estimate for that portion of the work would be uncertain. The more important issue is that OPG should get the benefit of the Mock-Up in setting the Target Price. It is our understanding that the DR Team has recognized this as an important issue and has commenced discussions with SNC/Aecon to see if it will be possible to include rehearsed times in the Class 2 estimate.

4. RFR Commercial Risks

The DR Team is currently considering how it monetizes the contingency, risk and incentives/disincentives in the RFR contract for purposes of forecasting the total project cost for the 4d Cost Estimate. Complicating the picture for 4d Cost Estimate is the fact that under the RFR Contract, SNC/Aecon does not have to monetize its contingency (including all identified risk/mitigation events and uncertainties) that will be included in the Target Price until it issues its Class 2 Estimate in May of 2015. Additionally, the DR Team is reviewing the incentive and disincentive structure to ensure that SNC/Aecon is properly enticed to meet the necessary performance objectives. The DR Team has engaged in preliminary discussions with SNC/Aecon with respect to both of these issues in order to agree upon an acceptable resolution. Considering the potential impact of these items on the overall DR Project budget, increasing the confidence on these projected costs will have substantial and obvious benefits.

5. RWPB Building

The Retube Waste Processing Building ("RWPB") project currently being performed by SNC/Aecon has experienced schedule delays and increases in scope that in many ways resemble those experienced by the D2O and Campus Plan projects. As with D2O Storage, RWPB's increases in projected cost represent increased functionality and additional scope that the DR Team has determined to be necessary. These changes, described further below, were initiated to mitigate potential Execution Phase delays in processing waste removed from the reactor that have impacted the critical paths or near critical paths of prior refurbishments. The original estimate that was prepared for the RWPB was done at a very early stage without consideration of these efficiency advantages; thus, it is not an accurate gauge for comparison.

The initial construction delays to RWPB were caused by the late turnover of the building footprint for preliminary geotechnical work and the scanning and daylighting of buried services. In addition, there are more buried services than originally anticipated and the RWPB needs to accommodate a contaminated tool maintenance area and low-level waste and flask storage and staging areas that were originally intended to be housed in the powerhouse. This additional space could not be found in the powerhouse and has been included as a proposed extension to the current RWPB design. SNC/Aecon's RWPB proposal includes space required above and beyond that of the waste tooling and provides a justification for its inclusion in the RWPB scope. The proposal was received from SNC/Aecon at the time this report was written that will require more thorough vetting and analysis to verify the increased scope and estimated cost for the RWPB and extension.

B. Turbine Generator

The SNC/Aecon Class 4 Estimate was submitted in May and the Class 3 Estimate is targeted for submission for OPG review and comment on August 29, 2014, with final OPG acceptance on September 30, 2014. Further progression to Class 2 is scheduled for March 2015. The scope of work for the Turbine Generator is essentially a large maintenance task and the Turbine Generator estimating team has access to station maintenance logs in Passport (including hours) and is working with OPG's Operations and Maintenance organization to match this data to scope items. In addition, OPG's estimating contractor, Faithful + Gould ("F+G"), is developing an independent "check estimate" concurrently with SNC/Aecon, aligning scope to ensure comparability when the estimate is delivered. Both Operating Experience ("OPEX") and F+G's check estimate will be used to test reasonableness of the final estimate. We will be vetting and reviewing the development of the cost estimate as it continues to progress.

C. Balance of Plant

In our Initial Project Assessment of August 2013, we identified a risk that the detailed engineering for BOP work would be delayed by the then-current procurement process which required the ESMSA contractors to compete for each package of work. The DR Team took action to revise its process to allow for direct award of work to vendors who were already judged to be qualified through a competitive process. On this basis we believed that the DR Team had resolved this potential issue which would allow them to complete BOP engineering on time.

However, the Balance of Plant work for Refurbishment is currently tracking behind plan for several reasons, including:

- **Scope Definition**: The BOP work has experienced some of the same early scope definition problems as the Campus Plan Projects in which the vendors, lacking specific scope identification, initially chose the most conservative design path possible, leading to over-design and the potential for unnecessary or unanticipated project cost increases. Fortunately, the BOP team recognized this trend and stopped these potential increases from materializing;
- **Uncertainty regarding Black & McDonald**: Some work packages that were initially intended for Black & McDonald have been reassigned, and the DR Team is awaiting the resolution of the NCAR;
- **Delays with Project Estimating and other Award Pre-requisites**: Despite abandoning the competitive process, the Project has retained the requirement for check estimates to be performed to compare to the contractors' estimates, and OPG's team and consultant have encountered throughput issues.

As a result, the DR Team has not been able to take advantage of the opportunity presented by the direct award process in order to begin detailed engineering earlier than they had originally planned. In fact, the DR Project is now behind key planned dates and as noted, these delays have put, among other key deadlines, the May 2015 milestone for detailed design completion at risk. While some of this delay could not have been avoided due to on-going contractor performance issues, improved planning and communication could have resulted in the earlier identification and removal of barriers to performance.

It appears that the BOP team has been able to get around some of these hurdles and work appears to be moving forward. The BOP team has developed and put in place a recovery plan in order mitigate these delays. BOP expects to award three packages (Emergency Heat Sink, Containment and Flux Detectors) by August 1, 2014 and has canceled three others based on positive inspection results. In addition, the final terms and conditions for the repair/replacement valve package appear to be close to resolution. The BOP team has sought confirmation that the vendors could support the May 2015 design completion milestone, and recovery work is in place. Nonetheless, these trends should be closely monitored, as any of these missed milestones could have an impact on the confidence level of a significant slice of the DR Project's estimate at RQE.

V. Functional Groups Update

A. Engineering

The risks associated with engineering have been front and center in the DR Team's plans and in our reporting of the Project. Last year, the DR Team's focus was on completion of the scope-defining MDPs so that detailed engineering could begin with sufficient schedule float. Unfortunately, some of the anticipated risks have materialized: while the MDP's were completed on time, the delay in award of work to contractors has compressed the time available for detailed design.

The Construction Industry Institute ("CII") Research Team 300 has been investigating the most common causes of late deliverables and the severity of their impact on construction activities. This investigation has examined many projects, performed in-depth case studies, conducted questionnaires and surveys and explored the experience of CII member organizations. CII confirmed what is widely believed in the industry, that engineering is the most common late deliverable which also has the most severe impact. While there is wide understanding within the DR Team of these risks, that recognition has not in all cases translated to optimal results.

The DR Team initiated some corrective actions, but valuable time was lost in the process. Once all of the detailed design is underway, the DR Team will need to attend to its ongoing engineering challenges, including: its ability to forecast engineering performance, efficiently managing the work and its need to arrive at final decisions more readily and quickly.

As noted in our 2Q 2014 Report, the DR Team has made a significant shift in engineering strategy and is now directly managing and supervising the engineering service providers' output. The engineering team is also pursuing how to recover some of the lost time and confirm vendors' commitments to meet target dates. In this Report we revisit three

aspects of the engineering effort, identifying the progress being made and the major concerns that remain for each: ongoing engineering initiatives; scope definition and management; and engineering metrics.

1. Engineering Initiatives

(a) Active Management

The DR Team has taken some strong steps to actively manage the engineering work: Engineering has issued a change management plan describing the necessary cultural changes; the updated engineering management plan is written around active management; engineers are now resident at the engineering service providers; the change in role has been stressed at several executive face-to-face meetings with the engineering staff; and the VP of Refurbishment Engineering has held informational sessions with the engineering service providers to provide information and guidance with respect to these changes.

The DR Team is exhibiting a growing sense of ownership of the work, developing a sense of urgency in resolving issues, an improved responsibility to make decisions and a desire to find solutions to help the engineering service providers navigate the detailed design phase. In discussing this initiative with the engineering service providers they acknowledge that this transition represents a much needed and positive change for the DR program.

(b) Front-End Planning

The DR Team has examined certain principles in the CII Front End Planning for Revamp and Renovation Projects, and Engineering has embraced this concept. The front-end planning engineering initiative is incorporated in the Collaborative Front End Planning ("CFEP") Process guide issued by DR Engineering in 2Q 2014. The intent of the CFEP is to get all key stakeholders together to establish project scope solutions before mobilization of the detailed design effort. The process is intended to reduce the downstream scope additions and changes that have been evidenced in the past as a result of missing information in the design requirements. Whereas it is still too early to measure the benefits of this initiative, it has thus far been well received by the engineering service providers.

(c) Collaborative Approach

OPG's original management strategy and administration of the work has impacted the relationships between OPG and the contractors. OPG's "collaborative approach" initiative intends to reverse this situation by addressing the issues and improving the working relationships, and there is evidence that this initiative, in conjunction with the others is beginning to bear fruit.

Work is now being performed under the active management of the OPG design authority, with a greater focus on front end planning and a collaborative relationship with the engineering service providers. Based upon OPG's experience over the last year, there are several lessons learned that the DR Team needs to consider with respect to future engineering work, including: 1) facilitating the active management of engineering work by directly contracting with the engineers; and 2) contracting for engineering on a time and materials or target price rather than on a fixed-price basis.

2. Scope Definition & Management

In our Initial Assessment, BMcD/Modus noted that for the RQE to be reliable, detailed engineering must be sufficiently progressed by the 2nd Quarter of 2015 for the DR Team to develop Class 2 cost estimates (cost estimates that are deemed to meet the criterion of the Association for the Advancement of Cost Engineering ("AACE") cost estimating standards. Per the AACE recommended practices, to achieve a Class 2 Estimate, detailed engineering needs to be between 30% and 75% complete and the results of that estimating maturity need to be translated into the project's estimate. Mindful of the need to have detailed engineering in place for RQE, the DR Project set May, 2015 as deadline to have detailed design complete. However, for portions of the Balance of Plant work, the May, 2015 deadline will likely not be met without a significant recovery plan.

We have previously described the success the DR Team has achieved with the scope definition process deployed for Refurbishment. Furthermore the MDP process was well executed using the OSS vendors. However, the vendors' interpretation of suitable engineered solutions, delays in awarding the detail design work and inefficient engineering processes have all contributed to a compression of the engineering detail design effort. In addition to RQE, the delayed engineering work may also impact downstream procurement and construction activities.

3. Engineering Metrics

The DR Team has developed many of the requisite metrics, to provide visibility into the progress of the engineering effort. However, the reported metrics are being challenged by the project managers and are not proving to be reliable. There are observed issues with the quality of the detailed, level 3 schedules for engineering that must be addressed, including resource loading, logic and full detail of engineering tasks. Because the schedule is unstable at this time, it is not an effective tool for measuring performance.

RFR provides an example of what can be done with a reliable schedule. RFR is the one project that as of the date of this Report has a resource-loaded level 3 schedule for the Definition Phase. While engineering and manufacturing are currently behind plan, this slip is visible, highlighting the need for mitigating actions and active contractor management. In fact, the RFR contractor has a recovery plan that indicates its next milestone will be met. Without integrated, level 3 resource loaded schedules, a complete picture of the engineering effort required to complete detail design is not visible, hampering the planning of adequate resources for this work.

In this regard, schedule improvements for the DR Team to address include:

- Completing integrated level 3 resource loaded schedules;
- Establishing engineering work flow streams with vetted rules of credit needed to verify earned value;
- Including appropriate placeholders in the schedule for un-awarded work (without exceptions) for projects that are lacking schedule detail;
- Ensuring that all engineering work needed for the Project is in the schedule as soon as possible; and
- Identifying and correcting errors cited by DR Team members in Engineering performance metrics.

The effort ahead for the DR Team to complete engineering for RQE needs to be supported by reliable metrics so that the team can make reasoned choices if issues with throughput of engineering product persist.

B. Project Controls

The DR Project's project controls development is behind where we thought it would be by this time this year in our Initial Assessment. The Project's master integrated schedule still lacks the entirety of engineering activities for all of the Refurbishment work. Earned value management remains immature as well in part because establishing planned values has lagged in conjunction with the schedule; because the planned schedule is not robust, earned value is not being properly calculated. While to a certain extent it is expected that there be a "shake-out" period for earned value, for the P&M work, which is in or close to execution, earned value is an essential management tool that is currently lacking. For the Refurbishment work, the earned value information that is currently needed is for engineering. Until these issues are resolved, the DR Project will have difficulty measuring progress, forecasting work completion and associated cost progression.

It is our understanding that the DR Team intends to reorganize its project controls department to allow the project management team more direct control and access to the scheduling team. The DR Team also intends to have a consolidated scheduling team that will be shared between Refurbishment and P&M, which should increase the overall quality of the scheduling effort for both organizations. As we have noted, the Campus Plan Projects suffered from a lack of schedule control and development, the first solution to which was loading the contractors' schedules into the master

schedule as they were available. These schedules, as described above, turned out to be lacking in many respects. Having a single department with consistent criteria for schedule development should be a positive step.

The DR Project's earned value/performance measurement ("EV/PM") system currently has other shortcomings. Despite not having all of the necessary data inputs in place, a well-functioning EV/PM system should still be able to provide meaningful measurement of performance in those pockets of work that have existing plans. The DR Project's current system shows some deviations between the contractors' reports and those from the DR Project, resulting in the need for manual corrections in order to reconcile the reports. The Project Controls Team should instead instruct the contractors regarding how the OPG system works so that their inputs are correct at the outset. In addition, certain modifications will be needed to support the smooth operation of the scheduling software P6 during the Refurbishment project including aspects of OPG corporate governance. We will provide the Project Controls team with our recommendations in this regard.

C. OPEX/Lessons Learned Program

Concurrent with this report, BMcD/Modus has issued an Assurance Report regarding the DR Team's OPEX and Lessons Learned Program. Of paramount importance is whether the DR Team can provide some assurance that: 1) it is incorporating the lessons learned of other, similar refurbishment projects; and 2) it is capturing and implementing Lessons Learned from its own performance so that it can implement process improvements as well as incorporate OPEX from one unit to the next. As a result, we have recently conducted an in-depth review of the DR Team's OPEX and Lessons Learned Programs.

In our August 2013 Project Assessment, BMcD/Modus identified the several issues with respect to the OPEX Lessons Learned Program. Since that time, the DR Team has continued to develop, implement and make improvements to the OPEX program. Meaningful improvements have been initiated that address matters such as:

- **Communication of potential OPEX and Lessons Learned items:** Identification and communication of external OPEX is now well established. However, we have noted that broad participation in identifying and communicating internal OPEX still needs to be improved, though the Project Controls Team ("PC Team") is taking specific action to improve internal OPEX generation. This will become increasingly important to inform forthcoming activities, such as RQE, final schedules and Execution Phase processes.

- **Training:** The PC Team initiated an OPEX training program at the beginning of 2014 and has addressed topics such as capturing and reporting OPEX, utilizing the new OPEX website, and identifying Lessons Learned.

- **Coordination with the Corrective Action Program:** Monthly OPEX metrics and Lessons Learned Report are now being addressed in Corrective Action Review Board (CARB) meetings. Beginning 3Q 2014, quarterly CARB meetings have been extended an additional 30 minutes to address details of the OPEX Program.

Overall, the PC Team has a clear appreciation for the value of OPEX and has significantly considered Lessons Learned in numerous aspects of the Definition Phase organization and planning processes. The P&C Team tasked with implementing the OPEX program has been able to make significant progress in a short period of time. However, complete implementation and refinement of the above improvements is necessary to ensure that Lessons Learned are efficiently generated and addressed throughout the life of the Project. To that end, an OPEX/Lessons Learned Strategic Plan is under development, which is expected to advocate specific actions for continuous improvement of the OPEX program. Our Assessment Report identifies four areas where further improvement is needed. These include, but are not limited to:

- **Limitations of Reporting and Tracking Software:** Databases used for documenting and tracking OPEX/Lessons Learned items and their associated implementing actions are still not integrated. It is now scheduled to be in operation by the end of 4Q 2014.

- **Internal OPEX identification:** Currently, the process is in place for disseminating and evaluating OPEX; and for developing Lessons Learned implementation plans. However, more needs to be done to stimulate the generation of OPEX from within the various projects and departments; and to communicate items to others outside the initiating group. Much of the valuable OPEX and Lessons Learned (both positive and negative) will be derived from the day-to-day management of the contractors. At this time, it appears that lessons learned are generated only as a result of a significant negative event, such as the recent Campus Plan experience. We do note that the PC Team has developed guidance for capturing internal Lessons Learned and has commenced some training activities. Success in this critical area is going to depend on the entire team's awareness of this guidance and their proactive identification and communication of relevant lessons learned.

- **Action Tracking and Management:** OPG has set up an Actions, Issues, Decisions, and Key Assumptions database called AIDA. The intent of this database is to track, review and manage actions and document issues, decisions and assumptions—though "significant" decisions and assumptions have to be further documented through additional processes. The AIDA Actions Database includes activities intended to address lessons learned. In general, the AIDA database has a large number of entries, many of which that have not been actively managed. The condition of the database suggests that many action items are loaded and then forgotten. Obviously, the purpose of an OPEX/Lessons Learned program is defeated if actions to address the lessons are not performed.

- **Implementation of OPEX from Similar Projects:** The question of whether OPG has adequately integrated the lessons learned and OPEX from other, similar refurbishment projects will be a topic of interest for the public and OPG's shareholder. It possible that OPG will have to articulately convey these efforts on an on-going basis. There is clear evidence DR Team has actively sought out and implemented OPEX from these projects. However, OPG's responses to similar-project OPEX and lessons learned are disaggregated throughout its databases or other project documentation. OPG should consider the best way to document and relay its efforts to external stakeholders, particularly its risk mitigation of known significant issues that caused delays and additional costs on other projects.

D. Supply Chain

In our 2Q 2014 Report, we noted some concerns regarding the interface between Supply Chain and the DR and P&M Project Management teams. This concern regarded the fact that there were on-going and significant delays to the contract award and the issuance of purchase orders milestones for the Campus Plan, SIO, BOP and Shutdown and Layup work. These delays could have potentially serious downstream consequences such as compression of detailed engineering after the vendor contract award, compression of the construction and commissioning planned level 3 schedule degradation of the accuracy of RQE. Over the last month, we have conducted several interviews of Project Managers, Contract Managers and Supply Chain personnel in both P&M and Refurbishment, reviewed the applicable Supply Chain policies and procedures and various other documents including correspondence between members of the various groups.

As noted, the P&M and DR Teams have struggled with getting work ready for award to contractors—even under the ESMSA contracts where a significant portion of the terms and conditions for the work have already been negotiated and there is a "direct award" process. In particular, award of work in Refurbishment's BOP and Shutdown Layup is currently trending 100 or more days behind schedule. Many of the affected purchase orders still have not been issued, though they are expected to be in the coming weeks and recovery plans have been developed and are in the process of being implemented. The DR Team has expressed on-going frustration with Supply Chain's procedures and perceived lack of support for the Project, and Project Schedule.

There is a perception within the DR Team that Supply Chain sees itself as a strict enforcer of technical procurement rules rather than as a helpful member of the Refurbishment team focused on the DR Project's success. This perception, whether true or not, has impacted the on-going working relationships to some degree. We recognize that Supply Chain

serves an important control function on the Project. Supply Chain's mandate is to ensure that the procurement process is open and fair and that OPG is given value for money for each and every transaction, and to ensure contract compliance and enforcement during execution of the Project. It is not unusual for there to be a natural tension between Supply Chain and the Project Team. This tension can be a good check and balance to ensure that cost, quality and schedule are each championed. However, it is important that the balance is maintained, and that this tension does not become a barrier to the execution of the project. In our review, we have taken a closer look at the interaction and communication between Supply Chain and the project teams as well as the Supply Chain policies and procedures that govern its support of the Refurbishment Project. Based upon our review, we have made several observations, including the following:

1. The Project Teams and Supply Chain Do Not Effectively Communicate

We found that one of the biggest drivers to the perceived issues between Supply Chain and the project teams was a lack of effective communication. Misunderstandings and lack of alignment have contributed to the delays leading to finger pointing and frustration. The areas that need improvement include:

- The DR and P&M Teams should communicate clear expectations and priorities to allow Supply Chain to plan and utilize its resources effectively. Additionally, Supply Chain should be an active participant in setting a reasonable schedule and then be accountable for delivering according to the agreed-upon dates. On the Refurbishment side, each of the project managers makes demands on Supply Chain specific to his project. What is lacking is a prioritization of these demands for the overall program. Additionally, dates that the DR Team expects Supply Chain to meet need to be vetted openly in advance to ensure their reasonableness and buy-in. The communication of expectations also includes discussing dates for completion of various activities and holding the responsible party accountable for meeting those dates. P&M has set up a weekly Projects and Modifications Oversight Committee ("PMOC"), the purpose of which is to communicate and discuss its needs and priorities. P&M has indicated that it sets its expectations, including need dates for Purchase Orders at the PMOC, and though Supply Chain is invited to this meeting, it does not send a representative to participate.
- There needs to be a joint effort to identify and remove barriers to performance. The causes of the delays during the procurement cycle are varied, but one theme prevails—many of the issues that have caused impact thus far could have been quickly identified and eliminated if the DR Team, P&M Team and Supply Chain had proactively worked together. Examples of this are the delays reported by the Shutdown/Layup ("SDLU") project bundle, which the project team said were caused by delays to the contracting process even though most of the work was being awarded under existing contracts on a direct award basis. It appears that the cause of this delay was the inability of the third-party estimator to timely produce a "check estimate"—which the project team had interpreted as a requirement of Supply Chain's procurement procedure (OPG-PROC-0058)[2]. As a result, SDLU waited several months for these check estimates to be completed. Supply Chain, however, does not interpret this requirement as so prescriptive and would have accepted SDLU's 4c Cost Estimate for this work, making the completion of a check estimate an unnecessary barrier and the cause of a 3-4 month delay.[3] Thus, the DR Project's limited estimating resources could have been utilized more effectively and efficiently to simply verify and vet the estimate provided by the contractor rather than create a separate full project estimate. Going forward with thus understanding, the DR Team can eliminate the step of reconciling both the 4C Estimates and the check estimate to the contractor's proposal, which should dramatically speed the award of the work.

[2] The OPG-PROC-0058 requirement states: "OPG has obtained a cost estimate for the services in question from a third party estimator or internally prior to reviewing a cost estimate from the supplier."

[3] The Project has its own procedures regarding check estimates, but puts it at the discretion of the project manager who has the flexibility to determine the benefit of a third party estimate versus the harm caused by the delay, and seek a waiver for the requirement from DR management.

2. Inadequate Planning and Lack of Scheduling of Reasonable Procurement Durations

Many of the principles in the Supply Chain processes and procedures are dictated by the Ontario Ministry of Finance's Broader Public Sector Procurement Directive. Supply Chain has published and communicated the anticipated amount of time needed for each phase of the procurement process that should be integrated into the schedule by the Project Managers. Supply Chain indicated its willingness to discuss its ability to shorten those durations on a case-by-case basis, a decision which would be based upon objective factors such as the type of procurement, the contractors involved, its internal resources and workload based upon priority. However, it appears that the DR Team did not adequately plan for the expected procurement activity durations in its work planning schedule, nor did it confer with Supply Chain regarding its capability to meet needed milestone dates, some of which that turned out to be unrealistic. As a result, Supply Chain has never "bought in" to the procurement milestone dates in the schedule, and therefore, does not feel accountable to it. Compounding this issue is the fact that the procurement process is only represented by a single "contract award" or "PO issued" milestone in the Level 3 integrated schedule.

Without visibility to the necessary activities leading up to the milestones, it is difficult to manage the procurement process or to identify on-going issues that need to be corrected. The DR Team and Supply Chain should be focused on a realistic schedule that both can support, and Supply Chain should commit the resources needed to meet challenges if the DR Team needs them to, though such challenges should be known and planned as much in advance as possible.

3. Confusion With Respect to Contract Management Accountabilities

The P&M and Refurbishment Organizations have a "Strategic Contract Management" organization that is not found anywhere else in OPG. It is our understanding that the Strategic Contract Management group was first established in order to provide specific expertise in developing contracting strategies for a megaproject. Since its inception, the Strategic Contract Management team has gradually taken over performing contract management responsibilities on behalf of the project managers, though some of those responsibilities, including drafting contract amendments and providing contract interpretation are squarely within the province of Supply Chain accountabilities. There is currently no governing document outlining the Strategic Contract Management group's responsibilities, nor is there a division of responsibility that has been agreed to among the necessary parties (DR Team, P&M Team, Supply Chain and Strategic Contract Management).

The lack of clear roles and responsibilities is causing confusion among the project managers and even within Supply Chain and Strategic Contract Management themselves. In some instances, Strategic Contract Management has started activities that would normally be Supply Chain accountabilities (such as drafting a Contract Amendment) due to the perceived inability or unwillingness of Supply Chain to prepare the necessary documents in a timely manner.

In our experience, the commercial support of a megaproject requires embedded resources who understand the day-to-day events, pace and rhythm of work, and these resources need to act and react quickly to challenges when they occur so that the work is not adversely interrupted. This support also involves allowing the project managers to stay focused on their essential responsibilities. The sheer volume of commercial correspondence, contract notices and the like typically generated on a megaproject can be overwhelming if it is not effectively managed. There is no reason to think that the DR Project will be different. We understand that both Supply Chain and Strategic Contract Management are in the process of developing guidance documents to this effect (albeit separately), but we would encourage them to discuss face-to-face and resolve any outstanding ambiguities first and then cooperatively draft the necessary documents, and tabletop these processes with the DR Team's leadership. This is an issue that needs to be resolved quickly, however, as it is a source of on-going frustration and conflict.

4. Processes and Procedures

Supply Chain does not believe that the DR Project should have its own Supply Chain rules that are different from any of the hundreds of projects currently on-going within the company. We would respectfully disagree with this assessment,

as the DR Project is not only very large but commercially complex. We would encourage Supply Chain to look at its policies and procedures from the corporate level to ensure that they are both flexible and agile enough to support the needs of the Project as it proceeds. We find certain processes, such as the need in P&M to revise the Purchase Order for each and every project change to be cumbersome and time-consuming, utilizing resources that could be better spent elsewhere. Additionally, there may be some ways for OPG to take advantage of some streamlining that is already built-in to the process, such as delegation of signature authority.

E. Project Team Development

With the recent changes in leadership to both P&M and Refurbishment, the team should view this as an opportune time to clearly define the path forward to both RQE and the Execution Phase of the Project. Leadership should embrace the change and develop a strong communication plan that emphasizes the reasons changes were made and clearly sets out the cultural and behavioral expectations required for the DR Program's success. The Campus Plan Projects have provided clear lessons learned for the DR Team to incorporate in their plans relative to contractor management. There are additional lessons that can be drawn from the Refurbishment project, in particular the progression of the RFR Project that can be used as a positive example of the benefits of active management. As the DR Team is finalizing its functional plans for the 4d Cost Estimate, the team leaders should be mindful of the changes needed to actively manage the work through the entirety of the Execution Phase.

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Attachment A – 3Q 2014 Risk Perspective

Area	Observations	High	Medium	Low	Current Status / Mitigation
RFR	**SNC/Aecon Performance**: Largest Program risk due to overall risk to the DR Project and OPEX.		●		▸ Tooling recovery progressing; final tool production is being accelerated ▸ Detailed Engineering behind schedule though impact limited ▸ RWPB and Definition Phase Engineering showing signs of slow progress
	Class 3 Estimate: Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted		●		▸ SNC/Aecon completed and OPG accepted Class 3 Estimate on time ▸ Monetizing contingency remains a risk for 4d Cost Estimate though SNC/Aecon has agreed to provide input
	Schedule Development: Level 4 schedule under development; requires challenge to total duration		●		▸ Level 4 schedule accepted though there is room for significant improvement ▸ SNC/Aecon identified schedule tracking plan that needs to be proven ▸ Integration of support activities and logistics in schedule remains a risk
	RWPB Delays: Facing similar problems that have plagued Campus Plan projects		●		▸ Contaminated soil, interferences, and seismic issues delaying engineering ▸ Lessons learned from Campus Plan work are being integrated
	RFR Commercial Risks: Contract provisions currently in place may not drive desired contractor performance		●		▸ The RFR Team has approached SNC/Aecon regarding the need to potentially renegotiate incentives and disincentives ▸ Need to understand potential changes for 4d Cost Estimate accuracy
Campus Plan	**ESMSA Performance**: D20 Storage and AHS work is behind schedule and over budget	●			▸ [redacted] ▸ Cost estimates and schedule remain in flux ▸ D20 is a threat to Unit 2 breaker open ▸ Re-evaluation of business case required in light of new estimates
	Engineering and Planning: D20 provides key lessons learned for remaining Campus Plan and BOP		●		▸ Engineering is co-locating with ESMSA vendors and taking more active role in directing and managing the work ▸ Clarification of RFPs and process ongoing
BOP	**ESMSA Performance**: Concern over ESMSA contractors' performance and ability to execute BOP work		●		▸ Allocation of work underway; some issues with cost/scope estimates ▸ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed ▸ Detailed engineering milestone at risk due to late assignment of work

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Attachment A – 3Q 2014 Risk Perspective

Area	Observations	High / Medium / Low	Current Status / Mitigation
Engineering	**Engineered Solutions**: Options Review Board has increased scrutiny of design decisions		► Conservative design decisions are driving up cost ► Misinterpretation of OPG's requirements are creating churn ► Options Review Board has been effective in challenging scope decisions ► Additional scope decisions may be necessary due to cost velocity measured in 4d Cost Estimate
	Planning of Engineering Work: Engineering work was not well understood and is poorly planned		► OPG engineering is taking more active role in directing and managing the work at the engineering studios ► "Bottoms-up" estimating process initiated for engineering activities ► Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place
Project Controls	**Continued Schedule Development**: Schedule approach was unproven; integration at appropriate level at risk		► Project Team is moving toward industry-wide recommended practices for scheduling ► Substantial work remains to populate detailed level 3 schedule ► Logic and critical path definition remains an issue with Campus Plan Projects; backward pass cannot be accomplished at this time ► Placeholder schedules needed for BOP work to assess resources ► Accurate earned value measurement will be delayed until schedule is more stable
	Progress Towards RQE: The plan for developing RQE is being developed.		► 4d Cost Estimate is an essential step to RQE and will expose gaps and issues ► RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs. ► The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.
	Risk Management Program: Risk registers require scrubbing; monitoring tools are cumbersome		► DR Team is cleaning up the risk register and improving reporting ► Risk Group is taking a more active role in managing the Risk Program ► Risk training is being conducted but more is required ► Campus Plan Projects risk awareness remains an issue

In our Initial Project Assessment of August 2013, BMcD/Modus summarized our conclusions and recommendations for the DR Project in a concluding table. Below, we have revisited these initial issues, risks and recommendations as a way for NOC to see the Project's progress since our Initial Assessment.

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	• Continue the process of reducing and optimizing the Project's scope. • Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn. • Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.	• Scope reduction was accomplished via Blue Ribbon Panel review and results were incorporated in 4c Cost Estimate • Scope remains an issue with BOP work – some of the design solutions proposed under ESMSA contracts have been excessively complex • Options Review Board and strengthening of Gating process required to root-out remaining potential scope busts • 4d Cost Estimate may result in another round of required scope reductions
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	• Review strategic considerations for procurement of remaining scope. • Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews • Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.	• Engineering for major bundles (RFR/Turbine Generator/Steam Generator/Fuel Handling) appear to be largely on course • BOP start of detailed engineering is currently as much as 12 months behind plan which may impact accuracy of large portion of RQE • Concerns expressed by BMcD/Modus in August 2013 regarding risks have largely materialized due to late award/start of BOP work • Metrics for tracking engineering earned value need additional work and lack fidelity • Constructability and Planning & Assessing reviews are underway with RFR and Turbine Generator but lagging behind detailed engineering for BOP

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	• As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration. • Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts. • Clarify reporting lines for matrixed Project Controls Personnel. • Actively seek to assemble the Execution Phase team as soon as possible.	• Project team development is progressing though with some notable alignment issues • Refurbishment management for execution has been strengthened and "projectizing" of functions is progressing • P&M is undergoing a fourth leadership transition since July 2013 and stability and direction is urgently required • Project Controls standardization across the entire DR Project is a work in progress and will require significant effort
Schedule Development	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	• Continue development of the C&C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase. • Redirect the Project Controls Team's efforts from the C&C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.	• Refurbishment has corrected early potential faults in the schedule methodology and will utilize a Level 3 schedule for execution that is currently under development • P&M continues to populate the C&C Schedule though the schedules for individual projects require updating and vetting once final scope and engineering is in place
	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	• Clarify and include in commercial contracts OPG's requirements for schedule development by the contractors.	• DR Project chose not to update its contractual requirements though is seeking a high level of definition from contractors, who appear to be in compliance on Refurbishment but not Campus Plan • We continue to recommend that OPG update its commercial arrangements for project controls information that will be propounded by the contractors at the time of finalizing the target price contracts for the Execution

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
			Phase
Risk Management	The current methods for scoring risks are inconsistent and the risk register includes ”issues” or “concerns” that needlessly dilute management efforts.	• Provide consistent characterization and scoring of risks. • “Concerns” as currently defined should be eliminated from the Risk Management Program. • Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking. • Consider revising probability scoring to increase granularity and ranking of risks.	• Risk identification is improving in the Refurbishment organization • Scoring and “business as usual” risks are being addressed • Risk Management Program deficiencies are still present and have not been addressed
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	• Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function. • Review qualifications within the existing risk team. • Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team. • Provide training with a focus on the overall importance of the Risk Management Program	• The DR Project’s risk management team has been strengthened over the intervening year and has new energized leadership in place • Additional training and risk discussion is still necessary • Reporting of risks needs additional clarification and work
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	• IT needs to resolve the outstanding issues as quickly as possible. • Training should include instruction for populating databases. • The AIDA database should be examined and updated if it is to be useful for rate proceedings.	• Database integration issues remain, and still need to be resolved • AIDA still requires examination for usefulness for rate proceedings.

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	• Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.	• AACE guidelines have been addressed in the continued development of the Project's estimates; contractors appear to have a better understanding of the nature of compliance with AACE standards
	Revised planning assumptions for the 2014 Business Plan are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	• Document and characterize the information for the BOD and consider meaningful reporting metrics. • Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts than can be improved based on current OPEX. • Review, capture and document Unit 2 OPEX information so maximum benefit is derived from this revised plan.	• Documentation of major decisions still could be strengthened • Discussion of key commercial agreements (in particular RFR) is pending though have been fully considered by DR Team management • Metrics are still under review for effectiveness, as is earned value system
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	• Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates as far as possible before the date of the RQE. • Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.	• 4d Cost Estimate work is progressing, though we have concerns that it will fall short of a full Project reforecast. BMcD/Modus sees a risk in holding back on full examination of the underpinnings of the 4d Cost Estimate for certain cost centers that have not substantially matured since 4c Cost Estimate • DR Team has appointed a manager of the RQE efforts, who should be engaged to find gaps in 4d Cost Estimate

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
	Contingency calculations need closer alignment with the Risk Management Program.	• Actions summarized above • Create a clear and repeatable process for calculating contingency at all levels and for all program participants.	• BMcD/Modus will be reviewing and vetting the process for contingency identification for 4d Cost Estimate • As the Project matures, our expectation is for the DR Team to move toward deterministic risk and contingency identification with monetization of specific known risks
Management Processes	OPG's new processes and procedures are in some cases conflicting and repetitive.	• Look at reducing the number and optimizing the process map.	• The Project Management Plan remains a work progress • BMcD/Modus recommended each project manager revise the bundle management plans to incorporate changes to management principles
RFR	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	• Consider asking SNC/Aecon to monetize risks at a much earlier stage.	• SNC/Aecon has agreed to provide certain information related to risks for 4d Cost Estimate though the extent to which it is helpful has to be determined
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.	• The difference between SNC/Aecon's Class 4 and Class 3 estimates needs to be properly characterized • The RFR team, with vetting from BMcD/Modus, provided a prescriptive estimating plan for the RFR Class 3 Estimate that clearly defines the deliverables.
	Project maturation	• The Class 3 Estimate	• The Class 3 Estimate addressed

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
	specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	preparation should be expedited if possible. • OPG should seek SNC/Aecon's monetizing of PMT costs.	these gaps; however, SNC/Aecon did not utilize time well, creating a substantial effort by SNC/Aecon and OPG in a short window of time • The Class 2 Estimate development must occur at a more predictable pace, as there is less time for SNC/Aecon to prepare it and this estimate will form the basis for target price negotiations.
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	• While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.	• This remains a work in progress. BMcD/Modus believes it is OPG's intent to close needed gaps in the commercial contract prior to the final Execution Phase negotiations.
	There are technical improvements that should be reviewed based on OPEX.	• Study opportunities now that the effort is turning to Darlington.	• This is part of Class 3/2 Estimate effort is and under evaluation for the target price
ThisBOP	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	• Accelerate engineering work as necessary / practicable with the OSS vendors. • Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort. • Change procurement method to a packaged approach (see below). • Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process. • Eliminate unnecessary duplication of effort between OSS vendors and EPC designers.	• MDP preparation was accelerated and was completed ahead of schedule • Detailed engineering for BOP work remains a risk; despite changes to the procurement model, assignment of work to ESMSA contractors continues to be delayed or impacted • DR Team has initiated a collaborative approach to reviewing and approving engineering product that is intended to eliminate delays in approvals and duplicative effort; results need to be monitored

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
		• Review and eliminate OPG delays in approval of design work.	
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this "competition" is essentially already known.	• Assign work to ESMSA vendors based on qualifications in smaller bundles. • Use the existing ESMSA agreements and eliminate bidding process.	• Procurement process has been changed and Secondary Competition has been eliminated • The direct award process has been hampered by process delays
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	• Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise. • Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.	• ESMSA performance problems with the Campus Plan Projects have persisted • Metrics measuring progress and resource allocation have not been developed • Assignment of BOP work is now capability-based • DR Team has re-assigned work from non-performing contractor's scope
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently anticipated to the BOP work.	• Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders. • Increase visibility of this potential risk.	• Scope defining inspections thus far have resulted in narrowing of the DR Project's scope • Risk of additional work is decreasing
Campus Plan	The D20 Storage Facility work has been delayed and the contractor's performance has been subpar	• Continue to devote adequate resources to recover the D20 Storage Facility's schedule. • OPEX from this project should be used to guide management of the future Execution Phase	• D2O Storage remains a significant threat to Refurbishment • Contractor performance and P&M's failure to actively manage the work have resulted in cost overruns and continued schedule

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
		work.	delays • OPEX from D2O Storage has been well-studied and was a significant topic of BMcD/Modus's 2Q 2014 Report • The DR Team is endeavoring to insert lessons learned into BOP work, though this requires close monitoring
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	• Additional management attention is needed to ensure planning and execution of the work	• Management issues with Campus Plan Projects persist
	The Campus Plan's scope is too large	• Continue to review the Campus Plan Scope and eliminate unnecessary projects.	• Some scope in the Campus Plan Projects was cancelled as part of the Blue Ribbon review—further review and scope reduction may be required.
OPG Critical Path	OPG-directed work is 25% of the Critical Path of the DR Project.	• Ensure that this work is given proper focus and resources.	• Defueling and Fuel Handling work appear to be progressing after some early delays in awarding contracts and assigning/splitting work with DNGS station.

MODUS
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CANADA

Report to Nuclear Oversight Committee

4th Quarter 2014

Darlington Nuclear Refurbishment Project

ONTARIO POWER GENERATION

Burns & McDonnell
Modus Strategic Solutions

November 13, 2014

MODUS Strategic Solutions CANADA

Report to Nuclear Oversight Committee – 4Q 2014
Darlington Nuclear Refurbishment Project

Burns & McDonnell CANADA

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 30, 2014. Attached to this Report is the updated quarterly summary of the Project Risks with annotations regarding the Darlington Refurbishment Project Team's ("DR Team") actions with respect to these risks since our August 13, 2014 Report ("Attachment A"). The following is a brief summary of the DR Project's most significant developments over the last quarter.

A. 4d Cost Estimate and RQE Preparation

The DR Team is presenting to NOC its 4d Cost Estimate, an important step in the progression to next October's Release Quality Estimate ("RQE"). RQE will form the Project's control budget, or baseline of cost. Based on the results of the 4d Cost Estimate, Management remains committed to not exceeding the $10B ($2013) cost for the DR Project. Our team observed the DR Team's process for developing the 4d Cost Estimate and found it to be reasonably robust and followed frequently-seen practices as related to an AACE Class 3-5 estimate. This is in line with what we would expect to support progress to a reliable RQE.

B. Campus Plan Performance Update

The Campus Plan Projects remain a concern. Based on current projections (excluding the D2O Storage Facility and certain of the Facilities & Infrastructure projects ("F&IP") that have not started and will likely be cancelled) F&IP costs have increased by 20% since the cost estimate in the 2014 Business Plan ("Release 4c"). This growth is largely due to the maturation of scope; though these projects continue to be compared to and impacted by poor quality initial cost estimates and some of Project & Modification's ("P&M") legacy processes. P&M's leadership acknowledges these trends and is developing a plan to improve management of these projects and stabilize costs. The following is an update to certain key events discussed in our prior Reports.

- **D2O Storage Facility**

On October 16, 2014, OPG terminated Black & McDonald's purchase order for the D2O Storage Facility. In our last

[redacted]

Facility. Based on these events, the DR Team has intensified its efforts in its preparation of a mitigation plan to ensure that there is no impact to breaker open while pursuing options for completing the D2O Storage Facility with another vendor. OPG is preparing a revised business case in which it will fully evaluate options and its next steps with D2O Storage Facility considering the least cost and most prudent option.

- **Auxiliary Heat Steam Building**

The AHS project has an in-service milestone of March 15, 2015, just prior to the start of the station's Spring 2015 Vacuum Building Outage ("VBO") scheduled to begin April 3, 2015. AHS is currently forecast to be in-service on May 25, 2015, nine weeks later than planned. This schedule is currently being reworked but there is a risk that the project may slip beyond the current late finish date. OPG has put into place a mitigation plan so that these delays are no longer a threat to VBO. Additional costs due to poor initial estimates will remain a risk until P&M has finished its detailed vetting the vendor's latest cost estimate.

- **Contractor Performance**

In our 2Q 2014 NOC Report, we highlighted concerns with Black & McDonald's performance on the Campus Plan Projects, and its termination from the D2O Storage Facility does not alleviate those concerns. Black & McDonald is still

performing important predecessor work for the Refurbishment Project, including work that must be performed during the VBO. Black & McDonald's performance needs to be closely monitored so that the same issues that impacted its work on D2O Storage Facility are not repeated.

ES Fox has generally performed more predictably than Black & McDonald and has been much more responsive to OPG's requests and concerns. Nonetheless, ES Fox's scheduling and cost estimating practices need to be improved and P&M's project team needs to request more substantiation and transparency from ES Fox related to project estimates, changes in scope and schedule revisions. On October 15, 2014, OPG met with ES Fox's team and secured its commitment to provide more detailed estimates and schedules, starting with the AHS. Once received, this additional detail will help P&M improve its performance metrics, gate packages, and cost projections. In addition, aggressive action by P&M in seeking this critical information from the ESMSA contractors will improve contractor monitoring.

- **P&M Management**

P&M management is aware of the performance issues we have raised in past Reports and has plans for strengthening the organization, demanding increased rigor from its project teams and sharing processes and resources with Refurbishment. P&M now holds bi-weekly meetings with both of the ESMSA contractors that have key stakeholder involvement and are a good forum for providing visibility to issues, solving problems and improving alignment. Furthermore, OPG's active management of the engineering process is yielding some positive results.

However, P&M's controls currently in place to review and approve changes in scope have proven to be insufficient for forecasting overruns and are not aligned with the DR Project's processes. P&M's senior management is increasing its focus on the project controls program by evaluating and reworking its processes, though it will need to move more quickly in order to have an impact on the on-going work. We recommend all of the project managers be more diligent in establishing and reviewing trends and identifying the causes of adverse trends so that they can be reversed or mitigated. To this end, the DR Team should obtain and vet detailed information (cost and schedule estimates) from the performing contractors and then as the design progresses, closely monitor any scope changes (and their impacts to cost and schedule) to allow for more accurate forecasting during execution.

C. Retube & Feeder Replacement Project

Generally, the Retube & Feeder Replacement ("RFR") Project is progressing well, with a positive working relationship between OPG and SNC/Aecon. SNC/Aecon has performed according to its Recovery Plan and recovered some of the delays to tooling, and mitigated any downstream impacts. The recovery of SNC/Aecon's tool performance provides a good example of the DR Team's identification of an issue through reliable performance metrics and subsequent mitigation of the risk utilizing active contractor management.

The RFR Project's current major work streams include: (1) completion of the tooling for the mock-up; (2) completion of engineering; (3) tool performance guarantee testing in the mock-up; and (4) development of the Class 2 Estimate for the RFR work. Each of these phases is running on or slightly behind schedule at this time.

Our main concerns with respect to ongoing RFR Definition Phase work are: (1) the Class 2 Estimate does not currently contemplate including an assessment of logistics (such as material staging and tool transitions) supporting the removal and refurbishment of the reactor's internal components; (2) further delays to the design and construction of the Retube Waste Processing Building ("RWPB") could pose cost and schedule risk that could divert management attention from the main project work.

As part of the Class 2 Estimate, SNC/Aecon needs to provide an appropriate basis of estimate for its tool transitions, material staging and logistics, and other support activities. Because a significant amount of both the critical path and total hours of work on the RFR project relies heavily on the coordination of activities, not engineering product, it does not fit cleanly into the AACE Class 2 recommendations. The OPG team has proposed that this portion of the estimate should be supplemented through full mock-up simulations and other analytics, which are not currently in SNC/Aecon's plans. OPG and SNC/Aecon are currently working together to see how this logistical work can be incorporated into the

schedule. If OPG and SNC/Aecon can reach an agreement, it will reduce uncertainty in the Class 2 Estimate and will ultimately provide confidence that the Target Price is both reasonable and achievable.

Delays to the RWPB's definition are compressing the schedule and causing concerns at this time. However, DR Team has appropriately evaluated its options for the RWPB. The recent Options Review Board meeting set two conditions for the decision on the size of this building that have now been satisfied. This decision clears the way for the design to be finalized without further slippage to the completion date. The RFR project team is continuing to work with SNC/Aecon to improve its schedule. To that end, SNC/Aecon is designing the foundations, and will continue with their construction in parallel with the building design.

D. Other Major Projects

Planning and engineering work for the remaining scopes of work continues to progress. The design phase for the Turbine Generator is ongoing. OPG made the decision to maintain the existing Unit 2 controls without modification which will further simplify that work. Balance of Plant ("BOP") and Shut Down/Lay-up work is lagging, in part due to the late award of this work that was further complicated by the issues with Black & McDonald. The DR Team has put in place recovery plans for these projects in order to mitigate delays and the work is being awarded, defined and advanced to this plan. Defueling, Fuel Handling and Specialized Projects appear to be on pace at this time.

E. Engineering

Over the last quarter, we have examined the status of OPG's engineering in light of the initiatives the DR Team launched earlier this year. We looked at the impact of the DR Team's decision to actively manage the work, increasing front end planning and collaboration with the vendors. In general, we have observed improvements in the engineering process and vendor commitment, though this is largely anecdotal information. As we will discuss, better engineering performance metrics will allow objective confirmation of these observations.

Engineering's PIMS milestone completion date for all detailed engineering is in August, 2015, though the team is working to a May 15, 2015 target date, often referred to as the "stretch goal" ("May 15th Milestone"). While the August date is adequate for purposes of having all detailed engineering completed prior to the Execution Phase, this milestone is not optimal for supporting estimate development for RQE. Thus, the DR Team is currently working to be approximately 90% complete with detailed engineering by May 15, 2015, with the remainder of detailed engineering to be complete by August 2015. Assuming the work planning and assessing can proceed as planned, the majority of the major project work will have advanced to support the development of Class 2/3 cost estimates for RQE. The DR Team will need to a carry larger bandwidth of contingency for any project estimate that cannot be categorized at Class 2/3 levels.

Currently, the DR Project reports that it is 69% complete with design engineering, which is approximately 5% behind plan. The major scopes of work which comprise approximately 65% of the DR Project—RFR and Turbine Generator—appear to be on pace or slightly behind the May 15th Milestone. The work that is behind appears to be confined to the BOP, Shut Down/Lay-up and Refurbishment Additional Facilities, the latter of which includes a number of projects that will be cancelled or deferred, as well as some of the remaining Campus Plan Projects. Thus, the engineering work that risks missing the stretch goal represents approximately 7-8% of the total direct cost value of the DR Project.

OPG continues to develop an integrated, Level 3 resource loaded schedule for engineering, and this is needed to provide clarity to the current plan. OPG's current summary metrics show a very steep rate of detailed design package completion to meet a May 15th Milestone, meaning that a large number of engineering packages will be completed and submitted to OPG at the same time. These metrics need to be further substantiated. We believe that OPG should supply sufficient evidence that this plan is reasonable and achievable including how OPG will perform it is necessary design reviews within a compressed timeframe, and provide assurance that the engineering providers have sufficient resource capacity to complete the work. Further, the DR Team would benefit from giving visibility to those engineering packages that are most likely to miss the May 15th Milestone, and what impact, if any, there would be to RQE. This was an effective strategy the DR Team employed to meet its goals for the recently concluded Health of Scope campaign.

F. Project Management and Controls

The DR Team's Outage Management and Execution organizations have each developed detailed staffing and plans for actively managing their respective portions of the work. We see this as a major step in the DR Team's acceptance of its role and obligations for the Execution Phase.

All DR Team bundle and functional schedules are integrated in the Level 3 master schedule database at both Level 2 and Level 3. Over the last several months, we have witnessed a marked improvement in the Execution Phase schedule's development. All DR Team bundle and functional schedules are integrated in the Level 3 master schedule database at both Level 2 and Level 3. While these schedules are expected to mature further, the master scheduling plan establishes the right set of priorities and requirements that OPG will need for active management of the contractors.

In our past Reports, we have highlighted some concerns with the Project's Earned Value Management System. During the past quarter, we have performed a detailed assessment of the Cost Management and Earned Value Management Systems. The DR Team's metrics are still maturing and the goal is to have meaningful and industry-standard earned value metrics that provide a complete picture of contractor and Project performance. The DR Team has recognized certain gaps in its processes and is currently working on an improvement plan.

G. Corporate Support

In our last Report, we identified certain communication, performance and process issues with Human Resources, Supply Chain and Information Technologies that were impacting or had the potential to impact the DR Team from outside the Project. In particular, the Supply Chain issues related to communication and accountability to the Project are the most immediate concerns to the DR Project. Leadership of Supply Chain has been responsive and has shown a willingness to help the DR Project. Supply Chain and the DR Team have participated in face-to-face alignment meetings which have had an immediate impact on the working relationships. While this will require a continued effort, we are encouraged by efforts made so far.

II. Assurance Reporting

In addition to our on-going independent oversight efforts, we have been tasked with providing detailed observations and recommendations on various high-risk areas of the Project as a part of OPG's "Assurance Plan" in conjunction with Internal Audit and Nuclear Oversight. Over the past year, we have issued six Assurance Reports covering the following areas:

- Risk Management Practices and Procedures
- Scope Definition Management and Process
- Release 4c Process
- Schedule Management Program
- Campus Plan
- OPEX Program

BMcD/Modus has been working closely with the DR Team with respect of implementation of acceptable management responses to the observations and recommendations found in these Reports. Attachment A is a summary of all of the Reports completed to date. This summary will be submitted to the Audit & Finance Committee as a part of Internal Audit's composite report of the Assurance Plan for the DR Project. Over the next year, we plan to update our earlier findings as well as evaluate and provide assessments in the following areas:

- Release 4d Process/Gaps for RQE
- Cost Management System
- Commissioning Plan
- Change Management Processes
- RQE Development and Process

We also meet almost daily with members of senior management, Engineering and the project teams for RFR and BOP to monitor Project cost and schedule status, engineering progress and project planning for these high-risk activities. Additionally, we continue to meet monthly with the Refurbishment Project Executive Team ("RPET") and weekly with the DR Team's Management Systems Oversight group to discuss the recommendations we have made in these Reports to NOC in order to engage in discussions of appropriate OPG management actions. The DR Team continues to provide its cooperation and transparency to our oversight efforts.

III. Campus Plan Update

A. Overview

The Campus Plan Projects continue to have schedule and cost risk (particularly D2O Storage). Scope definition of smaller Campus projects may continue to reduce management reserve and contingency. Over the last year, the Campus Plan Projects, excluding D2O Storage Facility, have incurred approximately 20% cost growth overall. While these projects are generally smaller in size and, in aggregate, represent ~5% of the program cost, their success remains important to Refurbishment. In addition to D2O Storage and AHS, some Campus Plan Projects that have received partial funding are showing signs of scope creep and schedule issues; OPG is actively monitoring and mitigating these issues to the extent possible and has increased the effectiveness of its regular meetings with the ESMSA contractors and associated metrics that are intended to root out problems before they increase in in severity.

The D2O Storage Facility remains the principal focus for P&M due to its size, growth, lack of predictability and importance to Refurbishment. OPG is currently estimating the cost of the D20 Storage Facility to be $373M, an increase of $263M from the full funding release request in May, 2013. The on-going performance issues with the principal contractor, Black & McDonald have diverted management attention from the other projects. While the work needed to replace Black & McDonald and mitigate the impacts will require an intense effort by P&M, the change in course for D2O Storage Facility should have an overall positive impact on P&M and the F&IP work.

B. Major Campus Plan Projects

1. D2O Storage Facility

On October 16, 2015, OPG terminated Black & McDonald that its purchase order for the D2O Storage Facility. This termination was limited to D2O Storage Facility; Black & McDonald is expected to continue with its remaining purchase orders for both P&M and Refurbishment, though OPG had previously announced its intentions to restrict or reassign much of that work to other ESMSA contractors. Under the provisions of the ESMSA, OPG has also provided a written notice to Ellis Don that OPG will be assuming direct control of its subcontract to continue work in the field on the D2O project. For the time being, the work will proceed on site according to the current schedule while the DR Team considers the next step.

In light of the termination, OPG will need to reassign or rebid the work to another contractor while it develops a mitigation plan capable of draining the water from Unit 2 with minimal impact to Refurbishment. OPG will need to devote significant attention to vetting the new plan so that it is developed with sufficient quality to meet the needs of Refurbishment. The DR Team has assigned a team consisting of appropriate Engineering and Operations & Maintenance personnel to develop options for an alternative approach that will allow the DR Project to meet the breaker-open date for Unit 2 in the event that D2O Storage is not complete. Such a solution should be properly planned and made ready for execution with a mature a Class 2 level cost and schedule on the assumption that it could, at some point, be the only alternative for storing water from Unit 2.

OPG is currently considering its available options and is developing a revised business case for proceeding. We recommend that OPG consider the following options in its business case:

- *Reassign the D2O work to one of the other ESMSA contractors (assuming there is another ESMSA in place with capacity to handle the work) through either direct award or a secondary compete process*. The new ESMSA

contractor would have to quickly mobilize, take possession of all purchased materials, plan and schedule the work, subcontract off-site prefabrication and other work, and perform on an accelerated basis in an attempt to complete the building prior to Unit 2's breaker open (or as soon as possible thereafter). The alternative approach will be used only as a mitigation strategy so as not to delay breaker open; or

- *Issue an RFP to qualified contractors that assumes an aggressive schedule in order to complete the work as quickly as possible.* Again, this option would require quick mobilization and acceleration costs. Bid evaluation will be based upon rate sheets, overhead, supervision costs, fees and potentially the best construction plan, but the bid period will be short so that a full schedule and estimate of the work cannot be developed and evaluated as a part of the bid. This plan would allow negotiation of a project-specific contract that would incorporate appropriate milestones for developing cost and schedule as well as incentives and disincentives for contractor performance.

- *Issue an RFP to qualified contractors assuming that the completion milestone will be extended for a reasonable amount of time allowing for a true "competitive bid" process based upon completed engineering.* In this scenario, OPG would implement the mitigation plan to drain the water and complete engineering and some of the current excavation work. Once engineering is complete, the project can then be re-bid on a competitive basis, seeking both a realistic schedule and pricing for the Project. This would also give OPG time to re-examine the needs for the D2O Storage Facility and decide whether the design properly addresses that need, and whether the cost is justified based upon a sound business case. This scenario may also allow OPG to achieve some of the value engineering solutions for reducing the D2O Storage Facility scope in a less compressed time frame.

While the design work is largely complete, the first and second options will require quick action for another contractor to assume the work, develop a cost estimate and schedule and re-plan the work effort to minimize lost time. Such a plan will likely include added costs for acceleration, and even with those added costs, the new contractor may not be able to complete in time to support breaker open. Moreover, whichever contractor takes on the work is likely to include a premium in its price due to these circumstances. The third scenario could provide OPG the opportunity to establish the true cost of the project (whether or not the design changes) in a competitive bid environment, and to show that the cost increases are reasonable and based upon increased scope. It may also enable OPG to seek a different commercial arrangement for its construction. The third option would have the disadvantage of OPG having to incur added carrying costs, which could actually make this option cost prohibitive, but it should be evaluated as a part of the business case.

Under any scenario, completing the D2O Storage Facility to support the start of the Unit 2 Refurbishment has a considerable amount of risk and the option OPG chooses to procure the completion of the building needs to fully account for those risks. Thus, having the alternative solution for draining the water from Unit 2 should be assumed for any modeled scenario, and we would recommend management establish a well-defined decision point appropriately in advance that specifies the direction the team will take if ongoing construction work on D2O Storage Facility cannot meet the needs of Unit 2's schedule. That plan needs to consider long lead items, approvals needed from external stakeholders and impact on operations, at a minimum OPG is reviewing its options at this time, and is preparing a revised business case that should consider these and any other reasonable scenarios for the Board of Directors' review.

2. Auxiliary Heat

The Auxiliary Heat System ("AHS") originally was scheduled to be in service prior to the start of the VBO. The current schedule for commissioning the new Auxiliary Boilers shows an in service date of May 25, 2015, nine weeks beyond the original target. P&M management has pivoted its focus on the likelihood that the new AHS will not be available for the start of VBO. The existing boilers will remain in place until the new AHS is available for service, which will meet OPG's needs for VBO. The remaining issues are with the AHS's cost and schedule predictability. As noted, ES Fox has also agreed to deliver to OPG its full estimate for AHS and is working with OPG to further refine its schedule. ES Fox is already working two shifts on the critical AHS work in an attempt to recover as much time as possible. The P&M team is evaluating ways to shorten commissioning and start-up and staging release dates for the equipment.

3. Containment Filter Venting System

In our last report, we identified that CFVS was one of the P&M projects that needed additional attention, as the cost of the project was projected to increase by as much as 35%. There has been an increase in scope, and thus its corresponding cost, however, the contractor's cost estimates lack rigor and P&M's has accepted large cost increases without sufficient justification or explanation.

When the project team proceeded to the Gate Review Board ("GRB") for its partial execution funding to perform some preparatory work before the onset of winter, the estimate for the work presented had not progressed beyond Class 4. This was despite the fact that the design was sufficiently mature to support the development of a much more detailed estimate at that time. Although the GRB rejected the request for being insufficiently supported, the estimate presented by the project team identified a project management weakness that P&M needs to address. As of this September GRB meeting, ES Fox had not provided a quantity breakout of its current cost estimate, and had submitted requests for change orders that were not vetted by the project team; nonetheless, the amount of these changes were included in the estimate at completion ("EAC").

Under the ESMSA contract, the Contractor's actual costs are open book and are subject to audit by OPG upon request. Moreover, the Contractor is obligated to follow OPG's scheduling standards and provide an integrated schedule, and report progress and status on weekly basis. It is essential that OPG enforce these contract requirements; otherwise, it is difficult to evaluate whether changes in scope are necessary and properly estimated. The project team's representation of an EAC that had significantly increased without proper vetting highlighted the need for the P&M project managers to have a better ongoing understanding of the cost impact from design changes, and for the contractors to provide more detailed and timely information to support cost increases. P&M's management is developing a plan to address these deficiencies.

4. Vendor Performance Issues

Black & McDonald is still performing work other than the D2O Storage Facility that is important to Refurbishment. As a result, OPG will have to closely monitor this work to ensure that Black & McDonald is meeting expectations for safety quality and performance.

ES Fox's performance has thus far been more predictable and its team has been very responsive to addressing any issues raised by OPG. However, the scope creep and cost increases evident in some of its work indicate that P&M needs to be vigilant in managing ES Fox's work. Any lessons from Campus Plan Projects should also be understood by the Refurbishment BOP team, which is using ES Fox for multiple scopes of work. Thus, the need for P&M and Refurbishment BOP project managers to vet ES Fox's estimating methodology, including how ES Fox is using factors for productivity, estimating project management team size and engineering costs, among other things.

C. Schedule and Cost Development

P&M's efforts to develop and update the project schedules for the Campus Plan Projects has had mixed results. The team met an initial goal to have detailed schedules loaded into the OPG network, though many of those schedules were found to have quality issues. As a result, the schedule performance index ("SPI") for these projects may not be reflecting the project's actual progress. The DR Team is are intensifying efforts to increase the accuracy of these schedules by performing back pass reviews which have established needed milestone dates for these projects and by holding focused reviews to correct logic and duration issues. However, the contractors' schedules still need improvements in critical path definition, logic and resourcing.

The following chart illustrates the current status of the P&M schedule development for the major F&I projects currently underway. We have distinguished those projects currently in the Execution Phase from those still being planned, as those projects need an executable schedule in place immediately.

MODUS Strategic Solutions CANADA

Report to Nuclear Oversight Committee – 4Q 2014
Darlington Nuclear Refurbishment Project

Burns & McDonnell CANADA

F&I Project Description	EPC Contractor	Schedule Development			Phase of Work/Comments / Schedule Confidence Level
		In OPG Schedule Network	Schedule Developed	Schedule Perf. Index (SPI)	
OSB Refurbishment	Black & McDonald	Yes	Yes	0.87	In the execution phase. Schedule appears adequate for project completion
D20 Handling & Storage Facility	TBD	Yes	No	0.55	In the execution phase. Schedule will have to be reworked by new contractor.
Auxiliary Heating Steam	ES Fox	Yes	No	0.98	In the execution phase. Low schedule confidence. Schedule in rework to address logic issues.
SIO - Emergency Power Generator 3	ES Fox	Yes	No	0.99	In the planning phase; execution schedule to incorporate recovery plan.
SIO - Containment Filtered Venting System	ES Fox	Yes	No	0.59	In the planning phase. Schedule for execution being reworked.
SIO - Powerhouse Steam Venting	Black & McDonald	Yes	Yes	0.89	In the planning phase. Schedule is currently under development for project execution.
Shield Tank Overpressure Protection	Black & McDonald	Yes	Yes	0.79	In the planning phase. Schedule appears adequate for project execution.
Water and Sewer	Black & McDonald	Yes	Yes	0.91	In the execution phase. Project is nearing completion.
RFR Island Support Annex (RFRISA)	ES Fox	Yes	Yes	0.78	In the execution phase. Schedule appears adequate for project execution.
Refurbishment Project Office	ES Fox	Yes	Yes	0.79	In the execution phase. Schedule appears adequate for project execution.
Electrical Power Distribution	Black & McDonald	Yes	Yes	0.73	In the execution phase. Schedule appears adequate for project execution.

The above SPI's for these projects reflect both the status of the projects and a number of deficiencies in the schedules themselves. In order to better understand the true performance trends, the following schedule issues need to be sorted out:

- Because P&M's rules for change management only allow the schedule for a project to reflect approved scope, the budgeted hours used for calculation of SPI appear to be skewing the indices. There should be place holders for known scope that approximate the effort associated with unapproved changes.

- These schedules were built utilizing principles commonly associated with outage or plant modification schedules, with each project's Engineering Change ("EC") packages having independent logic, rather than a typical construction schedule where work is depicted and logically tied by discipline. Scheduling by EC package does not allow for efficient management of contractor resources or prioritization of work—which is important when managing multiple projects, as some carry greater risk.

- As projects pass through gates, P&M allows the work to be fully rebaselined such that prior delays are no longer apparent. As a result, this and the quality of the current vendor supplied Level 3-detailed schedules continue to make efforts to establish meaningful earned value and schedule adherence metrics problematic.

As noted, P&M's project team also needs to increase its vigilance and perform more analysis of performance (schedule and cost) trends. P&M has recently increased its efforts to understand and adequately vet the projects' cost estimates. P&M has met with ES Fox to determine its methodology for developing cost estimates and specifically to obtain a copy of its detailed estimate for AHS to use as a template for all of the other projects. ES Fox was responsive to OPG's goals and has committed to providing its estimate and its cooperation. This is a good initial step though there is substantial work to be done, because the accuracy of earned value indices suffers without reliable cost estimates and planned values.

As noted, the Project Controls Team has been asked to review and standardize the approach P&M is using to conform to that of Refurbishment. However, because P&M is in the execution phase of its work, it needs an earned value system that is seamless to implement, will not cause interruption to ongoing work effort and is useable in the shortest possible time. The DR Team currently has devoted resources to improve P&M's earned value system. We have provided recommendations directly to the P&M and Project Controls teams regarding the method and structure of earned value for these projects. The temptation to over-complicate the implementation of earned value for these smaller, in-flight projects should be resisted. Once the base elements for earned value are defined and reported, the calculation of the performance metrics can be done very simply to allow for proper contractor management and tracking. In order for the earned value system to be useful for the P&M Refurbishment Prerequisite and Campus Plan Projects, it must be developed within the next quarter. We will continue to monitor and vet these activities.

IV. Major Refurbishment Projects – Summary of Key Risks

A. Retube & Feeder Replacement

1. Tooling Fabrication

In our prior Reports, we raised a risk regarding the potential for late tooling delivery to impact the quality or timing of the Class 2 Estimate. Much of our concerns have been alleviated over the last quarter as SNC/Aecon's tooling recovery plan achieved its target of returning to an SPI of 1.0 in September. Those few late tools did cause the SNC/Aecon to miss the Prototype Complete milestone on September 30th and are pushing the December 31st Qualification Complete milestone, though the impact of these missed milestones is minimal. Further, the project should benefit from a more rigorous qualification process that will result in a much more durable toolset during execution.

In addition to the above, as the tooling schedule has recovered and the delivery dates have approached, the predictability and adherence to the schedule from the tooling vendors has also improved. This has allowed SNC/Aecon to revise its schedule for tool performance guarantee testing, which will commence in earnest in November 2014 and run through March 2015, supporting the input to the Class 2 Estimate. A significant first step in preparations for tool performance guarantee testing was achieved in the first week of October with the delivery and installation of RTP-1 at the DEC mock-up facility. The focus will now be to drive the final few tools to qualification completion and delivery to the DEC to maintain the tool performance guarantee testing schedule.

2. Engineering and Procurement Status

As of the end of September, detailed engineering was 53% complete and showing an approximate one and a half month delay to the contract completion date of June 15, 2015. This delay is largely being driven by a delay in procurement of three subcontractor packages, with the vault crane upgrades being the most severe. SNC/Aecon is expediting the procurements and is working with the vendors to optimize the schedules in order to attempt to mitigate the delay. We will continue to monitor engineering progress throughout the winter months to gauge any impact late engineering could have on the Class 2 Estimate deliverables.

3. Class 2 Estimate

The Class 2 Estimate is progressing slowly at this point, although SNC/Aecon has indicated that it expects to meet the June 2015 completion date. The engineering is compressing the available time for completion of the Stage 3 construction work packages and the associated assessment of that work; however, SNC/Aecon will have completed enough engineering to support the AACE Class 2 Estimate guidelines. Similarly, the tool performance guarantee testing is progressing and, as discussed above, does not pose a risk to the Class 2 Estimate. The largest risk remaining to the completion of a quality Class 2 Estimate at this time is the completion of "validation" work for non-tool performance guarantee tasks. Validation work includes running rehearsals, story boards, and modeling of tool transitions, material staging, and other logistics both in the mock-up and/or in computer simulations. This work does not cleanly fit the AACE guidelines because it relies more on logistics activities and laydown space, which is not an engineering product. This work represents a significant amount of both the critical path and total hours of work on the RFR project and without a solid basis for the estimate of this effort; the Class 2 Estimate could be weakened. At this time, discussions with SNC/Aecon are ongoing to determine the work that will be validated in the mock-up over the coming months. If OPG and SNC/Aecon can reach an agreement, it will reduce uncertainty in the Class 2 Estimate and will provide confidence that the Target Price is both reasonable and achievable.

4. RWPB Building

The design, construction, and commissioning of the Retube Waste Processing Building ("RWPB") is a concern at this time and is being addressed by OPG and SNC/Aecon. The RWPB will house the tools that reduce the volume of the reactor components after they are removed from the vault. To this point, the RWPB has been delayed awaiting decisions on the final sizing of the waste tooling equipment and the determination of necessary staging and buffer areas around that equipment. In July 2014, SNC/Aecon submitted a revised proposal for the RWPB which has been under evaluation by the RFR project team. In early October, aspects of the proposal was presented to the Options Review Board which gave a conditional approval to move forward with foundation design and construction, as well as resizing and extending the RWPB, pending final evaluation of two alternatives, which have been subsequently closed off as too costly.

Concurrent with OPG's review of the proposal, SNC/Aecon revised its schedule for the RWPB and incorporated it into the master schedule. The result shows a very tight schedule to breaker open, with commissioning of the building to be completed in late January of 2017. OPG is working with SNC/Aecon to rationalize this schedule and improve the completion dates.

The RFR team believes it is important to enclose the building by fall/winter of 2015 so that the waste tools can be delivered, installed, and commissioned prior to breaker open in the fall of 2016. To support this schedule, SNC/Aecon is moving forward with caisson design and construction in parallel with the building design to mitigate the delays in the engineering of the resized and extended RWPB. To ensure the foundations can support the developing design, SNC/Aecon will have additional design margin to support the size of the building and any potential code changes, which is a common practice in the industry at large. In addition, lessons learned from the D2O building are being incorporated into the foundation design to prevent a repeat of the issues that have been encountered on that project. The progression of caisson design and construction, as well as the building design, will be monitored closely over the coming quarters to gauge the impact of any further delays.

B. Balance of Plant and Shutdown/Lay-Up

The Balance of Plant ("BOP") and Shut Down/Lay-up bundles have been impacted by the reassignment of work from Black & McDonald to ES Fox and by a need for better comparative cost estimates of work scopes. The BOP and Shut Down/Lay-up teams have increased the active management and collaboration with the contractors and the owner's estimator, Faithful + Gould. In addition, the scope of the work continues to narrow based on favorable results from in-plant inspections and further re-examination of the work through the Options Review Board and gate reviews. BOP has identified $14M that has moved from base scope to contingent scope based on future inspections of plant conditions, and has another $30M in work that it has similarly targeted. In addition, the recent 4d Cost Estimate work each team performed was very detailed and gives senior management the opportunity to fully examine this work.

Over the next two quarters, BOP and Shut Down/Lay-up will need to mature rapidly to make up for the initial delays in awarding the work. Both BOP and Shut Down/Lay-up have developed recovery plans and are now working toward those plans. The DR Team has now awarded all purchase orders for Shut-Down/Lay-Up and expects to have all of the purchase orders for BOP (except for the Adjusters) in place by the end of November 2014 at which time OPG will have detailed schedules. The estimating process is also being addressed based on lessons learned. Detailed design of many of the Balance of Plant and Shut Down/Lay-up work packages are behind schedule, but the main risk of these delays is limited to increasing the contingency for this work for RQE. Ensuring that the Shut Down/Lay-up work matures quickly is a higher priority right now than BOP as much of this work needs to be well-planned prior to breaker open. The DR Team is also examining the appropriate schedule windows for this work so that staffing plans can be further rationalized and schedule float maximized.

V. Functional Groups Update

A. Engineering

Over the last two quarters, we have been particularly focused on the DR Team's engineering efforts. In all manner of construction, engineering is typically a leading indicator for the execution phase. Moreover, engineering progress is a major factor in determining the Project's maturity and readiness for RQE.

1. Progress of Engineering Initiatives

During the latter part of 2013 BMcD/Modus stressed the importance for OPG to embrace its role as DR Project's integrator and to actively manage the multiple contractors hired to perform the work. We also recommended a greater focus on Front End Planning and suggested a more collaborative approach to working with the different engineering service providers. In early 2014, the DR Team made a shift in its engineering strategy and Engineering launched several initiatives aimed at improving the efficiency and effectiveness of the engineering portion of the program.

In order to assess the impact of these initiatives, our team has monitored the progress of the engineering effort including meeting independently with the engineering service providers to pulse their reaction to the changes OPG has initiated. Our observations confirm that these initiatives have generally improved the communication and work flow between OPG and its engineering vendors. It appears that management and staff have become more engaged, are developing a sense of ownership, and are working to resolve issues with a greater sense of urgency. Evidence that these initiatives are working include:

- OPG Engineering has developed an expediting team that is monitoring the work within the engineering firms on the Campus Plan Projects. This team has been effective at reducing the response time for outstanding inquiries by the vendors, and speeding the process for design reviews. So far, the four projects that have reached design completion have done so in less time as a result of this effort.
- OPG resident engineers have been located in the offices of the engineering service providers, which has eliminated several layers of management and supervision, improved communications and provided a clearer line-of-sight between the OPG Design Authority and the engineers performing the work.

- Process check points have been implemented so that detail design does not begin until the pre-requisite planning steps have all been satisfied.
- Design Authority decisions are being made on a more informed and timely basis, and the Design Authority is actively engaged in reviewing and answering questions at much earlier stages.
- Senior management has interceded and stopped Operations & Maintenance's untimely COMS reviews that had previously resulted in changes to approved design work at the 60% and 90% complete levels.

The benefits from these initiatives will continue to be realized as the DR and P&M projects advance. Reduced review and comment disposition cycle times, timely approvals, consistent stakeholder alignment to the adopted solutions, more rapid escalation, collaborative issue resolution all serve to enhance the effectiveness and efficiency of the engineering effort. OPEX from the F&I Projects has demonstrated that passive oversight, churn, late design changes, lack of stakeholder alignment, unclear direction, miscommunication and indecision delays the schedule and adds significant cost to the project. The full impact of any cost savings from the engineering initiatives will not be known until the execution phase. The expectation is the upfront planning work will eliminate or minimize late COMS reviews generating design changes and field changes. The DR Team should look for ways to track the overall savings derived from these initiatives.

All of the above have reduced the amount of time and effort required to produce the work product. Further gains in the efficiency of the engineering process and the effectiveness of the design solutions are possible and we encourage OPG and the engineering service providers to take the necessary steps to continue to improve.

2. Engineering Progress

Engineering's PIMS milestone completion date for all detailed engineering is in August, 2015, though the DR Team is working to a May 15, 2015 target date, often referred to as the "stretch goal" ("May 15th Milestone"). While the August date is adequate for purposes of having all detailed engineering completed prior to the Execution Phase, this milestone is not optimal for supporting estimate development for RQE. Thus, the DR Team is currently working to be approximately 90% complete with detailed engineering by May 15, 2015, and the remainder of detailed engineering to be complete by August 2015. Assuming the work planning and assessing can proceed as planned, the majority of the major project work will have advanced to support the development of Class 2/3 cost estimates for RQE. The DR Team will need to a carry larger bandwidth of contingency for any project estimate that cannot be categorized at Class 2/3 levels.

Currently, the DR Project reports that it is 69% complete with design engineering, which is approximately 5% behind plan. The major scopes of work which comprise approximately 65% of the DR Project—RFR and Turbine Generator—appear to be on pace or slightly behind the May 15th Milestone. The work that is behind appears to be confined to the BOP, Shut Down/Lay-up and Refurbishment Additional Facilities, the latter of which includes a number of projects that will be cancelled or deferred, as well as some of the remaining Campus Plan Projects. Thus, the engineering work that risks missing the stretch goal represents approximately 7-8% of the total direct cost value of the DR Project.

OPG's effort to produce an integrated, Level 3 resource loaded schedule for engineering continues, as the engineering service providers updating their Level 3 work schedules to incorporate awarded work. Some completion dates are currently being constrained by the May 15th Milestone, resulting in a depiction of the EC Completion that appears to be unachievable and unrealistic. We recommend that OPG verify that the engineering suppliers are prioritizing their work for the May and August milestone dates so that the higher value and achievable engineering work is prioritized completed in time for providing the basis to RQE.

The DR Team is also planning to develop a post-RQE check estimate prior to breaker open in 2016 at which time the remaining scopes of work can be refined and the Project's control budget adjusted as needed. At that time, the remaining design packages that are completed after August 2015 can be trued-up in the RQE control budget.

3. Recommendations

The DR Project's goal to complete all of the Detailed Design work prior to the May 15th Milestone is considerably challenged at this time. There are multiple contributing factors:

(a) Engineering Metrics and Schedule of Activities Need Improvement

OPG engineering's performance tracking metrics are missing a needed level of granularity and as a result, these metrics can be misconstrued. Current metrics in use by OPG and the contractors have been formulated on the basis of earning rules that track completed deliverables. These metrics are not based on resource loaded work schedules, which make progressive schedule performance (i.e. the status of each deliverable as they are being developed) more difficult to determine. The earning rules also incorporate level of effort activities that can skew the earned value picture. Thus, this metric shows a dramatic "cliff" of completion without the appropriate level of granularity to show that design completion can reasonably be achieved in this manner.

Our concern here is two-fold: (1) the engineering work down curve is not providing enough assurance of the work that leading up to the May 15th Milestone can be achieved; and (2) if this work-down curve is accurate, there will be a large bow wave of work at the end that will overstress OPG's engineering resources for its approval cycle.

BMcD/Modus sees the following as essential next steps to refine these metrics: (1) Engineering should include a better depiction of the events leading up to the May 15th Milestone and the August completion dates so that steps in the actual work effort are more visible; (2) the metrics Engineering is producing for the major bundles need to be verified against the contractors' plans so that there is confidence in the data; (3) to the extent that any design packages are going past the May 15th Milestone, those packages should have visibility so that priorities may be vetted; i.e. any work that carries a potentially high value can be prioritized for purposes of RQE.

We recommend that the DR Team adjust the engineering schedule and the related metrics to reflect more realistic expectations, prioritized by the importance of completing the work to the quality of the RQE, and provide more organized input into the downstream activities of estimating, procurement, construction work package development and on-line wiring.

(b) Further Gains in Execution Efficiency

OPG's EC process is intended to provide a systematic risk based approach to plant modifications—the higher the technical risk, the more rigor that is demanded. The EC process has been well established for the Project. It is consistent with sound engineering practice within the nuclear industry in North America. Despite the process being sound, from our interviews with the engineering service providers and observations of the execution of the process, the manner in which the work is performed still contains inefficiencies. OPG has embraced a number of activities to further improve the efficiency and effectiveness of the engineering execution summarized below:

- **Non-Value Added Activities:** To address execution inefficiencies, OPG will undertake a LEAN Value Stream Mapping assessment of the engineering performance of the EC process, performed by a third party experienced in this type of evaluation.
- **Value Engineering**: Value engineering is an important step in engineering design and OPG has formal value engineering requirements for the EC process. There is growing evidence that this work has not been performed to the level of rigor expected by OPG as part of the plant modification detail design. OPG are examining this in greater detail.
- **Options Review Board.** The ORB was initiated to deal with the emergence of less than optimal solutions finding their way into the design process despite the various challenge points built into the EC and Gate review processes. The ORB meetings are still evolving, but they do currently supply provide a forum so that the DR Team can make appropriate engineering decisions.

B. Project Controls

We noted in our 3Q Report that the DR Project's project controls development had not matured as expected by this time in the Project. The following is a current assessment of the state of the DR Project's Master Schedule and Cost System development.

1. Schedule Mechanics

OPG's schedule network is currently set up and functional with all DR Team bundle and functional schedules represented in the database at both Level 2 and Level 3. However, not all of the DR Project's contractors are currently working inside the active OPG schedule database. The DR Team has scheduled a summit to finalize a plan that drives contractor participation in OPG's network for early November of 2014. While the schedule development is somewhat behind, OPG has spent a great deal of time and effort developing the Level 3 Schedule Management Plan, that once implemented, will establish the right set of priorities for developing the Execution Phase schedule. We have reviewed the Level 3 Schedule Management Plan to verify that reasonable scheduling concepts have been incorporated.

2. Schedule Quality Assessment

Although each project now has produced a detailed Level 3 schedule, Balance of Plant, Shutdown/Layup and some of the facilities that support the DR Project are the least mature due to the issues as discussed in this Report. It is our understanding that the Level 3 schedule for Balance of Plant and Shut Down/Lay-up is in progress and will be completed in November 2014 with the exception of the Adjusters scope.

The DR Team is focused on developing and integrating the schedule details for the prerequisite work that must be completed prior to execution of Unit 2. The project controls leads for each team are currently focused on this key part of the live schedule. This effort needs to be completed as soon as possible to ensure that the execution work can begin on time. OPG is also growing its execution team and incorporating appropriate placeholders in the schedule for undefined work. The schedule organization is now embedded with the Outage Planning organization providing additional assurance that proper integration will occur.

As we have noted, resource loading is vitally important to measuring contractor schedule and cost performance during the Definition and Execution Phases. This is especially true given the target price nature of the majority of the contracts. The DR Team is currently working to resource load the schedules to support the earned value management system.

3. Cost Management, Earned Value and Performance Measurement

During the past quarter, we have performed a detailed assessment of the Cost Management and Earned Value Systems. Based on that assessment, we have made the following observations:

- In general, the Project's Cost Management System functions as we would expect for a project of this size. The DR Team's cost data is now standardized across all of the project bundles, and provides a controlled environment to provide reliable cost data.
- One of the concerns with the Cost Management System is that the data input is a manual process that requires a lot of time and effort. Project Controls is developing a process to automate this.
- Because the current work is mostly engineering and procurement, the DR Team is using deliverable counts as the basis of earned value. However, deliverable counts typically depend on completing by milestones. There can be considerable work needed between milestones that can be difficult to see and forecast. For long-range activities, the time between milestones can create "cliffs" in earned value metrics that appear to be unachievable. To the extent possible, we recommend OPG confirm that the current progress to the milestones will result in the milestones completing on time.

- For Execution Phase work, earning rules should be structured to emphasize installed quantities and work-hours to determine project performance. OPG agrees and has created a draft of its earning rules for each of the procurement and construction phases of the Project. The construction phase earning rules are based on installed quantities and will track work hours.

- The performance metrics and reports that are currently being generated from the Earned Value Management System need more detail to support active management of the contractor by the project managers and functional managers. In particular, these metrics need more focus on performance trends.

- The change control processes need to be improved. This includes improving the baseline estimates against which cost is measured and the utilization of an estimating database and standard estimating templates. Additionally, early recognition of trends through forecasting by certain project management teams is not effective.

OPG has recognized many of these issues and has devoted resources to review and implement solutions for these gaps. In particular, two teams have been developed to look at techniques for tracking and measuring man hours and quantities and to develop more effective and standardization of reports. The DR Team is reviewing its estimating and change control processes in light of these programs.

Additionally, the DR Team is planning to utilize the US Cost estimating database to facilitate the evaluation of quantities and work-hours. This database will bring continuity across the project teams and should provide a baseline for performance measurement and project forecasting. The next task at hand is for the Project Controls Team to increase its ability to accurately forecast the Project's cost and schedule based on better estimates and change control. Time remains for the DR Team to move forward with these project enhancements, though we would encourage the team to establish these as possible, given the importance of establishing a sound reporting regime.

Attachment A – 4Q 2014 Risk Perspective

Area	Risk	High / Medium / Low	Current Status / Mitigation
RFR	**SNC/Aecon Performance**: Largest Program risk due to importance to the DR Project and OPEX		► Tooling recovery achieved SPI of 1.0; minimal challenges remain ► Detailed Engineering behind schedule though impact limited ► RWPB behind schedule; working to optimize schedule
	Class 2 Estimate: Progression to RQE requires a robust Class 2 estimate that is thoroughly vetted		► Class 2 work is just commencing and is currently on-schedule ► Schedule is very tight and being further compressed by late engineering and TPG testing; OPG engaged in an iterative review process with SNC/Aecon to ensure early reviews and feedback are provided.
	Schedule Development: Level 5 schedule under development; requires challenge to total duration		► SNC/Aecon identified schedule tracking plan that needs to be proven; schedule durations to be challenged as part of Class 2 review. ► Integration of support activities and logistics in schedule remains a risk
	RWPB Delays: Potential risk to RFR schedule; RWPB and waste tools required for start of removal work		► RWPB extension conditionally approved by OPG; allows foundation design/construction to move forward, concurrent with building design ► Current schedule shows commissioning of RWPB occurring parallel with defuel, reactor drain, etc. with little room for error or delays ► Lessons learned from Campus Plan work are being integrated
	RFR Commercial Risks: Contract provisions currently in place may not drive desired contractor performance		► The RFR Team has approached SNC/Aecon regarding the need to potentially renegotiate incentives and disincentives ► Need to understand potential changes for Class 2 Cost Estimate accuracy
Campus Plan	**ESMSA Performance**: D20 Storage and AHS work is behind schedule and over budget		► D20 is a threat to Unit 2 breaker open; alternatives being evaluated ► Black & McDonald terminated from project, options under consideration for completing the project; civil contracts assumed by OPG and field work continues.
	P&M Engineering & Project Management: Process improvements are required in areas of vendor management, project controls, change management, and estimating		► Engineering co-location and active management beginning to yield results ► Bi-weekly ESMSA meetings providing visibility to issues ► More detailed vetting of vendor estimates and schedules required ► Some improvement in active PM oversight of scope, cost, schedule, and risk, but more is needed to control project baselines ► Need to improve project controls metrics ► More rigorous change management process required
BOP	**ESMSA Performance**: Concern over ESMSA contractors' performance and execution ability		► Allocation of work underway; some issues with cost/scope estimates ► Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed ► Detailed engineering milestone at risk due to late assignment of work

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Attachment A – 4Q 2014 Risk Perspective

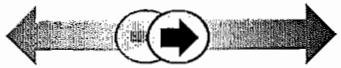
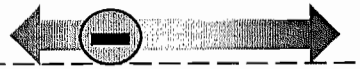
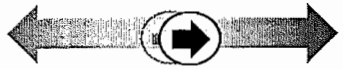
Area	Risk	High / Medium / Low	Current Status / Mitigation
Engineering	**Engineered Solutions**: Options Review Board has increased scrutiny of design decisions		► Conservative design decisions are driving up cost ► Options Review Board has been effective in challenging scope decisions ► Additional scope decisions may be necessary due to cost velocity measured in 4d Cost Estimate
	Planning of Engineering Work: Engineering work was initially not well understood requiring focus on re-planning		► OPG engineering is taking more active role in directing and managing the work at the engineering studios ► "Bottoms-up" estimating process initiated for engineering activities ► Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place
	Engineering Metrics: Current metrics lack granularity		► OPG needs assurance that engineering can be substantially complete by May 15, 2015 ► Metrics need more detail evidencing resources and planning
Project Controls	**Continued Schedule Development**: Schedule approach was unproven; integration at appropriate level at risk		► Project Team adopting industry-wide recommended scheduling practices ► Substantial work remains to populate detailed level 3 schedule; placeholder schedules incorporated; resource loading started but progressing slowly ► Logic and critical path definition remains an issue with Campus Plan projects; some backward passes have begun
	Progress Towards RQE: With 4d delivered, focus must quickly turn to executing the plan for RQE		► 4d Cost Estimate delivered within $10B range; bundle team challenges will require considerable effort to achieve savings targets included in 4d ► RQE development remains essentially on schedule, but will be heavily reliant on the quality and timing of the various inputs ► The DR Team has assigned a director to manage RQE integration
	Risk Management Program: Risk registers require scrubbing; monitoring tools are cumbersome		► DR Team is cleaning up the risk register and improving reporting ► Risk Group is taking a more active role in managing the Risk Program ► Risk training is being conducted but more is required ► Campus Plan Projects risk awareness remains an issue
	Cost & Performance Measurement: Current system effectiveness/ efficiency should be reevaluated; project controls metrics need improvement		► Earned value management techniques need to mature ► Tools for earned value tracking have limitations that need to be reviewed

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Exhibit L, Tab 4.3, Schedule 1 Staff-072
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Exhibit L-B2.02-CME-019
Attachment 3 Page 18 of 18

Report to Nuclear Oversight Committee

1st Quarter 2015

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

March 12, 2015

MODUS Strategic Solutions CANADA

Report to Nuclear Oversight Committee – 1Q 2015
Darlington Nuclear Refurbishment Project

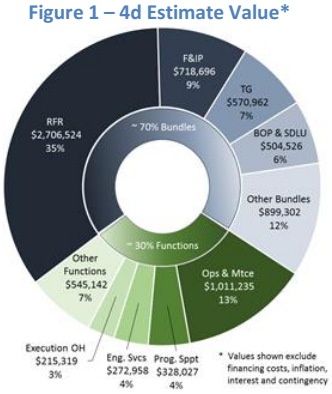
Burns & McDonnell CANADA

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of February 25, 2015. Our main focus for this report is the status of the DR Team's preparation of the Release Quality Estimate ("RQE") that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value*



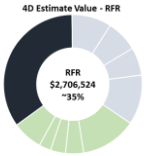
For purposes of evaluating the DR Team's progress in preparation for RQE, we have provided the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts. The following are the most notable cost elements of the DR Project at this time:

- **RFR** constitutes approximately 35% or $2.7B of the DR Project's estimated costs;
- **Turbine Generator** constitutes approximately 7% of the DR Project's estimated costs;
- **Balance of Plant and Shut Down/Lay-up** constitute 6% of the estimated costs; and
- **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the inputs to RQE progress, the DR Team will be comparing its revisions to the breakdown presented here from the 4d estimate.

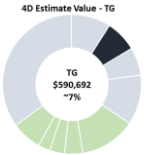
Over the last Quarter, the DR Team has spent a significant amount of time evaluating its plan and processes for developing the components of RQE, including improving the data the team and management will need for analysis and establishing confidence. The following is a brief summary of the status of the major inputs to RQE:

Retube and Feeder Replacement:



SNC/Aecon's Class 2 Estimate is the single largest input to RQE. OPG's Project Team recognizes the importance of this estimate and had requested SNC/Aecon to advance the delivery date to April 10, 2015 (from its original plan May 15, 2015). [redacted] OPG has granted a 2-week extension to April 24, 2015 [redacted] The OPG team is preparing for this review period and intends to vet the various estimate components to ensure they meet the DR Project's needs. Also, [redacted] OPG's Project Team is mindful of the Campus Plan Projects lessons learned and thus rejected SNC/Aecon's estimate. The OPG team has a clear understanding of the issues that need to be resolved to arrive at final target price with SNC/Aecon, though significant work remains, thus the current risk level.

Turbine Generator:



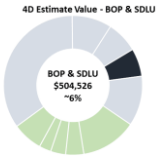
SNC/Aecon is on pace to complete its Class 2 Estimate by late 1Q for Unit 2. Some commercial issues related to the phasing of the turbine generator work over the four units will need to be resolved.

Steam Generator:

No issues are apparent at this time; these estimates should be sufficient for RQE.

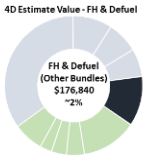
Low Moderate High
No Change
Decreasing Increasing

Balance of Plant/Shut Down-Lay-up:



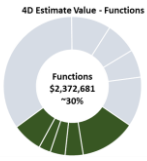
Detailed engineering for these bundles will not be fully complete by the May 15, 2015 target date; thus, development of Class 3 estimates for this work will be challenged to meet the RQE milestone. However, as we previously noted, from a cost standpoint, these estimates in total constitute approximately 6% of the direct costs of RQE, and the non-modification work (approximately half of Balance of Plant) is not engineering dependent and should have mature estimates for RQE. Balance of Plant and Shut Down/Lay-up project teams are proceeding with developing estimates based on the best possible information. The team is committed to carrying appropriate contingency for remaining uncertainties within RQE.

Fuel Handling/Defueling:



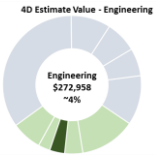
The DR Team is targeting Class 3 level estimates for RQE, and this appears to be an achievable goal, though some challenges remain with vendor submissions for non-critical path work. Defueling constitutes only about 2% of the direct costs of RQE, but it has a much higher risk profile due the reactor's defueling which occurs on the critical path. Therefore, careful planning, risk mitigation and adequate contingency are essential. Execution of the Fuel Handling Equipment Reliability plan is underway to ensure uninterrupted defueling operation.

Functional Groups:



Currently the DR Team is placing adequate focus on development of the functional group (indirect) costs. The DR Team has addressed a gap from 4d and is committed to developing detailed functional management plans that will allow management to fully vet all critical planning bases for the DR Project's management team. The functional groups must also follow-through on commitments for cost reductions included in the 4d Estimate by incorporating those reductions into their management plans.

Detailed Engineering:



The majority of the Project's detailed engineering should complete by May 15, 2015. While there are certain to be outliers to this milestone, the Project Team should be in substantial compliance with its goal to define engineering and scope sufficiently to support RQE.

B. Campus Plan Highlights

D20 Storage: As of this writing, the team is in continued negotiation with the ESMSA vendors over the D20 Storage Building's mechanical/electrical/plumbing ("MEP") completion package, and is evaluating the risks associated with this award. Construction of the foundation is ongoing though with some impacts from weather, and P&M is attempting to mitigate future delays by directly purchasing over 600 valves needed for construction.

ES Fox Resources and Capacity: ES Fox's field construction was impacted by two separate High MRPH safety incidents; these events plus ES Fox's overall support of the P&M and Refurbishment projects contributes to existing concerns regarding ES Fox's capability to support the volume of its Project work. OPG senior management has raised these concerns with ES Fox, and corrective actions are underway. ES Fox has committed to adding resources in key areas, including project management and project controls.

P&M Staffing: P&M has added resources at the Director level and is embarking on additional training and instruction for its management team, including inserting lessons learned to date from the Campus Plan Projects.

P&M's Project Controls: P&M's Project Controls will consolidate under Refurbishment. This means that common processes and procedures, including using work-hours for schedule performance tracking, should be employed for future work, including D20 Storage's completion. However, many of P&M's projects will not be fully standardized. P&M has several initiatives underway with the Project Controls team to track these projects, as discussed below.

II. Refurbishment – Areas of Focus

A. RQE Processes, Procedures and Team Alignment

The DR Team has formalized its RQE processes in conjunction with the RQE Roadmap presented to NOC in the January Meeting. These processes include a full re-examination of the requirements for each sub-project's Gate 3 submissions and Functional Management Plan ("FMP") submissions. In developing and finalizing these processes, the DR Team has addressed many process gaps BMcD/Modus identified in the 4d Cost Estimate regarding underlying documentation, quality checks, and assuring proper time and opportunity for management vetting of the results.

- **Schedule:** The RQE Roadmap has well defined milestones that have been fully vetted within the DR Team, and who is being held accountable to meet deadlines. The RQE Roadmap provides sufficient margin for developing program-level reviews for quality and contingency development. The DR Team has set goals for multiple RQE deliverables, including project playbooks, execution plans and improved functional management plans that are due in 1Q 2015. The detailed RQE working level schedule remains under development and will be completed in early March. The RQE team will conduct weekly meetings to review the schedule for adherence e with dates and quality of the products.
- **Estimating:** The team has rolled out new processes that will be applied to estimates for the projects and functions. The largest projects (RFR, Turbine Generator) are currently following estimating processes that conform to the new standards. This process moves the DR Team from parallel independent estimating used for validating bid proposals, which sometimes created confusion, to increasing focus on vetting of the estimates the contractors and work groups provide. This should provide greater confidence in the estimates underlying RQE. Moreover, previous quality concerns are being addressed with new processes.
- **Documentation of RQE**: The DR Team is preparing the following for RQE that will, when complete, provide a solid basis for vetting and a baseline for future comparison to actual project performance:
  - Data alignment to allow for transparency in support of project and regulatory reporting
  - Functional Groups are required to submit Functional Management Plans in advance of and in support of staffing estimates;
  - Project Teams are preparing "playbooks" that document execution method and other estimating considerations;
  - Project Teams and Contractors are engaged in "Day-in-the-Life" reviews to fully vet execution planning details, mitigate potential gaps, and consolidate similar common work scopes.

  We have additionally recommended the DR Team develop a formal division of responsibility ("DOR") matrix that clarifies goals, highlights potential gaps in performance and memorializes accountabilities.

- **Gate 3 Process**: The RQE team has re-evaluated and re-issued the process for the coming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has established clear rules for developing the documentation for Gate 3s, as well as a typical sequence of events so that both the Project Team and the reviewers can be adequately prepared. In addition, Finance is prepared to provide "Black Hat" reviews of the Project Team's gate packages to provide appropriate challenges to the information presented. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE.

B. Engineering Status for RQE

As of February 1, detailed engineering for the DR Project was 79% complete. The most significant design packages – RFR (~69% complete) and Turbine Generator (~90% complete) – have produced sufficient engineering product for their respective Class 2 estimates. Lagging behind are BOP and Shut-Down/Lay-up (~30% complete), and completion of the BOP engineering is a concern. However, the DR Team's overall engineering effort should produce sufficient output to adequately support RQE and reduce the risk that late engineering work presents. The engineering process has been

significantly aided by:

- **Front End Planning:** The DR Team and the vendors are working together, increasing the efficiency of engineering and providing a more complete product. In turn, the improved engineering product allows for better assessment for the purposes of developing RQE estimates.
- **Active Management:** OPG's leadership as design authority and proactive management of the engineering phase is driving more timely and appropriate decision making.
- **Collaborative Approach:** The placement of resident engineers in the offices of the engineering service providers is expediting the engineering process.

However, Projects & Modifications, who adopted these initiatives after the Campus Plan Projects were underway, continues to struggle with delayed engineering and problems masked by a lack of vendor transparency.

After considerable effort, the DR Project's engineering schedules are now almost completely integrated at level 3, many of these are also resource loaded. Consequently, the DR team now has insight into the resource demands created by the Project's design effort. The availability of the detailed design information is allowing for very tight monitoring of the completion of the detailed engineering design, and identification and resolution of remaining delays. This same approach now needs to be applied to downstream activities in order to forecast future critical resource needs in advance of the peak demand. The schedule and performance metrics and the quality dashboard deployed by Engineering allow the DR Team the opportunity to plan around and mitigate delays and issues with resources and the quality of the engineering product. With the possible exception of the pre-requisite projects (discussed herein), the slippage in the engineering schedules is not likely to affect the breaker open milestone, as more than adequate float exists for performance of most project work.

Other ongoing Engineering initiatives include the following:

- **Benchmarking**: A recent benchmarking exercise with Exelon, while validating the rigor of OPG's engineering change process, identified some areas worthy of further consideration including the benefits from self-performing procurement. Whereas the planned benchmarking with Bruce Power will support collaboration in the CANDU industry in Ontario, we also encourage OPG to pursue their involvement in INPO's planned nuclear engineering benchmarking exercise.
- **LEAN Process**: From an engineering efficiency perspective, we endorse OPG's LEAN evaluation of the engineering change process in order to identify areas where value can be enhanced. This goes hand-in-hand with Engineering's commitment in 4d to reduce its functional cost by 15%.
- **Quality Dashboard:** Project Engineering has created a quality dashboard, focusing attention on nine aspects of engineering quality. Data validity issues with these metrics continue to be addressed along with several process shortfalls that were brought to light by the creation of this dashboard. We view this quality dashboard as a proactive and innovative initiative by the DR team. The SCR process continues to be the vehicle of choice for identifying specific quality issues.

C. Areas of Focus - RQE Quality

RFR Project-Class 2 Estimate

RFR represents approximately 35% of the total estimated DR Project cost. SNC/Aecon's progression to its Class 2 Estimate and the parties' ultimate agreement to a target price for performance of the work represents the largest portion, thus the largest risk to RQE. Moreover OPG is motivated to close the approximate $700M gap between SNC/Aecon's Class 3

Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. This gap was due to OPG's well-founded determination that SNC/Aecon's Class 3 estimate was very conservative and there were multiple opportunities that SNC/Aecon needed to realize and take into account in the Class 2 estimate and its planning for RFR's execution.

As noted, SNC/Aecon's work on the estimate is behind an agreed target of April 10, 2015, resulting in its request for a 2 week extension of time to complete its work. At present, based on the multiple deliverables that SNC/Aecon is required to provide OPG, SNC/Aecon claims its overall completion is **57%** at this time. The following are concerns that are indicative of this effort to date:

- Construction Work Packages ("CWP's") form the basis of the detailed estimate and schedule, and are a key tool in establishing the direct field labor component of the Class 2 estimate. To date, SNC/Aecon reports being 70% complete with CWPs, though OPG only recently received the majority of these for review.
- The Tool Performance Guarantee ("TPG") testing is ongoing at the DEC's Mock-up Facility, and these tests have produced good-to-excellent results that should reduce the estimated direct field labour from the Class 3 estimate. However, the OPG team has observed SNC/Aecon's attempts to re-introduce risk and uncertainty into the estimate that negates these results. The OPG team has strongly objected to SNC/Aecon's attempts to do so.
- SNC/Aecon intends to assemble the Class 2 estimate into "chapters" to allow for OPG and other stakeholders vetting. SNC/Aecon is 4-6 weeks behind its schedule for producing these chapters and other key material OPG needs to properly consider the quality of SNC/Aecon's estimate.
- We have observed that SNC/Aecon's earned value trend for the tasks associated with developing the Class 2 estimate is growing increasingly negative. SNC/Aecon has expended 50% to 75% more hours than planned each of the last 3 months in estimating; nonetheless, its deliverables are not meeting the schedule target. We have challenged whether SNC/Aecon has recognized that its original work estimates are under-estimated and whether they have appropriately staffed the work to finish the work on the Class 2 estimate.

The result of SNC/Aecon's delays is that the OPG team will likely receive a much larger quantity of material from the SNC/Aecon to review and vet at the completion milestone than it expected when the process began. This happened with last year's Class 3 estimate, though the consequences around approving that estimate were much less severe than this time. In a recent Executive Oversight meeting with the CEOs of each company present, Tom Mitchell asserted OPG's expectations for SNC/Aecon to submit a transparent estimate with high quality, and that the parties may need to have a discussion at the appropriate time to discuss apportioning risk in order to disposition the likely gap between SNC/Aecon's estimate and OPG's assessment of it.

BMcD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG accelerating its review period. If current trends continue, RFR is unlikely to meet the current RQE milestones for its Gate 3 submission, at a minimum.

Refurbishment Waste Processing Building (RWPB)

Overall Risk Perspective

SNC/Aecon submitted a proposal for the RWPB, which is where SNC/Aecon's waste processing and volume reduction machines for disposing of removed contaminated reactor parts will reside. This proposal was rejected by OPG due to its lack of detail and inadequate schedule, which showed this building completing in the 2Q of 2017, well after breaker open of Unit 2. Moreover, this proposal for $93M is approximately $11M more than what OPG carried in 4d, which was a red flag to the OPG team.

Recognizing lessons learned from the Campus Plan Projects, OPG's RFR team has engaged SNC/Aecon in a series of challenge meetings intended make SNC/Aecon produce a more detailed schedule and cost estimate that is properly supported. This should be achievable largely because this building is not very complicated, though it represents a

distraction to the RFR team at a critical time. The OPG team is seeking to avoid the kind of cost creep that has impacted many of the Campus Plan Projects by having a solid cost estimate and schedule in place for RWPB at the work's outset, and have transparency to SNC/Aecon's subcontractors' work. OPG's VP of Execution initiated a weekly focus meeting on RWPB's challenges with SNC/Aecon leadership, which has increased the visibility of the issues. In order to reverse prior trends established by the Campus Plan Projects, it is critical for OPG to obtain and vet a detailed, well-formulated estimate from SNC/Aecon for RWPB and hold SNC/Aecon accountable for performing to that estimate. In addition, OPG is considering potential work shifting and award of other ESMSA work to SNC/Aecon that could benefit the overall program, particularly if SNC/Aecon can establish economies of scale with similar projects to RWPB.

BOP / Shut-Down/Lay-up

As we have noted in prior reports, the BOP and Shut-Down/Lay-up projects will be challenged to produce Class 2/3 estimates for their modification work projects in time for RQE. The BOP and Shut-Down/Lay-up project managers are mitigating these delays to the extent possible by monitoring the completion of engineering and assessing and advancing development of estimates for this work. The result for RQE should be estimates for this work in the Class 3-4 range with more refined Class 2 estimates available for the Project's planned 2016 Unit 2 check estimate. Assuming the engineering and planning work proceeds as planned, the impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. BMcD/Modus is more concerned over ES Fox's capability for planning and executing this work, which we discuss in more detail below.

Functional Groups

The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE team has been working to develop processes needed to increase the amount of detail the functional groups develop for their RQE estimates, and as noted, we see significant progress in this regard. Each functional group was challenged by the Project's VPs to reduce or otherwise rationalize their estimated costs for the Execution Phase, resulting in commitments from each to do so. It is important that those commitments are tracked to completion to avoid re-hashing old ground for RQE, and so management does not have to issue across-the-board directives to reduce cost.

II. Campus Plan

A. P&M Management

P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

1. Vendor Performance Issues

We have ongoing concerns, shared by the DR Team, regarding ES Fox's bandwidth to support the volume of the upcoming work on the DR Project. These issues are acute at this time as ES Fox has a number of "in-flight" P&M projects while also being required to support planning efforts for multiple Refurbishment projects. Our comments regarding ES Fox's scheduling and cost estimating capability have been discussed in prior reports, [redacted]

In addition, ES Fox must prepare approximately 45 separate project estimates for BOP and Shut-Down/Lay-up Refurbishment projects prior to RQE and oversee the final development of the associated detailed engineering packages from its engineering subcontractors. The Refurbishment BOP and Shut-Down/Lay-up directors have tasked ES Fox with developing estimates and schedule pilots that will be used as a template for the remaining estimates; these pilot estimates and schedules are under review.

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. ES Fox's actions bear watching, as their ability to complete these critical Campus Plan Projects while simultaneously supporting the planning of BOP and Shut-Down/Lay-up work for Refurbishment is a growing risk to the Project. The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors.

2. Major Campus Plan Projects

D2O Storage Facility

The DR Team has prepared a Superseding Business Case Summary ("BCS") recommending an additional release of $270.9M, including $33.9M of contingency, with a projected total cost of $381.1M. The BCS examined four alternatives, including slowing down construction at different points and abandoning D20 Storage entirely. The BCS also considered and established the basis for an alternative plan to draining water from Unit 2 in the event that D20 Storage construction is further delayed, and the DR Team has established trigger dates for proceeding with the alternate plan in sufficient time to procure temporary tanks and other material if needed. BMcD/Modus believes the BCS has appropriately considered the reasonable options at this time and provides a basis for justifying the decision to proceed with the best available option, completing D20 Storage based on the original design in time for Refurbishment.

With $123.1M spent to date, the remaining cost to complete is estimated at $258M, of which approximately $140M is estimated for the new completion contract. As of this time, the award for the MEP completion of D20 Storage had not been made, as the OPG team is considering which of the ESMSA contractors should be awarded the completion of the work. In any event, the contract needs to be awarded and progressed by mid-March so that the selected contractor can begin piping prefabrication, procurement and further development of its execution schedule. The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.

Based on the current D20 Storage schedule, the revised plan appears achievable, though with all of the issues to date,

completion of the building will require close attention by the DR Team. Once the contract award is made, we recommend the P&M team: (1) re-evaluate the project risks based on the revised execution model; (2) fully vet the schedule and earned value set-up; (3) apply the project controls strategy to the completion of the foundation work.

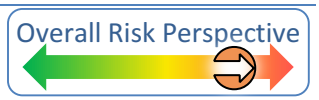
Auxiliary Heat

As noted, the work on the Auxiliary Heat System Building ("AHS") was impacted by ES Fox's safety stand-down following two separate safety incidents. AHS is also impacted by the change to the Vacuum Building Outage ("VBO"). AHS was initially planned to be commissioned before the VBO in the spring of 2015, though its completion was later relaxed because it was determined that the building was not needed for the spring VBO. However, AHS now must be available for service for VBO in the fall. The AHS schedule had slipped by 2 months to October 2015 due to the Steam and Condensate tie-in window changing. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of $85.14M is being challenged by ES Fox, who has over $6M in change orders ($5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, in particular because ES Fox has spent 78% of its EPC contract value through February 1, 2015 and ES Fox's SPI continues to deteriorate. P&M needs to validate these figures, and needs to ensure that ES Fox is motivated to expend the needed direct field labour to complete this project.

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

Emergency Power Generator 3



EPG 3's current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date is at risk by as much as 2 months. ES Fox's performance indicators continue to deteriorate and the Project's EAC is $96M, an increase of $8M since 4d. Engineering completion has been delayed to May 2015 due to vendors' performance challenges. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox's additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M's management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox's performance. Given the short timeline to complete this SIO project, ES Fox will need to increase its effort and improve its performance.

III. Other Focus Areas

A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG's corporate units to support the DR Project. Among the Project Team's recent issues is highlighting its software needs for IT to implement needed changes, particularly for change project controls systems needed for project. Large capital projects often struggle using enterprise level business systems to support project needs, and recognition of the shortcomings of the current systems is timely. A similar approach should be pursued with other corporate policies; as previously discussed, tailoring hiring and talent retention processes for short-

term project needs often requires flexibility that is not advisable for normal operations.

B. Project/Station Integration

Integration between the Project and the Darlington Station needs to be addressed. P&M projects have missed or are projected to miss tie-in dates to the plant, in part due to vendor performance but also due to the Station demanding a level of precision from the Projects that is difficult to achieve from a project environment. BMcD/Modus will be advancing our timeline for a more detailed assessment of this integration and will identify any process or procedural gaps.

In addition, with the shifting of the VBO, the DR Team and the Station will need to re-assess their mutual priorities and assess any impacts to either cost or schedule.

Report to Nuclear Oversight Committee

2nd Quarter 2015

Darlington Nuclear Refurbishment Project

DRAFT

Burns & McDonnell
Modus Strategic Solutions

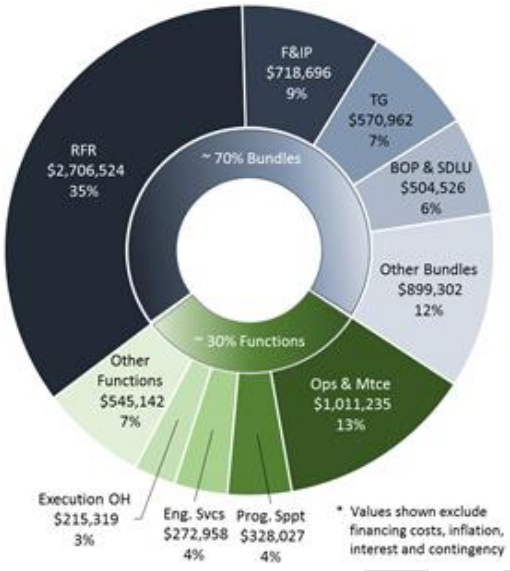
May 21, 2015

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of May 8, 2015. Our main focus continues to be assessing the status of the DR Team's preparation of the Release Quality Estimate ("RQE") that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value*



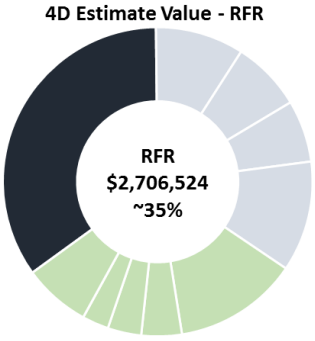
As with our 1Q Report, we provide the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts, as a basis for gauging the Project Team's RQE progress. The following are the most notable cost elements of the DR Project at this time:

- **RFR** constitutes approximately 35% or $2.7B of the DR Project's estimated costs;
- **Turbine Generator** constitutes approximately 7% of the DR Project's estimated costs;
- **Balance of Plant and Shut Down/Lay-up** constitute 6% of the estimated costs;
- **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the development of the inputs to RQE progress, the DR Team will be comparing variances based upon the breakdown presented here from the 4d estimate. Over the last Quarter, the metrics and the processes the DR Team has put in place to track its RQE progress have accurately depicted areas where the team is meeting its plan and other areas that have fallen behind. The largest components to RQE – the Retube and Feeder Replacement ("RFR"), Turbine Generator ("TG") and project functional costs - are capable of meeting their end milestones, as are Steam Generators, Islanding, and Fuel Handling/Defueling. However, Balance of Plant ("BOP") and Shutdown/Layup, which are an aggregation of smaller projects, are well behind, prompting the Project Team to reprioritize its efforts and approach with both the vendors and the basis for RQE.

The following is a brief summary of the status of the major inputs to RQE:

Retube and Feeder Replacement:



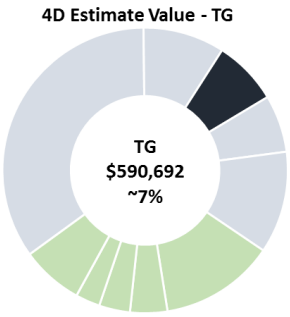
SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Over the last quarter, SNC/Aecon and OPG have made significant progress in the development of the Class 2 Estimate, identifying the major areas where the parties agree and distinguishing the issues that will need to be resolved prior to negotiating a Target Price for the execution phase. Significantly, the parties have agreed on the basic parameters of RFR's critical path schedule duration, and agreed to eliminate schedule contingency that had been built into SNC/Aecon's Class 3 Estimate. Thus, the agreed schedule that is at the heart of the Class 2 Estimate represents an aggressive, but reasonably achievable plan for Unit 2.

Nonetheless, considerable vetting work remains ahead over the next 4-6 weeks to confirm that the quality of SNC/Aecon's estimate is sufficient to qualify it as a Class 2 Estimate. On May 8, SNC/Aecon delivered its first full project estimate report for OPG's review. While the OPG team has been vetting the discrete sections of the estimate as it has been assembled, the team needs to now carefully consider how the various parts fit together.

Simultaneous to the estimate development, the parties have commenced some high-level commercial discussions at the project executive and CEO levels in an attempt to identify any major contract or commercial issues that will need to be resolved before the Execution Phase contract can be awarded to SNC/Aecon. Primarily, there remains a sizeable pricing gap between the parties that needs to be narrowed to the extent possible. OPG has identified specific areas for possible negotiation and is planning to discuss these items with SNC/Aecon in stages through June 15th. We have urged OPG to take whatever reasonable time is necessary to properly vet the Class 2 Estimate and associated schedule, most notably the near critical path work, to ensure that the estimate represents an achievable plan and comports with Class 2 parameters.

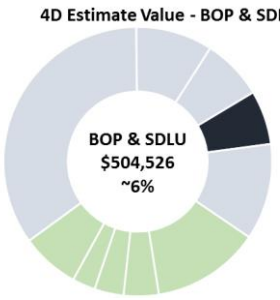
[redacted] OPG's Project Team is mindful of the Campus Plan Projects' lessons learned and thus continues to challenge SNC/Aecon's estimate. Limited field work has been started in parallel with SNC/Aecon's further attempts to bolster its estimate. RWPB has a separate Gate 3 from RFR in early June by which SNC/Aecon must complete its estimate.

Turbine Generator:



SNC/Aecon issued its Class 2 Estimate for the Turbine Generator for Unit 2 on May __, and Alstom has completed its detailed design. SNC/Aecon still must complete its estimate for the TG control work for the subsequent units, and reports it is on track to meet its July 31, 2015 deadline. OPG used the TG estimate as a proving ground for its new estimate vetting process, and this was a significant success. The OPG estimating team sampled approximately 3,000 line items of cost, or over 50% of the estimate, and issued hundreds of comments that SNC/Aecon had to disposition. We believe this process should be repeated for each of the major units of cost on the project. In addition, the parties resolved the commercial issues related to the phasing of the turbine generator work over the four units. SNC/Aecon needs to meet its commitment to identify economies of scale across its entire portfolio of work (RFR, TG, D20 Storage) that should reduce Project overhead cost.

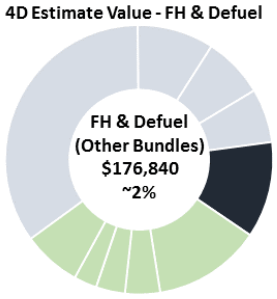
Balance of Plant/Shut Down-Lay-up:



Detailed engineering for the projects will not be completed by the May 15, 2015 target date. Based on current performance trends, BOP and Shut-Down/Lay-up will be challenged to meet the August detailed design complete milestone. Moreover, [redacted] This inability poses a significant risk to Refurbishment that the team is attempting to mitigate.

The BOP and Shut Down/Lay-up project teams are injecting collaboration into the estimating process to reduce potential gaps and misses that have been evident in the Campus Plan Projects. These bundles are attempting to overcome the lack of mature, detailed design to the extent possible and have directed the Contractor to develop estimates based on the best possible information at this time, though it is unlikely that these bundles will obtain estimates above Class 5 for the majority of this work prior to RQE. In addition, the team is taking appropriate action to re-prioritize those work packages based on the Execution Phase schedule's needs. OPG senior management has significantly ramped up project executive-level attention to the vendors' difficulties. The team is committed to rejecting work product of insufficient quality and intends to carry appropriate contingency within RQE. Refurbishment also needs to ensure that it is carrying program level contingency sufficient to account for the ESMSA vendors' known deficiencies in engineering progress, estimating and scheduling. In addition, [redacted] While from a cost standpoint, the BOP and Shut-Down/Lay-up estimates constitute approximately 6% of the direct costs of RQE, our concern is that the vendors' issues will drain a disproportionate amount of management attention and divert focus from the more significant scopes of work, which continue to be a risk to Refurbishment through the Execution Phase.

Fuel Handling/Defueling:

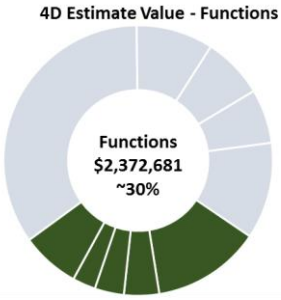


The DR Team is targeting Class 3 level estimates for RQE, and the team's work over the last quarter has improved the overall outlook for both the estimate and the technical basis for the work. While defueling constitutes only about 2% of the direct costs of RQE, it has a much higher risk profile due to the reactor's defueling which occurs on the critical path. Prior challenges with the vendor's supply of fuel handling equipment appear to be resolved, and the team is working to a more aggressive commissioning schedule to increase schedule float and reduce overall risk. The team has also worked to distinguish differences between Bruce Unit 1's defueling performance and its own planning for Darlington, and is focused on realistic opportunities for shaving time off the current estimated 113-day defueling cycle.

Steam Generator:

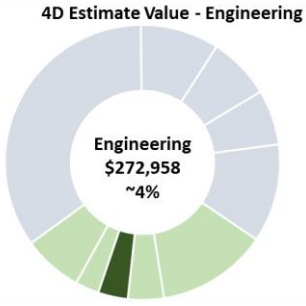
No issues are apparent at this time; these estimates should be sufficient for RQE. The team has addressed prior quality issues and its recovery plan has been successful.

Functional Groups:



The RQE Roadmap milestone for the DR Team's functional groups to complete their management plans and estimates by May 15th will not be met. The functions have developed initial management plans and related estimates which in aggregate are showing the potential to exceed the amounts provided in the 4d Cost Estimate. While it is still early in the vetting process and no firm conclusions should be drawn from this initial review, it is evident that management will need to devote significant attention to right-sizing the team, developing clear roles and responsibilities and locking down appropriate assumptions for RQE. We have recommended the team develop a detailed division of responsibility ("DOR") matrix to ensure there is no unnecessary cross-over or large gaps in the functional responsibilities within the Project. We have also provided some input to the team to increase the level and effectiveness of the vetting of these costs. Our team will be included in the "black hat" reviews led by Finance of the RQE estimates for the functional groups.

Detailed Engineering:



The Project's Detailed Design is 86% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE. However, BOP and Shut-Down/Lay-up engineering is delayed which is partially driving these bundles' cost estimates to miss current and downstream milestones. [redacted] these will require monitoring. The Engineering team's quality metrics highlighted some early warning signs, prompting the engineering VP to hold a brief stand-down of the vendors to examine quality and corrective actions. Thus, OPG management has visibility to the remaining engineering work and is timely managing those problems that manifest themselves.

B. Campus Plan Highlights

D20 Storage: P&M has issued a letter of intent ("LOI") to SNC/Aecon to perform the mechanical and electrical portion of the work for D20 Storage. The LOI's terms provide for $5M in funding and a 6-week time period for SNC/Aecon to refine its detailed estimate and schedule for the work, upon acceptance of which a final, conformed contract will be issued. P&M believes that the cost associated with the SNC/Aecon contract will be less than the $140M in 4d and will provide greater confidence in the overall cost and schedule. OPG is managing Ellis Don in the construction of the foundation, which is attempting to recover weather impacts. Ellis Don is currently working on its baseline schedule

for the remaining civil work. P&M is working with SNC/Aecon to mitigate delays in purchasing over 600 valves needed for construction.

- **ES Fox Resources and Capacity:** [redacted] OPG's senior management has escalated its concerns to ES Fox's executives, and secured Fox's commitment to add resources in key areas, including project management and project controls, [redacted] ES Fox has projected that it will exceed its baseline estimates on key P&M projects (Auxiliary Heat Building, EPG 3, RPO and RFRISA) and [redacted] In any event, OPG needs to perform adequate due diligence in vetting these cost increases and [redacted]
- **P&M Organization**: The focus on P&M's staffing, structure and capabilities for managing work for both the DR Project and the ASIC project portfolio is still under review. The additional senior resources that have been added to the team have had a positive impact on P&M's performance.
- **P&M's Project Controls:** P&M's Project Controls will continue to consolidate under Refurbishment and share processes and resources. The schedule for D20 Storage will be a transition point and allow for the team to establish appropriate metrics for tracking the work. In addition, the EPG 3 schedule for execution and cost estimate for completion is the next in line for detailed vetting, and should take into account the lessons learned from AHS.

II. Refurbishment – Areas of Focus

A. RQE Status Summary

In our 1Q 2015 report, BMcD/Modus noted that the team had put in place a processes for tracking RQE deliverables including a schedule and tracking metrics. The early milestones supporting RQE were generally met, though the underlying metrics are forecasting that a significant number of upcoming milestones will be missed.

The RQE Roadmap that provides all of the high-level RQE milestones has been augmented by a weekly report called the "Playbook #1 Weekly Execution Report". This Report measures the DR Team's progress against its plan for the Project-level cost estimates and schedules needed for RQE. The team has identified a total of 341 sub-project estimates and 226 sub-project schedules that are needed to support RQE. Of the estimates, 165 of the 341 (48%) and 156 of the 226 (69%) of the schedules are for numerous smaller projects under two project bundles – BOP and Shut-Down/Lay-up. Both of these project bundles' primary vendor is ES Fox. By comparison, the projects that represent the majority of the cost – RFR and TG – constitute only 10% of the number of individual estimates and schedules. Thus, these metrics are not intended to portray the weight of these deliverables to RQE but do provide a "bean count" of the remaining work and visibility to work that is falling behind schedule.

As of May 1, these metrics show that the smaller BOP and Shut-Down/Lay-up projects are lagging well behind the RQE Roadmap schedule. BOP estimating is 6% complete and 66% of its estimates are tracking behind schedule. The Shut-Down/Lay-up estimates are 11% complete, and 84% of these estimates are behind schedule. These delays mean that the estimates and schedules provided by these bundles in support of their upcoming Gate 3 meetings will be substantially below Class 3 quality. By contrast, the largest projects – RFR and TG – are generally on pace to meet the RQE milestones with Class 2 Estimates by the end of June.

Engineering maturity remains a leading indicator of the team's overall RQE development. The Project will miss the May 15, 2015 goal for completing detailed design, though its achievement of 86% complete at this relatively early stage is a nonetheless a major achievement. The larger packages – RFR and TG – are substantially complete and capable of supporting Class 2/3 project estimates. The remaining engineering work is predominantly in the BOP and Shut-Down/Lay-up bundles. The RQE metrics have highlighted the specific areas that are lagging behind, and using these metrics, the team has revised the engineering priorities for the Contractor to progress the more urgent packages to meet the August

engineering milestone. The Contractor's performance to date has been inadequate in managing its work and providing reliable cost estimates and schedules. This is causing the DR Team to devote considerable attention to the recovery effort.

The RQE team has re-evaluated and re-issued its process for the upcoming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has rules for developing the documentation for vetting the Project's Gate 3s. Each Project sub-bundle will be required to advance to Gate 3, even if that sub-bundle's maturity level is at a Class 4/5 level. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE. In addition, the DR Team's functional groups have submitted initial estimates and revised functional management plans which will also be vetted during 2Q 2015.

In summary, the major projects and functions, which comprise approximately 92% of the overall Project cost, are tracking on time to 2-3 weeks late with their RQE inputs while the BOP and Shut-Down/Lay-up bundles will struggle to complete Gate 3 with estimates more robust than Class 5 level. The DR Team will have to properly characterize the packages that are late and unlikely to mature beyond Class 4/5 level prior to RQE. A risk the DR Team needs to manage, among others, is devoting a disproportionate amount of attention to the BOP and Shut-Down/Lay-up bundles for the purpose of refining many of these estimates to a level not feasible prior to RQE.

B. Engineering Status for RQE

As of May 1, detailed design for the DR Project was 86% complete. While this falls slightly short of the 90% goal set by the Project Team, it is sufficient to support the estimating accuracy range for RQE. The most significant design packages – RFR (~__% complete) and Turbine Generator (~__% complete) – are enough to support their respective Class 2 estimates. BOP and Shut-Down/Lay-up engineering maturity (~__% complete) remains the primary outlier, and the team has reprioritized the work based on need.

The engineering team's schedule and quality metrics have matured and are being used to monitor vendor performance. These metrics have highlighted signs of certain adverse trends that the team is working to reverse:

- **Quality:** Project Engineering's Quality Dashboard has highlighted potentially adverse trends including: human performance errors; vendors employing under-qualified resources; over-specification of engineered materials and unique components; and other short-cuts that could result in downstream changes. To address these issues, the Project's Engineering VP initiated a quality "stand down" during which the results of multiple reviews and audits were shared and discussed with the vendors and OPG team. Each engineering vendor was challenged to provide an action plan to eliminate errors, rework and increase the quality of their work product.

- **Resourcing**: The metrics have highlighted the specific areas of focus for the remaining detailed design effort, and provide a basis for projecting the resources needed to complete this effort. In addition, these metrics have highlighted potential downstream gaps that require OPG resources, including the drawing office and TSSA registration.

Thus, the metrics tracking engineering are providing management with information it needs to actively manage the work. As engineering transitions to the next phase of supporting procurement and construction work package ("CWP") development, the tools developed during the design phase will need to shift focus.

The current Weekly Project meeting continues to focus on engineering, and remains a good forum for the team to work through issues and focus on the Project's schedule. The team is working to highlight gaps and develop management plans to resolve them. Over time, the team intends to expand this forum to include procurement tracking and construction readiness. The team is currently finalizing metrics for tracking procurement, and intends to introduce those metrics in June 2015.

Two issues that the DR Team needs to resolve in the upcoming examination of the Engineering functional cost include: (1) the level of support needed for replication engineering for the units subsequent to Unit 2; (2) the roles, responsibilities and level of effort needed from OPG Engineering and vendors in support of the field work and commissioning. There is valuable OPEX from Pickering Unit 1 RTS that should be reviewed in making these decisions.

C. Documentation and Data Alignment

The DR Team's data management group is working to align the Project's RQE and schedule data so that costs can be properly viewed and assessed over the entire Project's lifecycle at the work package/scope level. A key aspect of this work is properly mapping data so that the planned and actual cost of performing each element of scope can be baselined and then traced over time. The data management team is currently correcting flaws in data mapping present from the Project's inception. This work is essential to establish and maintain a proper Control Budget going forward from RQE. In addition, this data mapping is integral for future plant configuration control, and will be necessary for OPG to support rate recovery of its investment. If these issues are not resolved in the near term, the DR Team will risk struggling with data alignment issues throughout the entire Project. We have provided management with an assessment of current challenges in the Project's Cost Management system that provides further explanation of these problems in comparison with best practices. We recommend the DR Team make data alignment a priority for RQE so that further rework of these systems can be avoided and RQE has the data integrity necessary.

D. Areas of Focus - RQE Quality

RFR Project-Class 2 Estimate	Overall Risk Perspective

RFR represents approximately 35% of the total estimated DR Project cost, and thus the largest single risk to RQE. Since receiving SNC/Aecon's Class 3 estimate for RFR in June 2014, OPG's challenge has been to vet SNC/Aecon's plan and pricing of this work to ensure it is achievable, accounts for the OPEX from past refurbishments, improvements to the tool set and the value of the planning effort to date, including the full-scale mock-up at the DEC.

Moreover, OPG is motivated to close the approximate $700M gap between SNC/Aecon's Class 3 Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. OPG believes that SNC/Aecon's Class 3 estimate was conservative and included opportunities for SNC/Aecon to realize in the Class 2 estimate and its planning for RFR's execution. OPG has made SNC/Aecon fully aware of its position relative to these opportunities.

SNC/Aecon's Class 2 estimate was initially targeted for delivery by April 10, 2015, though SNC/Aecon was unable to meet this deadline. OPG provided SNC/Aecon with an extension to May 8, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality[1]. The OPG team also recognized that while monitoring and vetting the SNC/Aecon's incremental progress was necessary and beneficial, the OPG team now needs to review and vet the estimate as a whole.

SNC/Aecon and OPG have agreed on a number of key areas that will ease the vetting of the Class 2 Estimate, including:

- The critical path duration of 1084 days, including OPG's responsibility of 186 days from breaker open to defueling and 223 days after RFR is completed to breaker closed. SNC/Aecon's schedule and estimate are premised on it controlling the critical path in the vault for the 676 days in the middle (the "RFR Duration"). SNC/Aecon's RFR Duration was determined on the basis of its Tool Performance Guarantee ("TPG") durations that were tested in the mock-up and modified by assumptions gained from OPEX of prior CANDU refurbishments. Importantly, SNC/Aecon's RFR Duration is shorter than the actual duration of Wolsong, which was the previous best

[1] SNC/Aecon's Class 2 Estimate was received concurrent with the preparation of this report; thus, we cannot comment on its content at this time.

refurbishment.

- A major sticking point in the Class 2 Estimate development was SNC/Aecon's conservatism toward potential owner-caused delays. By accepting the critical path in the RFR Duration, SNC/Aecon has agreed to remove contingency time in the schedule, which is a significant concession.
- While still higher than OPG's expectations, SNC/Aecon's initial Class 2 Estimate reflects modest reductions from the Class 3 estimate.
- SNC/Aecon has identified approximately $40M of additional opportunities to reduce the base cost that are different from those OPG had identified. OPG needs to consider whether these opportunities can be realized. In addition, there is a list of approximately 50 items that OPG has developed that are additional opportunities of varying size that can be worked down.
- The parties have agreed to revisit current assumptions around project risk allocation once the base cost is determined.

The OPG team's vetting process for the Class 2 Estimate is geared toward identifying any areas in the estimate that remain suspect from a cost perspective. While the vetting process will review all aspects of the Class 2 Estimate, the particular areas of focus for the team include: (1) right-sizing of SNC/Aecon's project management team ("PMT"); (2) right-sizing of SNC/Aecon's Support Services; (3) review of non-critical path direct field labor; (4) unit-over-unit resource leveling; and (5) productivity rates utilized for direct field labor. In addition, the parties will work to finalize the risk register and develop contingency.

Assuming there is agreement on the Class 2 Estimate, the parties will finalize target price parameters and seek resolution of any remaining commercial issues. The DR Team has been preparing options for performing the RFR project without SNC/Aecon in the event there is no agreement. However, coming to mutually agreeable terms with SNC/Aecon is clearly the best possible option for performing RFR, given the time investment the parties have made to date and the difficulties inherent with starting over with a new vendor.

BMcD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG through acceleration of its review period. OPG should weigh the risks of rushing the review and vetting process versus missing the RQE milestone.

Refurbishment Waste Processing Building (RWPB)

SNC/Aecon is continuing to develop its cost estimate for the RWPB. SNC/Aecon has submitted different iterations of the estimate and schedule that the OPG team rejected as having insufficient detail. OPG has made clear to SNC/Aecon that the schedule must provide adequate detail to ensure that sufficient float is maintained prior to the mid-2017 need date for this facility. SNC/Aecon has developed a schedule, which still requires full vetting, that pulls the completion date back to December 2016.

With respect to the cost estimate, SNC/Aecon and OPG have agreed on key aspects of the basis of estimate regarding the ability of the RWPB to withstand a seismic event. This agreement may have some additional cost impacts, but these changes will be necessary to support the nuclear safety case. The team has set-up a separate Gate 3 for RWPB from the RFR work with a deadline of June 6th. The OPG team has challenged SNC/Aecon to produce the cost and schedule based on final resolution of the design basis and benefits from the Campus Plan Projects' lessons learned in the planning of this work. In the meantime, SNC/Aecon continues to perform caisson work and site preparation to mitigate any further schedule issues. The project executive-level meetings will continue until such time that OPG has confidence in SNC/Aecon's plan for the work, and weekly construction progress meetings will continue through completion.

BOP / Shut-Down/Lay-up

Overall Risk Perspective

The DR Team has acknowledged that the BOP and Shut-Down/Lay-up modification work projects will be no better than Class 4/5 in time for RQE. However, the relative impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4/5 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. The BOP and Shut-Down/Lay-up teams continue to press the Contractor to develop the highest quality estimates based on the best information possible for RQE. ES Fox has set-up an estimating "war room" at its offices, and the OPG teams are actively collaborating with ES Fox to guide the process, provide answers to questions and highlight assumptions. OPG has established for ES Fox a seven-step vetting process and is tracking throughput. The team is committed to carrying sufficient contingency in RQE to compensate for the expected bandwidth around these estimates. BMcD/Modus recommends that these teams increase the level of documentation that is kept so that the actual basis of these estimates can be fully understood and vetted, and so that appropriate classification of these estimates can be applied.

[redacted]. Refurbishment's answer is to ensure that it properly characterizes the nature and maturity level of the estimates at the outset. [redacted] We have recommended to the team to consider this history because it is the most relevant information OPG needs to establish truly appropriate contingency levels for these Refurbishment projects.

In addition, based on the experience to date, the DR Team should be examining other options for delivering this work where practicable. If the schedule allows, [redacted] The BOP and Shut-Down/Lay-up teams are already taking extraordinary measures [redacted] The team should evaluate whether it would really be taking on additional risk by directing the effort. From our team's experience, the risk posed to execution by BOP has to be managed or this typically non-critical path work can have a significant impact on both cost and schedule.

Based on what we have observed of this process, the DR Team is actively managing and attempting to mitigate the deficiencies in these estimates. The DR Team now has metrics in place that should provide early warning signs for management to take mitigating actions. The DR Team's Gate 3 process requires that these projects proceed to their respective gates and visibly report all deficiencies that erode the quality of these estimates.

Fuel Handling/Defueling

Overall Risk Perspective

The Fuel Handling/Defueling team, which is integrated between Refurbishment and the station, appears on pace to deliver its Class 3 estimates and has shown the results of good overall cooperation and vendor collaboration. These projects are not significant in terms of overall cost but represent OPG's most significant critical path risk to the Project.

In the ongoing collaboration with Bruce Power, the Project Team received more granular information regarding the success of Bruce Unit 1's defueling for its refurbishment. Bruce Unit 1 achieved defueling 63 total days compared to the

Project's assumption of 113 days. However, the additional details the team received allowed for more detailed analysis, and the team determined that Darlington's more complex and less efficient base design and related processes accounted for 30 of the 48 day difference, and those areas are not ripe for improvement. However, the analysis did net an opportunity to vet the 18 day difference between the stations in assumed Trolley Duty Cycle, which OPG executive management expects to be challenged.

With respect to Fuel Handling, the main challenge remains to improve the fueling machine reliability to increase the potential success for the fueling system's ability to simultaneously support Refurbishment and ongoing station operations. Over the last quarter, the team has made good progress in working through key issues, and OPG and vendor, GE-Hitachi, agreed to move forward by three months the schedule for commissioning the equipment to provide the Project with greater schedule float. While there have been challenges, it appears the schedule is achievable; that cooperation with the OPG team (including the station) and GEH has been good; GEH's engineering product has been of high quality; and the team has accepted and mitigated challenges along the way. While the risk of actual performance will remain until the reliability of the enhanced fuel handling equipment is proven, the actions taken by the team appear to have increased the overall probability of success.

Functional Groups

The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE Roadmap milestone for RQE Functional Estimates Complete by May 15 will not be met, though progress toward defining the functions' purpose and related estimates has matured over 4d. Unfortunately, this maturation has resulted in the functional cost estimates for virtually each group increasing over their 4d levels.

These increases require extensive vetting, which as of this writing, has only recently started. Key areas for this vetting process should include:

- Assuring that the functions are properly supporting the Projects, and not duplicating effort the performing contractors are expected to provide;
- Ability to meet all of the true oversight needs an owner's management group should provide, including validation of field execution, timely decision-making when issues arise and management of risks;
- Examining how the functions mesh together so that there is no duplication of effort, excess cost or confusion over roles and responsibilities;
- Identifying whether the functional groups have met 4d goals for right-sizing their teams.

In our view, these goals can be met through: (1) detailed vetting of the functional management plans in comparison to the functional cost estimates to assure that all assumptions for staffing are fully identified; (2) development of a division of responsibility ("DOR") matrix that shows both ownership of functional areas and potential rub points; and (3) detailed vetting of the cost estimates themselves. While considerable work remains before these estimates can be considered to be complete, the progress made thus far allows management to view the functions in a consolidated manner and make appropriate decisions on right-sizing the effort for RQE.

II. Campus Plan

1. P&M Management

P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on

training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

2. Vendor Performance Issues

ES Fox's bandwidth to support the both the ongoing P&M work and its current work load for Refurbishment has received considerable attention from OPG's management. [redacted]

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. In addition, the Sr. VP of Nuclear Projects has requested ES Fox to take immediate action to reconcile its cost and schedule positions on the Campus Plan Projects and utilize lessons learned from recent projects to help properly characterize the nature of their project estimates.

The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors. The team is taking measures to do so and must measure how ES Fox responds.

3. Major Campus Plan Projects

D2O Storage Facility

Overall Risk Perspective

The DR Team has awarded the mechanical and electrical package to SNC/Aecon via a LOI, with the full conformed contract to follow once SNC/Aecon presents its full, detailed execution budget and schedule. SNC/Aecon was given a short but reasonable time frame to complete its work. Based on the multiple iterations SNC/Aecon's RWPB team has produced for that building, we have advised OPG to request ongoing updates during this period to ensure SNC/Aecon prepares its budget and schedule. SNC/Aecon is currently working with OPG to prepare for its mobilization and work through procurement issues. On April 30th, RCMT completed its design work and provided SNC/Aecon with the engineering packages it will need to plan and execute the work. SNC/Aecon will provide field engineering through the completion of the work.

Ellis Don continues to work at OPG's direction on the foundation work, which is currently running on or near schedule. The OPG team reported the end date for foundation work had slipped 2-3 weeks, though the teams are working together to look at different shift patterns and work calendars to pull the dates back into early December 2015, if not earlier.

The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.

Based on the current D20 Storage schedule, the revised plan appears achievable to meet the needs of Refurbishment, though with all of the issues to date, completion of the building will require close attention by the DR Team. With the contract award to SNC/Aecon, the P&M team should re-evaluate the project risks based on the revised execution model and implement and report on the revised project controls strategy to the completion of the foundation work.

Auxiliary Heat

The Auxiliary Heat System Building ("AHS") schedule and cost estimate continues to be a concern. ES Fox's current date for construction completion is September 1, 2015, and AFS is scheduled for October 27th. These dates have been challenged by OPG's team. The schedule pushes that are causing these dates to slip appear to be from issues that could be mitigated. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of $85.14M is being challenged by ES Fox, who has over $6M in change orders ($5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, [redacted]

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

Emergency Power Generator 3

EPG 3's current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date has slipped to April 7, 2016. [redacted] and the Project's EAC is $___, an increase of $___ since 4d. Engineering completion has been delayed to May 2015 due to vendors' performance challenges, though ES Fox reported this date will be met. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox's additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M's management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox's performance. Given the short timeline to complete this SIO project, [redacted]

III. Other Focus Areas

A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG's corporate units to support the DR Project. Finance is embracing its role in the vetting and challenging of the various elements of RQE, and continues to provide its full support to the Project. The Project Team and the CIO are working together to implement needed changes that are tailored to the needs of the Project. This collaboration has resulted in the CIO supporting upgrades to software and necessary attention to the Project's hardware needs. In addition, we are encouraged by the increased focus People and Culture's senior

leadership is providing to develop flexible plans to address the personnel and succession issues that have been highlighted as major risks.

B. Risk Management

An effective risk management program is integral to the success of the Project. The Darlington Risk Management Program continues to evolve. Overall guidance, process and tools have matured and visibility of senior management support has improved. From a process standpoint, the DR Risk Management Program has matured into an excellent vehicle for identifying and facilitating the management of risks. The recent launch of the Risk Management and Oversights ("RMO") tool has greatly facilitated the review, analysis, tracking, and management of refurbishment risks across bundles, functions, and "Key Risk Areas".

The concept of "Key Risk Areas" ("KRAs") has been introduced to consolidate program and project risks by common themes or drivers (e. g. "Regulatory Approval", "Cost & Estimating Management"). A senior management sponsor is assigned to each of the Key Risk Areas for the purpose of ensuring that project managers and functional team leaders, along with the risk owners focus proper attention on identifying and managing the risks. We have observed a tendency for the project team to focus only on "urgent" issues. The KRA assignments are very critical because managing risks seems to fall into the "Important, but Not Urgent" category of priorities that managers face every day. In fact, the purpose of a risk management program is to identify the important issues before they become urgent—and so they can be effectively mitigated. Once an issue becomes urgent, the possible resolutions are inevitably limited and more costly. The KRA sponsor concept in theory is a good one—however, it will only be effective if it is given a priority and managed daily. That effectiveness has yet to be realized. We have made several recommendations for the improvement of the Risk Management Program and will continue to monitor its progress.

DRAFT

ONTARIO POWER GENERATION

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Quarterly Report to the Darlington Refurbishment Committee of the OPG Board of Directors ("DRC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of August 7, 2015. Our main focus continues to be assessing the development of the Release Quality Estimate ("RQE") that the team intends to provide the Board of Directors at the October 1-2, 2015 retreat.

Specifically, this report focuses on the DR Team's current status with its RQE preparation, a summary of the processes used for deriving the estimate, remaining gaps in the RQE effort that the DR Team will need to close, and recommendations for the DR Team to take into account as it evaluates risk and contingency. As we have previously observed, the DR Team's RQE effort has followed an appropriate process for deriving the Project's estimate, though there have been some unexpected challenges that have impacted the planned pace of RQE's completion. Most notably, while some of RQE's work is significantly advanced, the date for OPG's acceptance of the estimate for the Retube and Feeder Replacement ("RFR") project with the SNC Lavalin/Aecon joint venture ("SNC/Aecon"), has slipped from June 15 to at least August 31. The additional time for vetting the RFR Class 2 Estimate has been extremely valuable, as the end result of the DR Team's efforts should be a very robust and defendable basis of cost estimate and schedule for the most significant scope of work in the DR Project. In addition, the team has encountered issues with assembling, verifying and validating the amount of cost data that is inherent with an effort of the magnitude of RQE. Thus, the DR Team's ability to assess the Project as a whole, including the full schedule, resource allocation, contingency and other such considerations, has been delayed and compressed. As a result, we believe the DR Team will be challenged to meet the current schedule for presenting a RQE that can serve as the Project's control budget by October 1-2.

Following the Recommended Practices provided by the Association for the Advancement of Cost Engineering International ("AACEi"), the DR Team has committed to provide a full, four unit Project "Class 3" estimate with an intended accuracy range of +10% to +30% (on the high end) to -10% to -20% (on the low end).[1] Per the AAECi recommended practices and OPG's own procedures, the RQE would be based on a sufficient level of maturity to form the Project's control budget, against which the overall Project's progress will be compared to completion. The DR Team intends to prepare unit-specific check estimates immediately prior to the start of execution for each unit that will leverage additional maturation of the planning effort and account for any lessons learned from prior units' performance. The check estimate for Unit 2, the first unit to reach the execution phase, is scheduled for August 2016 and the goal is to further mature the Unit 2 estimate and schedule for optimal management of the Execution Phase.

The total RQE amount will include the $2.547 billion OPG plans to spend during the current Definition Phase through October 2016. OPG engaged in this extensive planning and preparatory effort in order to mitigate issues that have severely impacted prior CANDU refurbishments and other nuclear megaprojects. This includes a commitment to complete engineering by August 15, 2015, more than one year before opening the breaker of the first refurbished unit, Unit 2. The Definition Phase has also included hard construction costs for:

- Completion of $1.2B of pre-requisite Campus Plan Projects needed for Refurbishment and ongoing operations;
- Purchase of all specialized tools required for the units' refurbishment;
- Procurement of Unit 2 pressure tubes, feeders, end fittings needed for refurbishing the units' reactors;
- Fees to vendors for development of detailed engineering, project estimates, execution schedules and construction work packages ("CWPs") needed for execution.

[1] For purposes of characterizing RQE and its component parts, OPG has utilized AACEi Recommended Practice No. 18R-97 COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES

In addition, OPG has already negotiated the terms and conditions of the most significant execution contracts with EPC contractors, many of which include provisions for establishing target pricing and incentives based on acceptance of detailed vendor estimates.

BMcD/Modus recognizes OPG's commitment to plan the work in advance and the DR Team's many accomplishments to date in the Definition Phase. However, the DR Team's RQE effort has been substantially compressed. The original schedule for RQE was to complete the estimate integration and analysis by October 15th and then present to the Board in November 2015. RQE preparation for that November delivery included a planned 3 ½ months of detailed integration and vetting of the amassed data; that work under the current schedule has been compressed to 1 ½ months, with much of the work being done in parallel. Significant work remains for the DR Team to meet its commitments with respect to the submission of RQE, as discussed below.

As noted, the DR Team intends to use the period from RQE to Unit 2 breaker open in October 2016 to further mature its planning, estimates and schedules, and present a Class 2 check estimate and detailed execution-ready schedule in 2Q 2016. The team has developed a "Readiness to Execute" regime through which it plans to test multiple processes and improvement initiatives with smaller BOP and Shut-Down/Lay-up packages that need to be performed prior to Unit 2's breaker open.

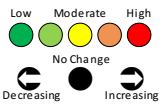
II. DR Project RQE Overview—Status

On January 20, 2015, the DR Team presented its RQE Roadmap to the NOC. That initial Roadmap anticipated the DR Team would produce RQE for Board approval at the November 12, 2015 meeting. This schedule was premised on a number of key milestones being met, most notably:

- Completion of Functional Estimates – May 15, 2015
- Acceptance of SNC/Aecon's RFR estimate – June 15, 2015
- All Execution Phase project Gate 3's complete (except for BOP and Shut-Down/Lay-up) and Project Data Frozen – June 30, 2015
- Presentation of RFR target price to NOC – August 20, 2015
- A six week review and validation period of the estimate and schedule date (July 1 to August 20)
- From August 21 to October 15, the senior team planned vetting and rationalization of changes;
- Finance had 3 weeks to provide a final review and approval before the October 15, 2015 planned completion;
- One month (October 15 to November 12) to prepare and route the materials before the November BOD meeting.

The DR Team's time to finalize RQE has been significantly compressed, and the once planned 3 ½ month period (July 1st to October 15th) for vetting of the integrated cost and schedule has been reduced in its current plan to 1 ½ months (July 31st to September 15th). The current schedule is premised on the DR Team completing the RQE base cost and contingency and associated unit by unit cash flows and consolidated business case by September 15th for presentation to the DRC 10 days later. To meet these challenging dates over the next month, the DR Team must complete:

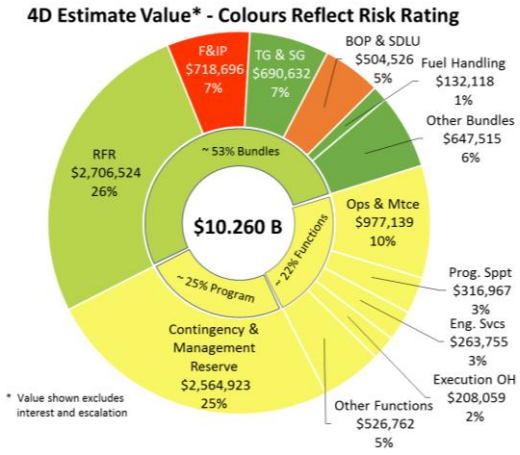
- A thorough vetting of the Project's cost components through a series of "Program Integrated Scope and Reasonability Reviews" with the Project Managers leveraging the work completed to date;
- The receipt and review of an acceptable estimate and schedule submission from SNC/Aecon, which is currently expected on August 31, 2015, though which will still require verification, vetting and reconciliation with the rest of the RQE files;
- Concluding the negotiations with SNC/Aecon on the RFR target price;



- Finalizing the documentation for the basis of estimates for each of the Project's "bundles" or sub-projects;
- Final vetting of the DR Team's Functional groups, functional management plans, and associated cost estimates
- Senior management vetting and challenge of the program and its constituent parts to validate the overall schedule, resourcing, roles and responsibilities and confidence level in performing the work;
- Finalizing development of the DR Project's contingency, including reviewing all of the discrete risks for each bundle and the program as a whole, and capturing and properly modeling risk of performance for all four units;
- Integrating the cost and schedule data for each of the Program's component parts so that an integrated review can be performed to ensure proper alignment for future cost and schedule control; and
- Addressing potential quality control and quality assurance concerns in order to provide the confidence in the reliability and accuracy range RQE as the control budget for the Project.

This represents a tremendous amount of work in a short period of time and assumes that work feeding RQE outside of OPG's direct control will finish on time and with requisite quality. Moreover, for this effort to be successful, the data produced for developing RQE must be free of error and understandable, as there is no margin for rework. As discussed below, the team is currently integrating the data for these reviews to begin, and this effort has also proven to be more time consuming than initially thought, and currently lacks the final and most important part, the RFR estimate. BMcD/Modus is concerned that the remaining time to October will not be sufficient for the DR Team to finalize RQE commensurate with the necessary quality to establish the Project's control budget.

A. Status of the Components of RQE



As with our prior reports, Figure 1 shows the 4d cost estimate values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency. Once RQE is finalized, we will update this figure to reflect the current values and percentages of the Project's cost.

Figure 1 also provides context for the size and percentage of each component of RQE. The three largest parts of RQE are: RFR (26%); OPG Functions (22%); and Contingency and Management Reserve (25%). BOP and Shut-Down/Lay-up (5%), the Turbine Generator project (6%) and Campus Plan Projects (7%) are next largest slices of the budget. Below, we provide a brief update regarding the status of each of the major inputs to RQE, and in Section IV below, we provide additional details regarding key areas – RFR, Functions, and Contingency.

B. Major Inputs to RQE

Detailed Engineering:

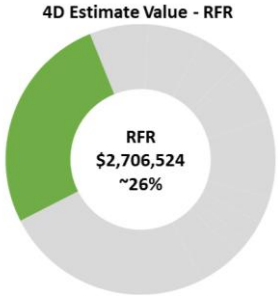
One of the lessons learned from other refurbishment and other nuclear megaprojects is that the control budget should be based upon completed engineering in order to mitigate the risk of unreliable and uncertain initial cost estimates. As a result, OPG has made a commitment to complete as much engineering as reasonably possible for the basis of the RQE control budget, and to ensure that engineering is sufficiently complete for each unit to prepare a Class 2 cost estimate prior to field execution. As of June 30, the Project's Detailed Design was 92% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE.

As the BOP and Shut-Down/Lay-up projects proceed with their development of detailed Class 3 estimates for their upcoming Gate 3s and prior to the check estimate, the DR Team should account for a risk that has manifested itself in

the Campus Plan Projects, that the definition of "design complete" needs to include in the engineering package all of the vendor/supplier procurement information. P&M projects have also had cost impact and scope creep due to the later incorporation of these details by the EPC contractor's revised "Issued for Construction" drawings, and this additional effort was not estimated at the outset of the work. The DR Team's Engineering VP has highlighted this risk which now must be monetized and carried in RQE.

Retube and Feeder Replacement:

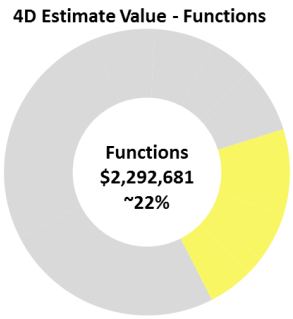
SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Some notable highlights since our 2Q Report:



- SNC/Aecon's initial Rev 0 submission dated 5/8/15 was rejected by OPG for quality deficiencies and omissions. SNC/Aecon's submitted schedule was significantly longer (1086 critical path days with 396 days of contingency time) and higher in cost (in excess of $3.3B) than acceptable to OPG.
- From 5/8/15 to 7/20/15, OPG led a series of challenge meetings with SNC/Aecon's VPs to identify gaps in schedule, cost and quality. On a parallel path, the project teams have engaged in "bottom-up" vetting of the estimate and schedule.
- These initial efforts resulted in OPG and SNC/Aecon agreeing to target a schedule duration of 1110 days and an associated cost of $2.6B (at P50 contingency level).

The teams are currently working to these goals with a target of mid-August for completing the analysis and August 31st for SNC/Aecon's "Rev. 1" submission, approximately 2 ½ months later than the DR Team anticipated. Because of RFR's importance to the Project, this delay threatened to impact the DR Team's ability to complete key elements of RQE. There has been increased cooperation between the teams to optimize the work flow to the extent possible. However, due to the enormity of the effort at both the project and executive levels, concluding this estimate is taking significantly longer than OPG anticipated. The DR Team has engaged in some work-arounds to keep the rest of the RQE process moving in parallel. Moreover, the DR Team and our team are concerned that SNC/Aecon will have a large amount of work in a short time to meet the August 31st date for the Rev. 1 submission, and this could impact the quality of the revised submission. OPG is attempting to mitigate this with near-constant contact with SNC/Aecon until the submission is delivered.

Functional Groups:

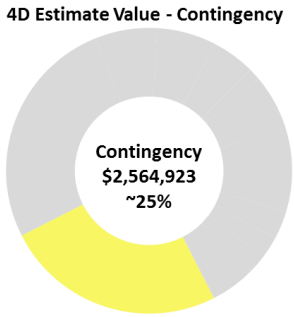


The DR Team's intention for RQE with the Functions is to develop a bounding estimate that incorporates all necessary roles and responsibilities, and then examine the organization in the Readiness-to-Execute roll-out after RQE.

Early in the RQE process, the initial functional estimates had shown 9% growth over what was presented in the 4d Estimate. The SVP commissioned a team drawn from multiple areas within the Project and the centre-led functions to examine the DR Team's functional estimates and provide recommendations for reducing redundancy and overall staffing size. The recommendations from this review have been accepted and are now being integrated into the various staffing plans. Once complete, the DR Team will need to vet the results to confirm that the current estimates are bounding in nature.

Management will still need to devote significant attention to right-sizing the team, defining clear roles and responsibilities and locking down appropriate assumptions prior to the Unit 2 check estimate. Past attempts to make top-down adjustments to the functional estimates have not been effective at holding down cost estimates, and this remains a risk. More importantly, the DR Team needs to be arrayed in a manner that is capable of effectively managing the execution phase. The DR Team's leadership is committed to doing so.

Risk and Contingency:

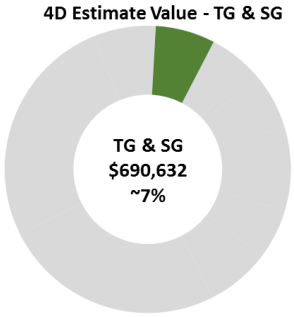


Contingency is the third largest category of costs in RQE behind RFR and the Functional Groups. The DR Team has developed and matured risk registers over the life of the project to date. The Risk team held workshops with each of the project and functional teams to review the current state of the risk registers to establish estimating uncertainty, clearly identify risks and fine-tune risk scoring so that contingency can be calculated and analyzed using Monte Carlo analysis methods. Once the data establishing the Project's base cost is fully available, the project teams will need to vet the results, and the DR Team's leadership intends to follow with full project reviews which are intended to challenge and affirm the variability in the estimates and approximate the level of estimate uncertainty.

We find the process for developing contingency to be robust, and the team has received help and advice from OPG's Enterprise Risk Management and OPG's vendor. However, the overall quality of the contingency development will be dependent on the quality of the data inputs. Due to the compressed RQE schedule, we remain concerned that the time for developing the base costs, understanding the estimate classifications and analysis of the residual impacts of discrete risks will compress the proper formation of contingency.

C. Status of Remaining RQE Inputs:

Turbine Generator and Steam Generator:

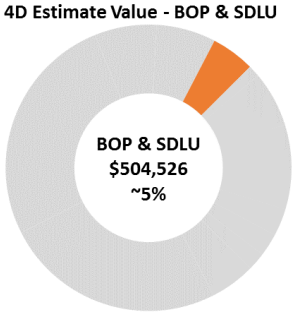


OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. OPG's approval of those detail estimates is pending final review, though is expected shortly.

As with RFR, the OPG and the SNC/Aecon project teams are integrated and working well together. The remaining risks at this time appear to center on completing the CWPs for execution and finalizing the Unit 3, 1 and 4 detailed schedule. In addition, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. This will be a first time evolution for OPG and will require significantly more planning than the limited scope for Unit 2.

The OPG Steam Generator Team has done a good job in managing its activities in order to meet its milestone dates and this project is currently on-track. No issues are apparent at this time; these estimates are expected to support RQE.

Balance of Plant/Shut Down-Lay-up:

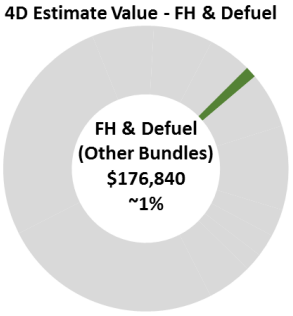


At this time, the focus for BOP and Shut-Down/Lay-up has been Phase I/II engineering and planning work. The DR Team projects that detailed engineering for these projects will be substantially completed by the August 15, 2015 milestone. The DR Team has provided guidance to ES Fox to improve the development and quality of its related project estimates, and is in the process of characterizing the estimates it has received at this time. Approximately 35% of the BOP and Shut-Down/Lay-up work estimates will be in the Class 4/5 range, which increases the risk of estimating uncertainty and accuracy bandwidth for these projects. The OPG Estimating Team has taken a reasonable approach in characterizing the estimates on the basis of differences in their maturity level. Prior to RQE, the DR Team needs to devote significant time in finalizing the risk registers for these projects so that contingency can be properly attributed.

In addition, ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and

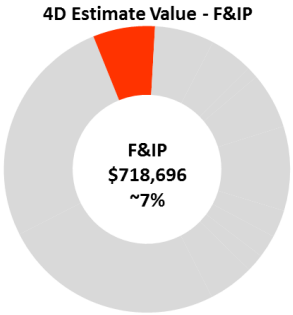
development of CWPs. The DR Team has placed a goal of having BOP projects proceed to their Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. To meet these goals, the BOP team has set interim milestone dates with ES Fox for these deliverables which will be regularly pulsed by the team.

Fuel Handling/Defueling:



The DR Team has received and accepted vendor Class 3 level estimates for RQE based on completed engineering from GE/Hitachi. Cold commissioning is ongoing for Fuel Handling system modifications, and while performance indicators had been lagging, recent progress has dramatically improved overall schedule performance. The recovery plan has also allowed the team to advance plans for testing and training. These recent improvements should allow for a better understanding of the critical path project durations and performance risks

Campus Plan Projects:



The overall performance of the most significant Campus Plan Projects – D20 Storage, Auxiliary Heat System ("AHS") Building, and Emergency Power Generator 3 ("EPG3") - has continued to be impacted by ongoing issues with poor initial estimates and scope definition, site conditions, contractor performance and OPG oversight.

- ***D20 Storage*** **–** OPG issued a purchase order to SNC/Aecon on July 31, 2015 that covers the mechanical, electrical and civil/structural work from grade. SNC/Aecon has provided an estimate and schedule for the work that still needs continued development. SNC/Aecon initially submitted its cost and schedule proposal on April 9, 2015 though it was rejected by OPG due to a number of unacceptable commercial and scope exclusions. SNC/Aecon revised its submission on July 8, 2015 including an estimate proposal of $148M, an increase of $8M from the prior submission, with a Class 3 bandwidth. OPG's estimating team issued approximately one hundred comments to which SNC/Aecon agreed to respond; to date, these have not been fully addressed. While it was necessary for P&M to release this work to SNC/Aecon, it is important SNC/Aecon complete and fully submit its estimate for RQE so that OPG can properly assess risks of performance and potential costs. The Refurbishment Estimating team is supporting P&M in completing the vetting of the details of SNC/Aecon's estimate to determine whether it is of sufficient quality to meet contractual requirements and allow for OPG's assessment of risk and contingency. This is needed to support RQE.

Ellis Don continues to perform the underground civil work, including foundations, dyke walls and closure slab at grade. Currently, the schedule (dated August 4) shows Ellis Don is 57 work days (82 calendar days) behind in meeting the key milestone for setting of the D20 tanks. On August 6, the D20 Storage team identified a partial recovery of approximately 15 days (to January 13th) of this milestone through resequencing of the work. However, at Ellis Don's current pace (SPI is 0.58), it is likely that these dates will continue to slip. If this work cannot be recovered, it will significantly compress SNC/Aecon's work and could impact Unit 2's need to use the D20 Storage tanks for moderator and primary heat transport drain after breaker open. OPG needs an execution schedule for D20 Storage that can be executed by the performing contractors based on the current understanding of the work, realistic projections based on field productivity to date, and which accounts for the limiting factors in the construction of the building.

We have recommended that P&M assess these risks using SNC/Aecon's estimate and schedule and revisit the business case to confirm whether the path chosen for execution is the most prudent course, and whether the team should revisit options for temporary storage of Unit 2's heavy water. It is notable that SNC/Aecon

currently classifies its estimate at Class 3, as the business case was premised on a Class 2 estimate, meaning that additional contingency may be needed to cover the risks. P&M is also pursuing options with SNC/Aecon to further improve the schedule and sequence of the work. In any event, this analysis must proceed so that the risks of performance are adequately captured and monetized in RQE.

- ***AHS –*** The AHS project, which has been subject to schedule delays and cost increases, is nearing completion. The current schedule shows the work is 92% complete and construction testing of the systems has begun. The target for completion is October 2015 based on a full understanding of the commissioning effort. OPG and ES Fox have executed a fixed price amendment to cover the outstanding costs that had been pending for several months. The current projected final cost is $99.5M, which has required a contingency draw of $15M over the approved $84.52M budget in 4d. AHS has provided multiple lessons learned that Refurbishment is taking into account in planning of BOP and Shut-Down/Lay-up work with ES Fox.

- ***EPG 3 –*** This project must be completed prior to Unit 2's breaker open. Construction has been impacted by issues with plant tie-ins and unforeseen underground conditions. Engineering of modifications to the EPG unit are complete, and ES Fox has provided OPG with an estimate at completion of $115M (increased from $88M in 4d). The Refurbishment Estimating team needs to fully vet the details of the estimate to determine whether it is of sufficient quality and represents a sound plan. In addition, the schedule for construction requires additional vetting to confirm the constructability and sequence of ES Fox's plan. These details need to be addressed before the project advances to its upcoming Gate 3.

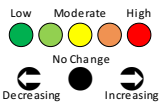
In prior reports, we have commented extensively on the P&M team's structure and capabilities for managing the work. P&M had previously committed to making improvements in areas of project management, project controls and risk management through additional training and adopting Refurbishment processes, where necessary. These improvements need to be accelerated to properly manage the remaining Campus Plan Projects to completion within the RQE control budget. In addition, we have raised the risk of ESMSA contractors' performance deficiencies. The step-up in collaboration between the Refurbishment team and the ESMSA contractors has resulted in higher quality engineering packages and project estimates. The vetting effort described above with SNC/Aecon's D20 Storage proposal provides an example of the benefits that P&M has achieved. These same efforts need to be applied to all remaining Campus Plan Projects, as necessary, to reduce risk of remaining performance and attempt to properly characterize the risks of these Projects to the Refurbishment program.

III. Areas of Focus - RQE Quality

Estimate Characterization

The process of validating and vetting EPC cost estimates for the Project's bundles has followed the approved DR Project RQE Cost Estimate Plan. The vendors presented the cost estimate packages to the OPG Project team in a multi-stage progressive review process for comments and disposition. Among the issues covered at each review stage were scope, COMS, schedule, identification of key cost drivers, estimate basis, benchmark ratios, exclusions and assumptions, as well as cost challenges on a number of issues, such as vendor PMT, indirect costs and productivity factors. Once the EPC vendor completed the comments and disposition phases, and a final revised estimate was received, OPG's estimating team then loaded the estimates into the US Cost estimating platform for analysis.

Once loaded into OPG's US Cost database, OPG's estimating team then vetted and validated the estimate data to determine if the estimate was accurate, reasonable and competitive to the desired classification; as well as, identified any gaps in the documentation or methodology that may negatively impact the quality of the final estimate. The team then performed a technical review of the estimate from a scope point of view and proposed an AACE classification for further review. The process is documented with review checklists. Another member of the estimating team performed



a peer review of the estimate checklists. The estimating manager then conducted a final challenge of the proposed classification of the estimate. Upon completion of the review process, the estimating team issued an estimate declaration of appropriate AACE estimate class.

The estimating team is in the process of performing a reasonability review to obtain buy-in of the vetting process. The focus was to ensure the estimate and its classification is transparent and justifiable. A final estimate review report is then issued memorializing and summarizing the AACE classification, scope review, estimate review, and reasonability review for approval by the Project Manager. This report is targeted for the end of August 2015.

Over the coming weeks, BMcD/Modus will be reviewing and sampling the process to test whether the OPG estimating team has consistently applied its standards and accurately assessed the estimates.

RFR Project-Class 2 Estimate

RFR represents approximately 26% of the total estimated DR Project cost (per the 4d estimate, including contingency), and thus, remains the single largest risk to RQE and the DR Project as a whole. To provide context for the RFR estimate's current status, the following is a summary of the events over the past year.

After receiving SNC/Aecon's Class 3 estimate in June 2014, OPG worked collaboratively with SNC/Aecon to ensure that its Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale mock-up at the Darlington Energy Centre ("DEC"). The collaborative review process spanned much of the year between the delivery of the Class 3 estimate in June 2014 to mid-April 2015, though SNC/Aecon was consistently behind in its preparation. In April, OPG paused its review to allow SNC/Aecon to complete the estimate documentation on its own. It was clear to the OPG team at that time that proper vetting of the estimate required SNC/Aecon to deliver the entire Rev. 0 submission, as piecemeal reviews of the estimate's components were of increasingly limited value. On May 8th, 2015, after several changes to the agreed to delivery date[2], SNC/Aecon presented its first draft of the Class 2 estimate to OPG.

From an initial reading, it was immediately apparent that SNC/Aecon's Class 2 submission was based on a substantially longer duration and higher cost than OPG anticipated, considering the results from testing in the mock-up were very favorable. In fact, the base duration in Rev. 0 exceeded the scaled-up duration of Wolsong (which is a smaller unit), and the reasonably achievable duration was in excess of Bruce Unit 1, both of which had problems during execution that SNC/Aecon and OPG had strived to eliminate for the DR Project.

Following SNC/Aecon's delivery of its Rev. 0 Class 2 estimate, OPG's project management team (including members of the Estimating, Scheduling, and RFR organizations) commenced detailed reviews, ultimately producing over 2,000 comments regarding various noted deficiencies. OPG began bottom-up estimate vetting exercises consisting of "deep dives" and "vertical slices" through the estimate documentation. The deep dives generally addressed specific items of cost such as tool management, support services, direct field labor, performance adjustment factors, and the like. The "vertical slices" evaluated SNC/Aecon's estimate at different key points in time, testing the veracity of SNC/Aecon's planning, resourcing, and constructability; in particular, areas of high complexity such as peak man-power staffing, unit over unit overlaps, and waste processing logistics were carefully analyzed. The results of the early vetting revealed problems with SNC/Aecon's submission that needed to be corrected for OPG to accept the estimate and utilize it as the

[2] The SNC/Aecon contract specifies that the Class 2 Estimate would be delivered by May 15th, 2015. By mutual agreement, SNC/Aecon's Class 2 estimate was accelerated for delivery by April 10th, 2015, though SNC/Aecon was unable to meet this deadline. OPG ultimately provided SNC/Aecon with an extension to May 8th, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality.

basis of the Project's target price.

Simultaneous to OPG's review, the parties jointly engaged an expert panel (including individuals selected by OPG and SNC/Aecon) who have played significant roles in virtually every CANDU refurbishment to date. The expert panel reviewed SNC/Aecon's submission and generally agreed with OPG's conclusions regarding the excessive schedule, cost, size of the labour force and risk monetization. BMcD/Modus also provided input from our review of the submission, focusing largely on inconsistencies in the information presented and areas lacking in appropriate back-up and rigor. Areas we highlighted to OPG were as follows:

- Overall quality is insufficient to support a Class 2 submission
- Contingency is built into the base estimate and schedule
- Subsequent unit estimates are assumed to be a replication of Unit 2, with overlapping schedules, and did not consider distinct risks from the overlaps and changes in the execution model
- OPEX is not utilized in a meaningful manner for establishing the basis of the estimate or testing reasonability
- Resource leveling is questionable and resultant resource curves are not achievable
- Based on comparable metrics, the PMT is oversized and is not presented as a well-integrated organization
- SNC/Aecon's inaccurate understanding of conformance to AACEi recommended practices for estimate preparation

Overall, the expert panel and BMcD/Modus produced over 300 comments regarding the Rev. 0 estimate's quality.

Based on the DR Team's initial reviews and input from third parties, it was clear to OPG that SNC/Aecon's Rev. 0 submission was insufficient, and resolving the multitude of issues would require substantially more time and effort than originally planned. The resultant estimate vetting process has run well past the initial mid-June 2015 target date for approving SNC/Aecon's Class 2 estimate. Starting in June, OPG and SNC/Aecon proceeded down parallel paths to resolve the current estimate issues:

- Project executive-level working sessions, intent on establishing a set of baseline cost and schedule objectives and addressing potential risks and barriers to performance that caused SNC/Aecon to take an excessively conservative approach to the estimate;
- Continued bottoms-up vetting of the detailed estimate and schedule, with subject matter experts ("SMEs") from OPG and SNC/Aecon working shoulder-to-shoulder to resolve OPG's comments and challenges.

Based on the agreement reached at the project executive-level, the combined OPG and SNC/Aecon teams have been given targets for what OPG deems an acceptable schedule and cost (a P50 schedule of 1,100 days and a target cost of ~$2.6B including contingency). These targets were provided for context only, as the direction given by both management teams was to focus on coming to agreement on what is realistic and achievable, supported by workable plans, concrete data, and OPEX, rather than meeting top-down targets. This process has netted excellent progress towards reaching closure on many of OPG's challenges and developing a principled basis for SNC/Aecon's estimate.

The current target date for delivery of the revised estimate is August 31th. Meeting this target will require completing the following:

- Finalize review of schedule critical path and sub-critical path durations from "bottoms-up"
- Rationalize risk register and reach agreement on nature, severity and ownership of risk
- Complete monetizing Unit 2 estimate based on outcome of SME examination
- Review all accepted changes to schedule and monetize differences in overhead/Project Management Team ("PMT") costs

- Provide analysis of discrete risks for Units 3/1/4 and monetization of same
- Complete all steps in pre-negotiated term sheet including finalizing incentive/disincentive approach
- Dispositioning all items in expert panel and BMcD/Modus list
- RWPB estimate which needs to be fully vetted.

From the outset, we have recommended that OPG take a reasonable amount of time to vet the Class 2 estimate given its importance. Completing all of this work by August 31st will be a significant challenge, and ensuring that the resultant SNC/Aecon Rev. 1 submission is of the quality capable of being approved will also take time. However, the work done to date in vetting the estimate has had tangible results and greatly improved the price, schedule and risk profile for the overall Project.

Functional Groups

The Project's functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance, Project Controls and the Execution Team) constitute approximately 22% of the DR Project's total cost. The RQE Roadmap milestone for completing functional estimates by May 15th was not met, and the initial functional cost estimates for virtually every group increased over their 4d levels.

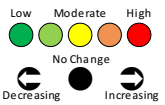
The SVP of Nuclear Projects challenged the functional team managers to both reduce their overall cost and right-size their staffing plans, and investigate ways to leverage other parts of OPG's business to reduce staffing burdens. To assist in this regard, the SVP requested formation of a senior review panel that included a broad spectrum of knowledge within the company. This panel provided the following observations from this review:

- Many of the panel's recommendations related to removing overlapping responsibilities between different functions;
- Future staffing reductions, based on Lessons Learned from the first unit, should be possible for the subsequent units included in RQE;
- Approximately 50% of the reductions contained in the report have been agreed to by the Functions. A 'top down' instruction will be required to achieve the balance of the reductions recommended. In addition, a single leader must be assigned to ensure the reductions are implemented and that a Divisional Self-Assessment or audit be performed prior to the 'Check Estimate' to ensure the reductions have remained in the estimate; and,
- Going forward, the project philosophy must be that if something is to be added to the estimate an equivalent reduction must be taken.

The panel made a number of recommendations regarding clarifying roles and responsibilities and resource allocation. From a cost estimate perspective, the panel essentially reversed much of the cost growth that the functions had estimated post 4d. These recommendations were presented to the SVP, who directed the functions to follow suit and revise their staffing plans.

In our view, the results of the senior panel still need to be vetted to ensure that the recommendations have been incorporated into both the teams' management plans and cost/staffing estimates. The SVP has directed top down adjustments in prior cost forecasts that have not been realized; thus, ensuring full buy-in of the panel's recommendations is necessary at this time. Moreover, once these changes are made, we would advocate vetting of the result to see whether the revised plans truly represent a bounding estimate. At a minimum, the functional management plans from the team must reflect that the panel's recommendations have been embraced and the staffing plan needs to reflect those assumptions.

Ultimately, the DR Team's leadership intends to "live test" the organization through the Readiness to Execute plan,



leading to potential refinements of the organization needed for the full Execution Phase. We have recommended that management also look at the division of responsibility (once available) to confirm the roles are well defined and duplication is eliminated, and examine the work itself and right-size the staff in accordance. The senior leadership is committed to doing so prior to the Unit 2 check estimate. There is considerable value in re-assessing the DR organization's structure considering the current transition to execution phase work and the ways in which the Project's planning has matured.

Risk and Contingency

Contingency for RQE will be comprised of seven (7) major "buckets", each of which require separate and unique inputs. These buckets include:

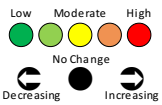
- Cost estimating uncertainty (determined based upon the class of estimate of the base costs and the opinion of OPG estimators and subject matter experts);
- Schedule estimating uncertainty;
- Discrete risks (both for the individual project bundles and the entire program);
- High impact/low probability risks
- Contingent work;
- Campus Plan/F&IP life cycle contingency estimates; and
- Insurance uncertainty

OPG has taken a scalable approach to calculating contingency for project bundles and functions. The rigor applied and method used (stochastic or deterministic) will depend on the state of the project bundle or function at the time the RQE package is assembled. Where the base plan cost and schedule estimate is mature enough to allow it, certain buckets will be run through a Monte Carlo simulation using the @RISK program. Other buckets (such as the high impact/low probability risks, Campus Plan life cycle contingency risks and insurance uncertainty) are derived deterministically using expert analysis and will be added to the outcome of the Monte Carlo simulations to comprise the total RQE contingency estimate.

OPG has retained the PALISADE Corporation to provide third-party expertise in supporting RQE and to ensure integrity of the modelling process. This third party expert will review the inputs generated by the risk management process, design the risk model, define the detailed modeling feed stock and execute and oversee the contingency modeling processes. PALISADE is the developer of the @RISK program and has performed this function for many capital projects.

During the week of July 20, 2015, the DR Risk Management team conducted contingency workshops with the project bundle and function teams. The purpose of these brief (1-2 hour) workshops was to guide the teams on the expectations regarding the data inputs needed for RQE contingency development. In these workshops, the discussions focused primarily on discrete risks and the scoring of those risks (probability of occurrence, cost and schedule impact if realized). These assumptions were then challenged by a panel that also reviewed the scoring, 3-point ranges and recurrence frequencies in the templates.

The Project and function teams were to take the comments from the workshop and update their contingency inputs for final submittal on July 27th. The Risk team has entered the input data and run a preliminary Monte Carlo analysis to arrive at preliminary contingency numbers for the DR Project. These amounts will need to be further analyzed to determine if the contingency is appropriate and reasonable. Once these inputs are adjusted, another Monte Carlo analysis will be run. The following are some of our key observations from these risk workshops:



- The workshop concept is good and leverages the work ongoing with risk identification since the start of the Project. However, the key to success is how the projects/functions develop appropriate contingency inputs. This is no small task considering the available time and the amount of effort involved. Individuals from the Risk Management Group will work with the project and functional groups to facilitate acceptable input for RQE. However, project and functional personnel must develop the justifiable content.

- When BMcD/Modus began work on the Project, risk was a very low priority for the managers. Over the last year, additional management focus has been placed on developing and rationalizing risks, and management's goals are well known to the project managers. Some groups have embraced risk analysis, but others pockets within the team have produced contingency input merely to meet the RQE deadline; despite effective Risk Management tools, infrastructure and a support organization. RQE will be the test of how deeply the DR Team understands the risk aspect of their work.

- Some of the estimates of the impact costs were not derived using accepted estimating practices—but were based upon the project manager or functional group representative's "gut feel". The calculations for the cost impacts of discrete risks should be estimated and vetted by the Estimating team with the same rigor as the base cost estimates.

- The Risk Management Team will also review all registers to identify and resolve duplicate and overlapping entries. Clarity and precision in the risk descriptions will influence how efficiently this review can be conducted. Eliminating such redundancy only increases confidence.

- The BOP team has a significant challenge. Its major contractor has noted performance issues on Campus Plan projects, nssitating significant BOP schedule and cost contingency in order to have sufficient funds budgeted. That creates problems developing firm estimates and schedules. Nonetheless, absent detailed Construction Work Packages, fairly accurate OPEX for executing some of the BOP work, such as valve repair/replacement, can be employed. To develop the best input for RQE contingency, the BOP team has to rely on creative approaches such as existing DNGS OPEX, SME input and appropriate risk analysis. BOP (and, where necessary, other groups) are working closely with the Risk Team to timely develop acceptable contingency inputs.

The Project Controls team managing RQE is intent on issuing a number of key questions for the team to consider in looking at their contingency. In developing the global, program level contingency, the DR Team should fully consider the following risk areas as part of that exercise:

- ***Address vendors' concerns regarding OPG's role as overseer and integrator of the work***: Each of the vendors have voiced their concern that OPG's history is to provide multiple points of contact during a work cycle, who often provide conflicting information and direction and otherwise interfere with the field work. For the Project to be successful, the DR Team needs to dispel these fears with an optimized Execution Phase organization with clear accountabilities, and ensure that the Station and the Project are fully integrated. To address this, the DR Team has identified a plan to test its Readiness to Execute the work using actual work scheduled in 2015-16 prior to Breaker Open. This plan should be finalized and fully vetted for RQE and tracked with appropriate metrics and targets during the coming year. Nonetheless, for purposes of RQE, these risks need to be fully addressed.

- ***Fully analyze and account for the distinct risks inherent with the performance of Units 3, 1 and 4***: RQE is establishing a control budget for measuring OPG's performance on all four units. While this is sufficient for establishing the control budget's base cost, the full DR Project as it currently is planned actually consists of four separate and distinct execution models: Unit 2 is intended as a stand-alone project; Unit 3 will be completed while Unit 1 is started; Unit 1 will be started simultaneous to Unit 3's completion and completed at the same time Unit 4 is started; and Unit 4 will be "lapped" at its start by Unit 1. The DR Team has embedded certain risks regarding the subsequent units; these should be vetted for consistency and whether they cover the impact, needed resources, and other key factors that could make the execution of the subsequent units different, if not

more difficult. Thus, full consideration needs to be given to contingency and other cost factors associated with future unit performance.

- ***Developing appropriate succession plans for both OPG and vendors***: OPG is carrying as its most prominent enterprise risk the availability of qualified staff and craft resources over the 12-year lifecycle of the DR Project. Mitigating this risk will require increased flexibility in hiring of staff and potentially additional cost for incentivizing workers. The risk of losing key staff over time will manifest itself in multiple ways, including losing the learning curve and "tribal knowledge" provided by the performance of prior units. Thus, unless this risk is properly addressed (as well as the aforementioned risk of multiple unit performance), assumptions regarding unit-over-unit performance improvement could prove to be overstated.

- ***Scope definition for subsequent units***: Our understanding is the Darlington units are as close to alike as any multi-unit station in the world. This assumption has been tested through inspections and operational performance. However, the methods for replicating engineering and scoping effort for the remaining units presents an opportunity to reduce cost. These assumptions also could impact the direct work, as the cost for "design once, build four times" needs to be confirmed.

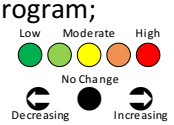
- ***Re-Assess utilization of the ESMSA agreement***: The Campus Plan Projects have provided OPG with an initial opportunity to assess its vendors under the ESMSA, and the record shows significant evidence of poor performance in both cost and schedule. Most of the ESMSA work in Refurbishment in the Balance of Plant and Shut Down/Lay-up bundles has not yet advanced to construction phase purchase orders. The DR Team has committed to finalizing the estimates for this work by next year's Unit 2 Check Estimate. The DR Team is aware of the track record established to date, and is committed to holding appropriate contingency for Refurbishment work. However, the team should consider whether the current contracting arrangement is also contributing to these problems, and whether there is a reasonable mitigation strategy available before finalizing the work plan for Balance of Plant and Shut Down/Lay-up.

Documentation and Data Alignment

Assembly of the massive amount of data that underpins RQE would be a challenge by itself; adding the compressed time for integration and quality assurance makes the integration effort much more difficult. The Project Controls team leading the effort is currently tasked with integrating the multiple estimate submissions from the vendors, OPG functions and other costs into a Master Consolidated File ("MCF") for purposes of analyzing the individual estimates as well as the sum of the multiple parts. As of this writing, Project Controls reports being substantially complete with compiling the data, though that is the first step.

For full vetting of the DR Project as a whole to be effective, the DR Team will need to have the MCF fully populated and QC checked so that the team can analyze issues such as whether:

- The project management team (both OPG and contractors) is right-sized;
- Work windows are available for non-critical path work;
- Resource profiles for craft workers are properly levelized so that the work can be supported, and so that troughs in the work flow are smoothed out and the contractors know when and whom to hire and train;
- Productivity factors and assumptions used in the estimates are consistent and properly characterized;
- Unit-over-unit direct work costs have been properly considered;
- Resources identified in the vendors' cost estimates match the resources in their P6 schedules;
- Ratios of direct field labour to supervision are appropriate for the work and consistent across the program;



- Other such considerations.

Vetting the MCF once assembled will take considerable effort and likely will run longer than anticipated.

MODUS STRATEGIC SOLUTIONS

BURNS McDONNELL

Report to

Darlington Refurbishment Committee

Board of Directors

November 12, 2015

Darlington Nuclear Refurbishment Project

ONTARIO POWER GENERATION

Burns & McDonnell
Modus Strategic Solutions

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I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Report to the OPG Board of Directors ("BOD") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 30, 2015. This report provides the summary of our team's assessment of the DR Team's development of the Release Quality Estimate ("RQE"). This report also summarizes the DR Team's current status of "post-RQE" work that will be its focus going forward, assuming the Board of Directors' approval of RQE at the November 2015 meeting and subsequent shareholder approval, as well as the status of work that is currently being executed on the Prerequisite ("Campus Plan") work and the DR Project.

A. RQE

OPG and the DR Team have been working toward developing a realistic RQE for the DR Project since 2009. The major focus of the DR Team over this time period has been the development of detailed cost estimates of sufficient quality and basis in order to establish a four-unit, program level ***control budget*** for the DR Project. In order to develop the control budget, the DR Team needed to mature the planning to the point where the cost estimates were substantively based. While the DR Team will continue to refine the unitized estimates for each of the four units in order to make specific funding requests, the control budget, if accepted by the Board, will be the baseline against which both the stakeholder confidence and public trust will be measured.

Megaprojects ($1 billion or more in cost) are often adversely impacted by overly optimistic initial cost estimates that do not fully consider the risks and complexities inherent in such undertakings. The DR Team is aware of the industry track record and has taken reasonable steps to account for the particular risks of CANDU refurbishments and develop its cost estimates accordingly. In order to properly communicate the nature of the DR Project's estimate and approximate appropriate contingency, OPG has chosen to utilize the guidance of the Association for the Advancement of Cost Engineering International ("AACE International"). OPG's strategy in this regard is aligned with reasonable and acceptable industry practice for a multi-year, multi-phase megaproject.

In our last report (October 2015) we noted that the month leading up to the November Board Meeting would be challenging given the amount of work the DR Team had left to complete. The DR Team met each of its goals, including:

- Finalizing the target price negotiations with SNC/Aecon on the RFR contract;
- Completing outstanding actions regarding all of the sub-projects from the initial round of senior management-level reviews and revising cost projections accordingly, and vetting the results of those changes;
- Firming up and vetting direct cost estimates and associated critical path schedule basis; and
- Performing integrated reviews of contingency and developing recommendations for amounts of contingency "buckets" and which entity (i.e. project, executive management, BOD) should control those buckets.

With these activities accomplished, the DR Team has completed the work necessary for establishing its control budget, and as an additional benefit, the team has an improved understanding of the Project. Based on our nearly three years of oversight of the DR Project's planning, BMcD/Modus believes the process used for developing the control budget and critical path schedule that form the basis for RQE meets or exceeds industry thresholds. The control budget is based, most notably, on well-defined scope and detailed engineering, which has sufficiently matured to allow classification using the AACE International guidelines in the manner OPG intended for RQE. In addition, the level of detail in the RQE control budget is in line with our experience for projects of this nature and should form the basis for a robust project controls regime that will be used to track progress.

Given the complexity and length of the DR Project, it is impossible for OPG to predict all of the issues that the DR Team may confront during execution. In order to reasonably incorporate the risk of these unknown issues, it is important to build a deterministic-based contingency augmented by a strong risk-management process and stochastic Monte Carlo model. Over the course of the Definition Phase, the DR Team's risk management approach has matured and the team has

put into place a robust process for modeling and monetizing contingency that considered the issues experience on prior CANDU refurbishments as well as issues previously encountered by OPG. In the course of developing the RQE contingency, all project and function managers increased their focus on risk matters to ensure that risks were reasonably identified; response plans were established; and occurrence probabilities and impact quantification were developed. The DR Team performed a reasonable amount of challenge and review of the risks. While risk management and contingency development has many subjective aspects, the DR Team's process is well constructed and executed. It is in the upper percentile of comparable project practices. As with any complex megaproject, contingency values can never be perfect, though OPG has developed contingency at an appropriate level of maturity for establishing the Project's control budget.

While there is still considerable work ahead for the DR Team to further refine its estimates, schedule and execution planning for each of the Project's units, the DR Team has substantially met the goals it set in 2009 at the DR Project's inception for its Definition Phase. With RQE's completion, the DR Team is focusing on ensuring the documentation needed to substantiate its decisions is properly archived and available for future needs, including the unit-specific estimates and future regulatory proceedings. The team has set a goal of completing the RQE document archive by the end of 4Q 2015. We discuss the process used to derive RQE's control budget and recommendations for further refinement in the Unit 2 Estimate[1] that will be issued prior to the Execution Phase in 2016.

B. Status of Prerequisite Projects

We have noted the need for Projects & Modifications ("P&M") to provide greater confidence that the remaining key Campus Plan Projects, most notably D20 Storage and EPG 3, can be completed in time to support Refurbishment and meet current cost estimates. Providing such confidence depends as much on progress in the field as it does on P&M providing requisite metrics and progress reports so that this work can be accurately forecasted and managed. P&M has made good progress over the past month with D20 Storage. The Project Controls team is now tracking quantities of installed concrete by Ellis Don, the civil contractor, which will allow for better forecasting. Ellis Don has also added a second shift to increase its production. All of these efforts have improved the outlook for the foundation work, though P&M must continue to track Ellis Don's progress in order to confirm that it can meet its recovery schedule dates for turnover to SNC/Aecon of November 30, 2015 for the south side of the D2O West Annex Basement and December 22, 2015 for the seismic dyke.

As P&M's attention begins to shift to SNC/Aecon, P&M is closely monitoring the SNC/Aecon's recovery of initial delays in its preparatory activities, including procurement and prefabrication of process piping. P&M has assigned key staff [redacted] P&M's ability to manage this transition should be further enhanced by performance metrics SNC/Aecon is providing for its critical path activities. The other key prerequisite project being performed by SNC/Aecon is the Reactor Waste Processing Building ("RWPB"). Site work is ongoing while SNC/Aecon continues to develop its full execution cost estimate and schedule.

Another key project, the Emergency Power Generator 3 ("EPG 3"), is being performed by ES Fox. Based on ES Fox's assessment, the civil construction of this project is currently approximately 20% complete, though ES Fox and P&M must still agree to a cost estimate and full performance schedule to progress the work. SNC/Aecon's performance with D20 Storage and RWPB and ES Fox's performance with EPG 3 should be a leading indicator of OPG's ability to open breaker on time in October 2016 for Refurbishment and provide important lessons learned going forward.

C. Readiness for Execution

With the completion of RQE, the Definition Phase also completes, and assuming BOD approval, the Execution Phase of the Project will formally begin. As we have noted, the key work ahead before Unit 2's Breaker Open in October 2016 will be focused on its "Readiness to Execute" plan ("RTE") in which the DR Team intends to live-test its plans for unit execution using pre-requisite work. During this time, the DR Team intends to, among other things: complete all execution processes and procedures; finalize its execution schedule and confirm the schedule's critical path and sub-critical paths for Unit 2; develop and test all of its tracking metrics for execution work; finalize tracking methods for vendor performance and

[1] The Unit 2 Estimate has also been referred to as the "Unit 2 Check Estimate". However, because the term "check estimate" has a particular meaning within the industry, we prefer use of the term Unit 2 Estimate.

Low Moderate High
No Change
Decreasing Increasing

procurement, and; finalize the Division of Responsibility ("DOR") and staffing for the execution organization. The Readiness to Execute is an aggressive plan that has multiple deliverables and will involve effort from the entire DR Team, and will leverage the work the DR Team has already accomplished with the vendors to prepare for execution. We have recommended that the DR Team schedule as many of the activities as possible in a resource-loaded, logic-based schedule and track its progress in the same manner as any project. The DR Team has initiated its Readiness to Execute planning in earnest and should be prepared to provide the BOD and senior management with meaningful progress reporting.

II. DR Project RQE – Summary of BMcD/Modus Assessment

A. Overview

RQE represents the culmination of the DR Team's efforts in the Definition Phase. In order to formulate our opinions regarding RQE, BMcD/Modus have performed two in-depth assessments:

- Assessment of the DR Team's Process for Developing RQE ("RQE Assessment");
- Assessment of OPG's Critical Path Schedule, on which RQE is based ("Critical Path Assessment").

This report summarizes these detailed assessments which provide the DR Team with our view of RQE and identify certain issues and challenges the Team should consider in its continued preparation for Unit 2's Execution Phase and beyond. In summary, the RQE Assessment and Critical Path Assessment conclude that:

- The estimates developed for the multiple sub-projects have the requisite basis to establish a meaningful control budget;
- OPG met the broad goals for RQE it established at the outset of the Definition Phase and in doing so followed acceptable industry practice, including its use of the guidance of AACE International that OPG chose for specific guidance in its estimating, risk and schedule development;
- RQE is based upon sufficiently mature scope and engineering definition, as well as an understanding of necessary operational experience ("OPEX") and lessons learned from prior refurbishments and other similar megaprojects, and reasonable alignment with the vendors who are performing the work;
- The DR Team and OPG as a company have adequately assessed the DR Project's risks and have reasonably approximated contingency necessary to offset those risks over time;
- The critical path for the Project was developed using a deterministic approach that considered past similar evolutions, simulated work in the Mock-Up reactor and reasonable assessments of potential improvements in key work series;
- The critical path has been captured using acceptable scheduling practices and resource curves have been sufficiently analyzed and incorporated into the estimate for the current phase of planning;
- The DR Team has a comprehensive plan to prepare for the Execution Phase of the Project; and
- The areas of RQE that are less mature – namely that Balance of Plant ("BOP") and Shut-down/Lay-up ("SDLU")– have adequate contingency for the known risks and uncertainties.

1. OPG's Goals and Adherence to AACE International Guidance

In order to aid OPG in its development and characterization of the RQE estimate, OPG appropriately chose to utilize AACE International's Cost Estimate Classification System[2], which explains the importance of these guidelines and the intent of their general use:

[2] See AACE's Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) and Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011)

An intent of the guidelines is to improve communication among all of the stakeholders involved with preparing, evaluating, and using project cost estimates. The various parties that use project cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates,… improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays or disputes caused by misunderstandings of cost estimates and what they are expected to represent.

AACE recommends that cost estimates be categorized into five different "Classes" based on the project's level of maturity and definition. Class 5 estimates are based upon a low-level of project scope definition and therefore these estimates have the highest amount of uncertainty and the lowest level of accuracy. In contrast, a Class 1 estimate should have little uncertainty and very high accuracy. As noted in our past assessments of the DR Team's cost estimates (4c and 4d), this approach was appropriate and allowed for better understanding of the nature of RQE.

Pursuant to the Nuclear Refurbishment Project RQE Cost Estimate Plan (NK38-PLAN-09701-10235):

The target classification of the RQE cost submission is AACE Class 3 with an expected 50% level of confidence on the point estimate and accuracy range, exclusive of applying escalation, interest and management reserve, within:

Class 3	*Level of Project Definition: 10% to 40%*	*Budget authorization or control*	*Accuracy Range:* *L: -10% to -20%* *H: +10% to +30%*

An assessment of the class of estimate achieved by each project bundle will be performed by the NR Estimating Team based upon AACE Recommended Practices and the nature of the project scope of work.

As stated above, AACE International's guidelines use maturity level of project definition deliverables as the primary characteristic for classifying estimates. In its procedure, OPG listed the specific deliverables that would need to be developed in order to sufficiently advance the Project to support an RQE within the target Class 3 classification.

Based on our RQE Assessment, we concur that the DR Team has sufficiently matured the work in these areas in order to support RQE as a Class 3 estimate and establish a control budget. We do note that some bundles lack Class 3-level maturity (i.e. BOP and SDLU) while others have been deemed Class 2 (RFR). These differences in maturity are not unusual for projects of this complexity, and the DR Team has a full understanding of those parts of the work that need greater definition.

During the Definition Phase, the DR Project's scope was substantially developed and supported with detailed engineering packages. With some exceptions, the detailed engineering packages were prepared in sufficient time for that scope to be adequately assessed and estimated by the DR Project's EPC vendors. Additionally, as we noted in our 3Q 2015 report to the DRC, the process the DR Team used for validating and vetting the cost estimates for the Project's bundles has followed the approved DR Project RQE Cost Estimate Plan, and the result of this process was as intended – the vendors' estimates for project cost have been classified so that management understands the underlying quality, accuracy and reasonableness. This knowledge aided management in identifying potential risks in performance, gaps in the vendors' planned approaches, and areas to shore up for the future unit-specific cost estimates.

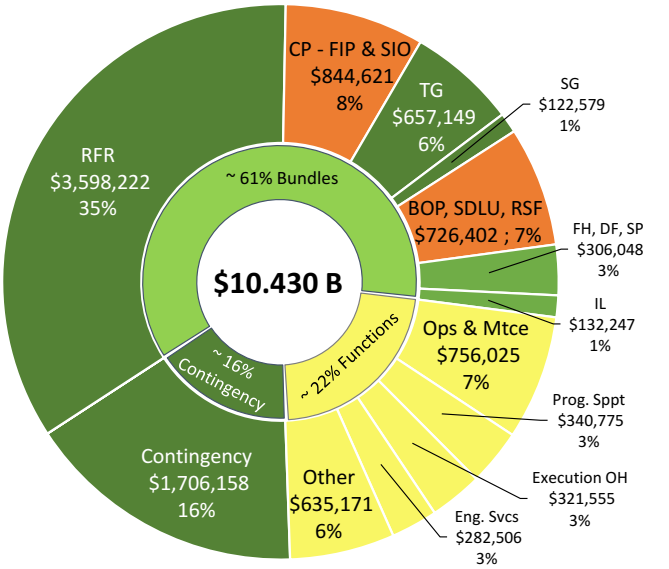
Moreover, with this effort complete for the control budget, the DR Team is better positioned for all of its remaining cost estimating work, which will be considerable during the Project's lifecycle. The Unit 2 Estimate the DR Team intends to deliver in the 3Q of 2016 to the Board of Directors will support that unit's execution. The team is committed to performing a similar estimate prior to each unit's execution. In addition, projects of this type must have ongoing cost estimate support for evaluating potential change orders, claims and cost overruns. The process the DR Team has used for RQE should be adaptable for each of these future needs.

In addition, with the development of the control budget, the DR Team has advanced its understanding of the Project's estimated costs such that it should no longer need to depend upon AACE International's cost estimate classification. The DR Team has now established its own measuring stick. With the exception of those projects (BOP and Shut-Down/Lay-up) that have not advanced to Class 2/3 designation and which still need to reach appropriate maturity, OPG should henceforth measure its progress against the control budget without further regard to AACE International classification.

2. Summary of RQE Elements

In the following sections, we discuss in summary fashion: the basis for each of the DR Project's major cost elements; how these estimates were developed and characterized; the risks identified for each bundle, and; recommendations for further maturation of the estimates.

RQE Value - Colours Reflect Risk Rating



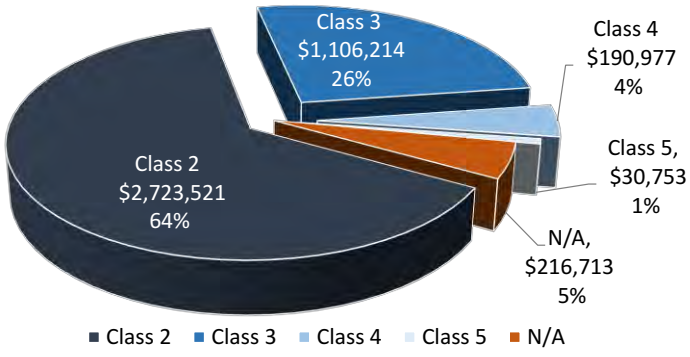
Note 1: Excludes Interest, Escalation, Inflation, and Management Reserve, $3.171B, for a total DR Project cost of $13.6B
Note 2: Contingency as a percent of estimate to complete is 29%
Data Source: RQE Total Cost Snapshot 4.vFinal - October 21, 2015

Figure 1

The adjacent **Figure 1** shows the updated RQE control budget values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency (in 2015$). Figure 1 shows the entire control budget including Definition Phase costs of $2.3B.

Figure 1 also provides context for the relative size and percentage of each component of RQE. The three largest parts of RQE are: RFR (35%); OPG Functions (22%); and Project and Program Contingency (16% of the total control budget and 29% of the estimated cost to complete). The Turbine Generator and Steam Generator projects (7%), Campus Plan Projects (8%), and BOP, Shut-Down/Lay-Up, and Retube Support Facilities (7%) are the next largest slices of the budget.

AACE Classification of RQE Estimate to Complete



Note 1: Excludes Interest, Escalation, Inflation, Contingency, and Functional costs
Note 2: N/A - Not Applicable
Data Source: RQE Total Cost Snapshot 4.vFinal - October 21, 2015

Figure 2

Figure 2 provides a depiction of the estimate class applied to each sub-project (or "bundle") per AACE International guidance and OPG's governance for RQE.

Below, we provide a brief update regarding the status of each of the major inputs to RQE in which we summarize the basis of the estimates that are being included in the control budget; the method and depth of vetting the DR Team applied to those estimates; a summary of the basis of the control budget's contingency, and; a summary of the current issues each project should address during the Ready to Execute period leading to breaker open.

B. Schedule Basis for RQE

Establishing a control budget for a construction project requires an understanding of the project's planned schedule. In particular, setting the control budget requires the ability to identify the execution critical path and the resources necessary to support it, as the critical path influences a large portion of the project's costs and the risks on which contingency is based. As a result, we performed a Critical Path Schedule Assessment as a part of our RQE evaluation to determine whether the DR Project's schedule provides sufficient underpinning to the RQE control budget.

Our Schedule Assessment is based upon our review of four main phases of the schedule: Pre-requisite projects to breaker open; defuel and drain with system shutdown / layup; re-tube and feeder replacement; and system commissioning / return-to-service. Due to the current maturity of the integrated schedule, we have focused on the critical path work and schedule only, covering primarily the following questions:

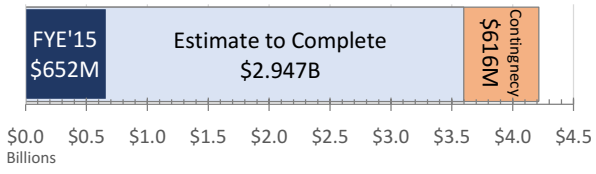
- Does the process used to develop the schedule conform with the DR Project's contracts and approved scheduling plans and procedures;
- Is the basis for the critical path well defined and documented;
- Does the resulting schedule match the documented critical path basis utilized in monetizing the cost estimates; and
- What work remains to complete the schedule and increase quality (i.e. Does the schedule reflect an executable plan for the DR Unit 2 Outage?).

As part of RQE, the DR Team has developed the integrated schedule's critical path at a level consistent with the overall project status. Due to several issues, including delays in issuing purchase orders, the projects have varying stages of schedule maturity. As a result, many of them (particularly those for Balance of Plant) are not detailed enough to be execution-ready schedules. For a large number of DR Project's bundles, implementation planning and work order development are in the early stages and overall integration between OPG Operations and outside vendors is not yet complete. These details are the subject of the next phase of schedule maturity that will occur during the Readiness to Execute period. However, we have determined that the schedule is sufficient for purposes of supporting RQE and is adequate as a baseline for the critical path durations. The DR Team recognizes that much work needs to be done over the next several months in order to have a fully integrated executable schedule.

C. Project Summaries

RETUBE AND FEEDER REPLACEMENT (RFR)

Retube and Feeder Replacement Project Summary			
Control Budget:	$4,214,626,000	**Control Budget** $4.215B	**Risk Perspective**
RQE Base Cost:	$3,598,222,000		
Estimate to Complete:	$2,946,571,000		
Contingency (as a Percent of ETC):	$282,820,000 (10%)		
(Project + Program Allocated Cont.):	$616,404,000 (21%)		
Estimate Class:	Class 2 (95%) Class 3 (5%)		
Percent of RQE:	35%		



1. RFR Basis of Estimate

RFR is the single largest element of the RQE and its budget reflects the overall importance of this work to the DR Project. The RFR cost estimate was developed over the past three years by SNC/Aecon, the project's EPC contractor, under the terms of contract executed between the parties on February 8, 2012. SNC/Aecon prepared four separate estimate submittals, each intended to be a further refinement of the prior estimate. SNC/Aecon's current estimate was updated and finalized on September 18, 2015 and forms the basis of the target price contract the parties intend to finalize prior to the Board of Directors meeting. OPG's estimating team confirmed that the underlying quality of this estimate is Class 2. The most significant supporting facts for this classification include:

- The final target price value of $2.750 B (2015$) has been fully negotiated and is based on mutually agreed upon project durations and schedule contingency, and encompasses 12.9M work hours, project management, supporting tasks, fee and all other costs;
- SNC/Aecon has designed and procured the specialized tools needed for the work. Some of the schedule task durations used in the estimate basis are derived from actually using the tools on the Mock-Up reactor and timing the results;
- All detailed engineering for Unit 2 is complete;
- Construction Work Packages ("CWP's") have been prepared and submitted as a part of the estimate;
- All 53,000 pages of the SNC/Aecon's submission were vetted by OPG's subject-matter experts;
- Both OPG and SNC/Aecon have teams with considerable experience on prior CANDU refurbishment projects and much of that experience has been incorporated into the estimate;
- Tool design has been significantly improved over those used in prior refurbishments, increasing reliability and making the tools easier to use;
- Training on the full-scale Mock-Up, which has never been done on prior refurbishments, should significantly increase the trades' performance in the field;
- Risk identification and contingency planning have been thoroughly performed and known risks are incorporated into the base schedule durations and work planning efforts.

2. Vetting and Characterization of Estimate

Over the course of the 3+ years of SNC/Aecon's estimate development, OPG worked collaboratively with SNC/Aecon to ensure that its final Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale Mock-Up at the Darlington Energy Centre ("DEC"). On May 8th, 2015, SNC/Aecon presented its first draft of the Class 2 estimate to OPG, [redacted]

From this point through September 2015, OPG engaged SNC/Aecon in a detailed vetting process aimed at reducing the overall cost estimate, providing substantive basis for SNC/Aecon's portion of the critical path, and challenging the nature of SNC/Aecon's stated risks and contingency. The OPG and SNC/Aecon teams established a review and vetting process that was driven by subject-matter experts from each team with specific experience in prior CANDU refurbishments. This process was extremely successful at achieving consensus between the subject-matter experts, who objectively agreed with the underlying schedule durations in most instances. In fact, there were only minor disagreements over a small handful of items with a value of approximately $12M of the nearly $750M of direct craft performance estimates. As we noted in our last report, the process utilized to reach these final estimates was extremely detailed and rigorous, which should provide confidence in the results of the vetting process.

3. Contingency

Contingency related to the RFR work is split between the following major buckets:

- The contract includes a contingency amount that can be utilized to resolve issues without impact on the target price. SNC/Aecon is holding, as part of the Target Cost, contractually required contingency in which the parties agreed to a set amount based on the results of the base cost development. The basis and monetization of this contingency was heavily vetted by the subject-matter experts and senior management. The resulting 13.5% contingency totaling $368M is largely based on a deterministic analysis of the potential duration for work task performance and other discrete risks that could impact the work, as monetized with the use of Monte Carlo simulation. The DR Team has assumed for purposes of the control budget that this contingency will be utilized.
- OPG is holding $282M of contingency at the project level which includes discrete risks not carried under the contract.
- OPG is also holding $334M for schedule uncertainty which, due to the RFR project's significant critical path duration, is based on the modeled difference in impact to the critical path between SNC/Aecon's "most likely" (or P50) schedule and OPG's "late finish" (or P90).

In total, OPG is carrying $616M in contingency for RFR or RFR-related risks over and above the contingency that is built into the contract. With a remaining cost for RFR of $2.33B, this equates to 26%. Given the track record of prior CANDU refurbishments, the work performed to identify performance risks and the overall importance of RFR to the work, this level of contingency appears, at this stage, to be appropriate.

4. Summary and Remaining Issues

BMcD/Modus have been closely monitoring the development of SNC/Aecon's cost estimate and OPG's vetting of same, and believes the process the parties used to develop the cost estimate was robust and produced an estimate with significant detail. Moreover, we have witnessed the relationship between the parties substantially improve at every level, which will be important as issues arise. Based on the initial commercial goals the parties set forth, the contract appears to have thus far driven appropriate behaviours and a beneficial result.

With the Class 2 Estimate and target price agreement in place, the RFR team's attention is now turning to execution. The major near-term focus will be on the following:

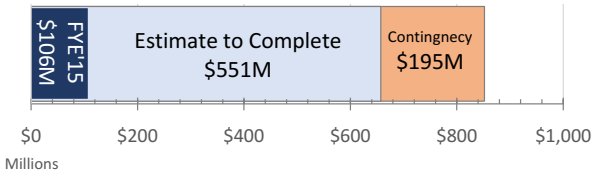
- Recovery of procurement dates for some components: SNC/Aecon's procurement is generally lagging behind, though some of this lag is driven by aggressive contract milestones, not actual needs for the material. This is currently being addressed by the joint SNC/Aecon and OPG RFR team who have established a "war room" similar to that exercised for the Class 2 estimate development.
- Retube Waste Processing Building ("RWPB") estimate, schedule and performance: the work on RWPB continues while the estimate and schedule preparation continues. The $167M estimate included in RQE was presented as an upper limit estimate, though SNC/Aecon's final estimate and execution plan needs to be fleshed out before that can be definitively stated.
- Logistics need further refinement: SNC/Aecon needs to devote further attention to its supporting activities for material and tooling logistics during the Execution Phase.
- SNC/Aecon's construction organization needs to be built.
- Execution Phase schedule needs additional work and must align with the Project's work breakdown structure so that metrics for reporting progress can achieve needed fidelity.
- SNC/Aecon needs to remobilize in the DEC and make full and beneficial use of the Mock-Up to practice tasks and

train workers (this work is commencing as of the end of October).

Each of these elements will provide necessary information regarding cost, schedule, risk and overall confidence as the DR Project advances that can be rolled into the Unit 2 Estimate.

TURBINE GENERATOR (TG)

Turbine Generator Project Summary			
Control Budget:	$852,004,000	**Control Budget** $852M	**Risk Perspective**
RQE Base Cost:	$657,149,000		
Estimate to Complete:	$551,203,000		
Contingency (as % of Estimate to Complete):	$194,855,000 (35%)		
Estimate Class:	Class 3 (85%) Class 2 (15%)		
Percent of RQE:	6%		



1. Turbine Generator Basis of Estimate

The Project's Turbine Generator work consists of two significant evolutions: (1) maintenance work; and (2) digital controls change-out for Unit 3, Unit 1 and Unit 4. In 2014, the DR Team decided to postpone the controls change-out for Unit 2 until the conclusion of the DR Project in order to reduce the risk of the Unit 2 work. Thus, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. The digital controls upgrade will be a first time evolution for OPG and will require significantly more planning than the limited maintenance scope for Unit 2. The risk profile of the subsequent units has been developed with this in mind. Based on the risk profile of similar controls replacements, the decision to delay Unit 2 appears to have been prudent.

Unit 3 will also be the first replacement of the generator mid-section and stator rewind. A new stator will be installed for Unit 3, and the existing Unit 3 stator will be rewound and installed in Unit 4. These evolutions have been planned sufficiently in advance that this work should not be a threat to the schedule of the later units.

OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. These estimates are expected to be fully accepted before the Board of Directors meeting.

2. Vetting and Characterizing the Estimate

Vetting of the Turbine Generator Project estimates came in two phases. Alstom, the original equipment manufacturer ("OEM"), is supplying parts and engineering per a fixed price. That contract was assigned to SNC/Aecon for management after its team was awarded the labour portion of the work. SNC/Aecon's estimate followed much of the same structure as its RFR effort, including successive iterations of the estimate from Class 5 to Class 2. The final Class 2 estimate that forms the basis of the target price with SNC/Aecon was the test case for OPG's estimating process which was robust and laid the groundwork for the RFR estimating vetting that followed thereafter.

3. Contingency

The total contingency of $194.8M equates to 35% of the project's remaining cost. The TG bundle includes three contingency buckets: (1) $27.9M for cost uncertainty; (2) $49.8M for discrete risks identified by the Project Team; and (3) $117M for potential component replacement based on the results of concealed condition assessments on each unit's turbine generator. This contingency bucket was vetted and classified using the OPG estimating process. The team has fully examined the potential schedule impact of discovery work and believes it has reserved sufficient non-critical path

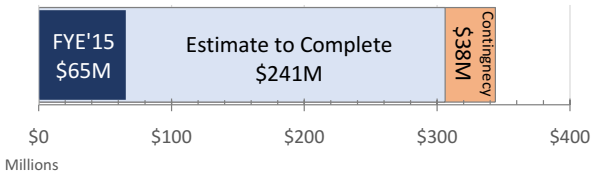
time for major component procurement and replacement in the event such work is required.

4. Summary and Remaining Issues

BMcD/Modus monitored the process used for vetting the TG estimates, and we believe this effort was robust and resulted in further maturation of the estimate. SNC/Aecon's plan for execution was fully explored and significant cost reductions were realized for RQE. As stated above, the Unit 2 work is essentially routine maintenance, though the performance of that work will allow for improved understanding and efficiency for the future units. The controls change-out for Unit 3 needs to be further examined so that the team is assured the labour hours are properly estimated and risks from schedule impacts are mitigated. These will be issues for future unit estimates.

FUEL HANDLING, DEFUELING AND SPECIALIZED PROJECTS (FH, DF, SP)

Fuel Handling, Defueling and Specialized Projects Summary			
Control Budget:	$343,890,000	**Control Budget** $344M	**Risk Perspective**
RQE Base Cost:	$306,048,000		
Estimate to Complete:	$240,888,000		
Contingency (as % of Estimate to Complete):	$37,842,000 (16%)		
Estimate Class:	Class 3		
Percent of RQE:	3%		



1. Fuel Handling, Defueling and Specialized Projects Basis of Estimate

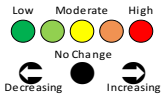
In summary, the scope of these project bundles includes: (1) Defueling each of the reactors to begin refurbishment, which is the first major evolution on the critical path and fully in OPG's control; (2) Fuel Handling equipment replacement to increase the likelihood of the power track maintaining operation through the Refurbishment outages; and (3) Specialized Projects to replace out of-date components to the Darlington Shutdown System computers, and replacement of the vault coolers that have reached the end of their useful lives. The work for these sub-bundles is directed by OPG, with the DR Team and the Darlington Station working cooperatively, with vendors supplying engineering, parts and labour for portions of the work. OPG decided to minimize the number of engineering changes to these critical components by calling for "like-for-like" replacements and thus limited the potential risk of execution.

While the total cost estimate for Fuel Handling/Defueling/Specialized Projects constitutes only about 3% of the total cost of the DR Project, each of these projects could strongly influence the critical path. Defueling each of the Project's reactors is the first critical path activity in the Unit 2 outage, and this is a first time evolution for Darlington. Ensuring the Fuel Handling components work throughout the DR Project is OPG's responsibility, as OPG will seek to maintain the operation of the running units during each defueling period of each unit's refurbishment. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. The DR Team has been focused on evaluating the past defueling evolutions at other CANDU plants and scrubbing the planned durations to the extent possible.

2. Vetting and Characterizing the Estimate

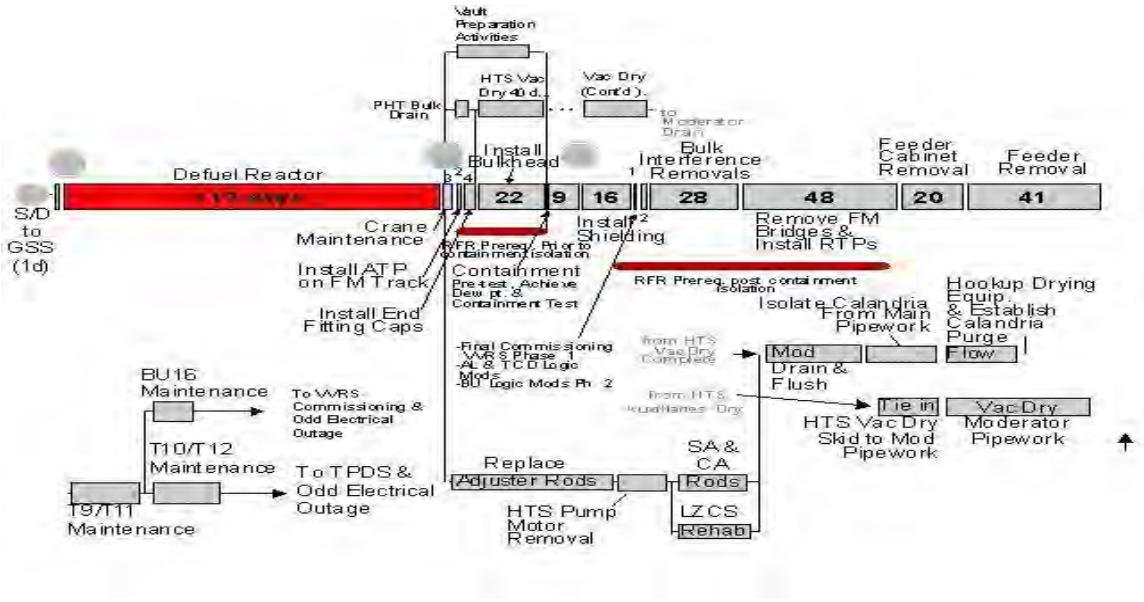
The process for vetting the estimates for these sub-projects was robust, included a team drawn from the station and the project and involved an assessment of reasonable performance in light of past CANDU refurbishment execution, station and vendor performance, and the first-of-a-kind nature of some of this work. It was the latter that drove the estimated Class 3 designation, as the Defueling/Fuel Handling team needed at least one unit's performance before committing to tighter cost estimates.

The current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely (i.e. P50) is 113 days, and the 90% confidence level duration is 134 days. **Figure 3** below depicts the criticality of the defueling duration



at the beginning of the Project.

Figure 3



The Defueling Project Team believes these same durations should be utilized for all four units, as the learning curve for performing defuel will have limited value in improving performance over time. The team believes the 90 day best case is strictly a function of core hydraulics and cannot be improved, while the worst case is based largely on the potential for equipment failure. In the course of deriving these point durations, the Defueling team has dispositioned OPEX from Bruce Power and Pickering and has consulted with its vendor, GE/Hitachi. The due diligence performed by the Defueling team has greatly improved the DR Team's understanding of this critical duration.

3. Contingency

Each of the sub-bundles within this Project is carrying contingency that was assigned on the basis of the work's approximated risk. The following depicts the level of contingency assigned to each:

Bundle	Base Cost Estimate	Est. to Complete	Contingency	% Contingency on ETC
Defueling	$39.6	$10.6	$5.4	51%
Fuel Handling	$158.6	$144.7	$19.6	14%
Specialized Projects	$107.9	$85.5	$12.8	15%
Total	$306.1	$240.8	$37.8	16%

The Fuel Handling and Specialized Projects contingency appears to be appropriate based on the "like-for-like" nature of the work, while the Defueling bundle is carrying a significantly higher percentage due to the risk of delaying the critical path. The discrete risks identified for this work tend to be schedule-focused, which seems appropriate.

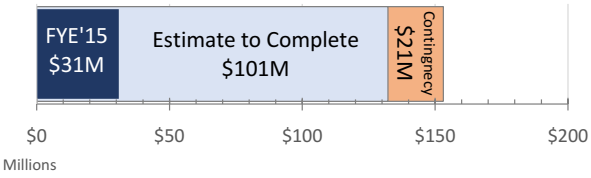
4. Summary and Remaining Issues

The Defueling/Fuel Handling teams have done a very good job of rooting out the risks and finding mitigation approaches. The commissioning of the test fuel handling equipment is complete and the team accelerated the schedule to maximize the amount of practice the teams can perform in advance of breaker open. OPG's performance of these projects will be under tremendous scrutiny going forward, so practice and proving-out processes for documenting progress will be important during the Readiness to Execute phase.

ISLANDING (IL)

Islanding Project Summary	
Control Budget:	$153,104,000
RQE Base Cost:	$132,247,000
Estimate to Complete:	$101,418,000
Contingency (as % of Estimate to Complete):	$20,857,000 (21%)
Estimate Class:	Class 3
Percent of RQE:	1%

Control Budget
$153M



Risk Perspective

1. Islanding Basis of Estimate

The various islanding projects are relatively small in cost but are very significant to the DR Project's success. The design of the Darlington plant makes isolating a single unit for refurbishment a challenge. These projects include: (1) Installing a bulkhead that isolates the Refurbishment unit reactor vault from station containment once the irradiated fuel has been removed from the core, which will allow both airlock doors to be opened to facilitate worker and material transfer into/out of the vault, thus significantly improving RFR worker efficiency. Bulkhead installation is the single largest element of the Islanding Project and its performance will be by SNC/Aecon; (2) Establishing barriers and access control around the Refurbishment Island to keep the Refurb station staff from entering operating unit areas and to keep Station workers from entering Refurbishment work areas; and (3) Establishing terminal points on station systems to allow them to be isolated from the operating units to the maximum extent possible.

2. Vetting and Classification

The majority of the cost for the Islanding work is being carried under SNC/Aecon's contract and was estimated by SNC/Aecon using essentially the same process as it did for RFR.

3. Contingency

The total contingency of $20.86M equals 21% of the remaining costs. The largest and most significant driver of contingency is the potential impact on the DR Project's schedule from potential delays installing the bulkhead. The risk register for Islanding appears to be appropriate for its current state of maturity.

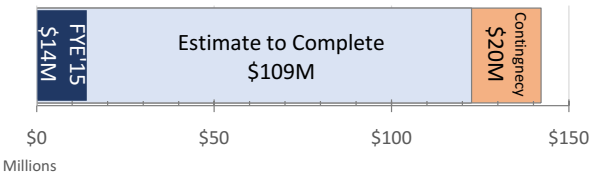
4. Summary and Remaining Issues

The DR Team has performed extensive reviews of plant conditions and OPEX, particularly from Bruce Power, and its efforts appear to have isolated and mitigated the risks to the extent possible. There will be some Islanding work during the Readiness to Execute phase that will allow the team to test its processes and metrics for the larger, more important scopes after breaker open.

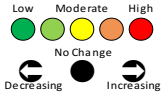
STEAM GENERATOR (SG)

Steam Generator Project Summary	
Control Budget:	$142,171,000
RQE Base Cost:	$122,579,000
Estimate to Complete:	$108,589,000
Contingency (as % of Estimate to Complete):	$19,592,000 (18%)
Estimate Class:	Class 2 (72%) Class 3 (28%)
Percent of RQE:	1%

Control Budget
$142M



Risk Perspective



1. Steam Generator Basis of Estimate

The scope of the Steam Generator Bundle is largely composed of maintenance work, including the following: (1) Primary side cleaning; (2) Secondary side cleaning (Tubesheet Water Lancing); (3) Access Port installations (modification); (4) Inspection and Repair (Primary and Secondary Side); (5) Divider Plate Inspections, Boiler Open/Close & Inspection Support; (6) Lay-up work, and; (7) Bleed Cooler Inspection. All of the work has been executed in other plants. The contract for the work was let to a joint venture of B&W and CANDU Energy, a subsidiary of SNC Lavalin.

2. Vetting and Classification of the Estimate

The SG work is classified as Class 2 due to the nature of the work and the fixed-price contract.

3. Contingency

The project is carrying $19.6M in contingency (18% of remaining cost) which is largely driven by the potential for discovery work, and coordination issues with RFR and OPG's Inspection Maintenance Services.

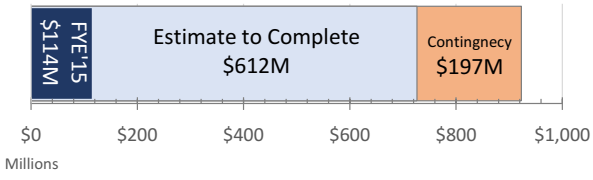
4. Summary and Remaining Issues

The development of the SG project has proceeded well and the work planning is well underway. The risks discussed above with coordination and the Project's schedule appear to be the most important factors for the team to consider. The performance of the Primary Side Cleaning is currently planned to be the only work other than RFR to extend past the 60% window designated for non-critical path work.

BALANCE OF PLANT, SHUT DOWN LAY-UP AND REFURB. SUPPORT FACILITIES (BOP, SDLU, RSF)

BOP, SDLU, and RSF Project Summary	
Control Budget:	$922,940,000
RQE Base Cost:	$726,402,000
Estimate to Complete:	$612,043,000
Contingency (as % of Estimate to Complete):	$196,538,000 (32%)
Estimate Class:	Class 2 (1%) Class 3 (53%) Class 4 (39%) Class 5 (6%)
Percent of RQE:	7%

Control Budget
$923M



Risk Perspective

1. BOP, SDLU and RSF Basis of Estimate

This work scope includes a number of smaller to medium-sized packages. Approximately two-thirds of the work is based on design modifications, while the rest of the work is like-for-like replacement of aging components. The DR Team completed detailed engineering for the modification projects in time for the August 15, 2015 milestone, with some minor exceptions. The BOP work includes seventeen unique sub-projects that range in value from approximately $700,000 to $66M, and the scope includes replacement of components, electrical cable, and inspect and repair/replacement of valves. SDLU consists of twenty-eight different sub-projects and includes a number of prerequisites for construction, including breathing air for workers in the vault and barriers, as well as lay-up of plant systems for the unit being refurbished. RSF consists of building, improving and maintaining shops and other facilities for use during construction. The majority of this work has been released to ES Fox under the terms of the ESMSA contract.

The majority of the BOP work will be performed during the first 50-60% of the refurbishment schedule, with the goal of keeping BOP work off the critical path. Much of the SDLU and RSF work will proceed breaker open, but maintenance of the lay-up of systems will stretch throughout the length of the Project.

2. Vetting and Characterizing the Estimates

These project bundles are the least mature in the Refurbishment scope, which is reflected by their respective estimate classifications; 1% is Class 2, 53% is Class 3, 39% is Class 4, and 6% is Class 5. Based on our observations, these characterizations by the estimating team appear to be appropriate. The DR Team has set aggressive goals to receive all of ES Fox's remaining BOP/Shut-Down/Lay-up/RSF estimates to a Class 3 level by no later than January 2016. The OPG estimating team is collaborating with ES Fox's estimators on these remaining estimates to keep the process on schedule and test the quality of the estimates.

3. Contingency

These bundles' contingency is broken down as follows:

Bundle	Base Cost Estimate	Est. to Complete	Contingency	% Contingency on ETC
Balance of Plant	$430.0	$353.6	$125.3	35%
Shut-Down/Lay-up	$218.0	$196.8	$53.1	27%
Refurbishment Support Facilities	$78.4	$61.6	$18.1	29%
Total	$726.4	$612.0	$196.5	32%

The drivers for contingency include: (1) cost uncertainty due to the maturity level of the packages and the recent completion of supporting detailed engineering; (2) potential upfront delays to Refurbishment causing early schedule issues; (3) past performance of ES Fox on the Campus Plan Projects; and (4) potential for discovery work.

ES Fox's performance on the Campus Plan Projects provides vital OPEX that the team has considered in identifying risk for these projects. The DR Team is aware of the issues [redacted] and are attempting to mitigate those issues. [redacted] The OPG scheduling team has recognized these shortcomings and worked with ES Fox to improve the deliverables. 45% of the BOP and Shut-Down/Lay-Up work estimates are in the Class 4 or 5 range, which increases the risk of estimating uncertainty for these projects. Moreover, the risk profile of these projects should reflect the risks from ESMSA vendor performance. The BOP and Shut-Down/Lay-Up project teams have identified discrete risks related to vendor performance. Additionally, OPG has included some program-level contingency due to the past track record of these vendors in the event performance issues resurface during Refurbishment.

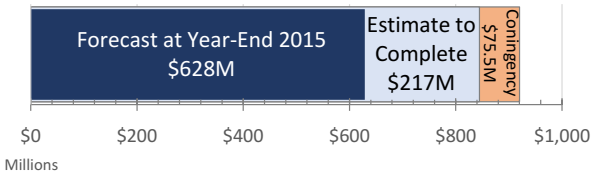
4. Summary and Remaining Issues

BOP and Shut-Down/Lay-Up will be under significant scrutiny once the DR Team's focus shifts to the Readiness to Execute plan. ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and development of Construction Work Packages. The DR Team has placed a challenging goal of having all of the BOP projects proceed to their respective Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. The BOP team has set interim milestone dates with ES Fox for these deliverables which may be too aggressive for the DR Team to receive quality work product.

CAMPUS PLAN PROJECTS (CP – F&IP AND SIO)

CP – F&IP and SIO Project Summary	
Control Budget:	$920,079,000
RQE Base Cost:	$844,621,000
Estimate to Complete:	$216,713,000
Project Contingency (as a Percent of ETC):	$41,525,000 (19%)
(Project + Program Allocated Cont.):	$75,458,000 (35%)
Estimate Class:	Not Applicable
Percent of RQE:	8%

Control Budget
$920M



Risk Perspective

1. Budget Status

There are six active Campus Plan Projects in execution at this time with the Refurbishment Project Office ("RPO"), the RFR Island Support Annex ("RFRISA") and Replacement of Buried ESW Piping approaching completion. There are two other pre-requisite projects, the Auxiliary Heat System ("AHS") which for budgetary purposes was reclassified as a Station project though P&M is still managing the work. The costs for AHS are no longer carried in RQE. The other pre-requisite project, the Refurbishment Waste Processing Facility ("RWPB") is being performed by SNC/Aecon under the RFR Definition Phase contract and is not part of P&M's reporting.

We have noted in past reports that while the remaining dollars involved in the Campus Plan Projects do not necessarily have a significant monetary impact to RQE, certain of the projects, most notably D20 Storage and EPG 3, remain a risk to breaker open of Unit 2. These projects' completion dates have shifted over time and further delays could result in drawing attention away from the Readiness to Execute plan. Overall, the entire portfolio of Campus Plan Projects experienced $76.3M in base cost growth from 4d to RQE, an increase of 9%, which resulted in contingency drawdowns from the allocated budget amount set in 4d. P&M is currently forecasting an Estimate to Complete ("ETC") for all remaining Campus Plan and SIO work of $216,713,000.

2. Contingency

Based on the history of these projects, the velocity of change and the volume of remaining work, the $75.5 million in remaining contingency needs to be closely tracked to ensure it is enough to cover any remaining cost issues with completing these projects. In particular, D20 and EPG3 pose the greatest risk to the remaining Campus Plan Contingency, and EPG 3's final cost estimate has not been fully vetted and approved. P&M's change control process needs to be monitored so that the use of contingency is readily identified and so there are sufficient funds going forward. In Section III below we discuss the status of these projects and describe some of the risks that could cause the base costs for these projects to increase.

FUNCTIONS

With the exception of Operations & Maintenance, the remaining functional groups that compose the DR Team jumped in size from 4d to RQE. The non-Operations & Maintenance groups' cost estimates increased in aggregate from $1.28B (2015$) to $1.53B, an increase of 20%. The largest gains were for the Execution Organization (48%), Contract Management (38%) and Managed Systems Oversight (42%). Operations & Maintenance's budget decreased by from $1.1B (2015$) at 4d to $0.81B for RQE, a reduction of 27%. This reduction was due primarily to identification and removal from the DR Project of non-Refurbishment Operations & Maintenance costs.

The DR Team has high confidence in the extent of the estimates it has prepared for RQE and are all-inclusive of what could reasonably be identified for staffing at this time. However, the pace of the proposed ramp-up of the DR Team's staff is aggressive and will be very difficult to meet. In order to meet the plan, the DR Team would have to increase from 770 to

just over 900 (17%) staff in less than 3 months. The team has been chronically under-spent during the Definition Phase, and missing these major ramp-up dates will further impact the accuracy of the team's staffing forecasts.

The commitment from the NPET to further rationalize and organize the functions on the basis of a division of responsibility matrix ("DOR") has been held over to the Readiness to Execute phase. The DR Team committed to putting a DOR in place that defines each function's accountability and responsibility by early 1Q 2016, which in turn should result in optimizing the organization. While the DR Team's goal for RQE was to identify the outer cost limit for the functions, BMcD/Modus is more concerned that the DR Team operate efficiently, have highly qualified and skilled resources, and actively manage the field work during the Execution Phase. The team has considerable work ahead to meet these goals.

D. Summary of RQE Risk and Contingency

As part of our assessment of RQE, BMcD/Modus has focused a lot of time and attention on the DR Team's development of contingency for the Project's control budget. Our review focused on the development of input factors, the Monte Carlo stochastic modeling, results analysis, and finalization of RQE contingency provisions. Specifically, we focused on the following aspects of the DR Team's contingency development:

- Whether the processes used for capturing risks were sufficiently robust;
- The extent to which contingency is properly modeled; and
- Whether the risks and associated contingency amounts were properly monetized.

The DR Team's development of the contingency for RQE compares favorably with what our team has observed in the industry. While risk management and contingency development has many subjective aspects, the DR Project's process is well constructed and executed. It is probably in the upper percentile of comparable project practices. Nonetheless, because of uncertainties and unknowns, contingency values are not perfect, but the DR contingency process likely contributes to a reliable and defensible RQE.

1. Contingency Process

OPG prepared and approved the RQE Contingency Development Plan NK38-NR-PLAN-09701-10006 in Q1 2015, establishing the approach for developing the RQE contingency and describing the associated contingency development principles and processes. The Plan established a contingency process utilizing a number of AACE recommended practices for contingency development. It appropriately states that the practices will be supplemented with the expert opinion and judgment of the NPET (Nuclear Projects Executive Team) to ensure there is confidence that the contingency estimate is robust and sufficient to deal with the risks and uncertainties characterized at the time of RQE.

Six basic buckets were addressed in developing the RQE contingency:

1. **Cost Estimating Uncertainty** - The project managers and function leads provided three point estimate uncertainty ranges.
2. **Schedule Uncertainty** – Uncertainty range estimates for critical path durations were provided to the risk team by the project managers. Schedule cost impact was determined by applying a daily "burn rate" to any schedule impacts. Allocation of schedule contingency between the affected project and the overall program critical path was carefully addressed.
3. **Discrete Risks** - Discrete risks from the project, program and function Risk Registers were reviewed and post-mitigation probability of occurrence values were finalized. Quantitative cost & schedule impact values were developed with associated three point ranges as model input. In addition, provision for risk event recurrence over the four units was established for model input.
4. **High Impact Low Probability Risks** – The Board of Directors Controlled Contingency was established deterministically to address these issues and to provide for some coverage of unanticipated items beyond control of the DR team.

5. **Campus Plan/ F&IP –** The nature of Campus Plan risk registers, estimates and schedules required that contingency be established a through a combination of stochastic, deterministic and expert judgment means. Probabilities and impact ranges for the discrete risks were updated. Cost elements were assigned uncertainty ranges. The results of the risk probabilities and impact quantification with three point ranging, along with estimate uncertainty ranges were then submitted for Monte Carlo analysis. The Monte Carlo contingency values were assessed by P&M's management and deterministic adjustments were made for RQE. The stochastic and deterministic numbers were then compared and justifiable adjustments were made. In addition, program contingency was added to reflect the historic performance issues associated with Campus Plan projects.
6. **Insurance Uncertainty** – A premium cost point estimate and pessimistic/optimistic uncertainty range was provided by Finance and factored into the contingency calculation.

In developing the contingency at the project level, the DR Team took care to ensure there was no double-counting or duplication. From our review, the team was successful in not over-generating the contingency.

2. Vetting of Risks and Contingency

The RQE contingency was subjected to many stages of review and vetting. The RFR project received focused attention from SNC/Aecon and the DR Team, given its overall importance to the Program. The process used for vetting the base contract amounts also resulted in thorough understanding and development of the risk model.

For the various projects the Risk Team conducted contingency workshops, where subject-matter experts challenged, critiqued and provided constructive feedback. After the workshops, members of the risk team met with the respective managers to update data that was entered into the @RISK Monte Carlo model and preliminary results were obtained. Those results were analyzed and changes were made to the model and input data was refined. To monetize schedule impact, Finance reviewed cash flow projections and developed a point estimate for daily burn rate and an associated uncertainty range. That approach is considered reasonable.

The DR management team recommended establishing a contingency to be controlled at the Board of Directors level. This was done by considering deterministic estimates primarily based on experience-based judgement. Other considerations included OPG's risk tolerance, the budget ceiling, and the overall established contingency. Provisions for "Black Swan" (high impact low probability) risks were considered in establishing this layer of contingency. Factors included acts of God, the labor and political environment, vendor defaults, nuclear safety or security events, unforeseeable scope increases, and financial matters. No strict rules or best practices exist for estimating low probability/high impact events and the subjective approach employed by DR is not uncommon.

3. The Monte Carlo Model

The DR Team used modeling experts from the Palisade Corporation[3] to develop a Monte Carlo simulation method for the Project. In Palisade's final report, which focused on the RQE contingency process, Palisade stated that the model used by the DR Team contains all the elements of risk management's best practices and contains well-defined methodology as its foundation. Palisade also cited the collaboration of risk experts interfacing with project/functional managers and SMEs.

The RQE Monte Carlo model is extremely robust and comprehensive. All four units are addressed in one integrated fashion. Over 2600 three point estimates were used to model outcome (maximizing use of three-point range estimating contributes to the veracity of the input by allowing the source to avoid conservative single value "plug-in" numbers). Over 470 discrete risks were analyzed. Approximately 273 risks were included in the contingency calculation, which 55 were program/function related and 218 were from projects. Close to 800 estimate uncertainties were analyzed and 128 schedule activities assessed across the four Units.

[3] Palisade Corporation provides widely accepted @RISK software system to a global base of customers and consults on the process for developing stochastic tools for understanding and quantifying risks and uncertainties.

A schedule correlation factor of 70% is included the contingency model, reflecting interdependence of schedule activities. In addition, because DR is a multiple unit project, provisions to address risk recurrence are incorporated based on project and functional manager input.

4. Contingency Results

The resultant contingency amounts are reflected in **Table 1**. Monte Carlo based values are at the P90 level for Projects/Bundles/Functions and for allocated Program Contingency. "P90" means that, based on the inputs and model structure, there is a 90% confidence that the contingency value is appropriate to cover the risks and uncertainties analyzed by the model.

Table 1

RQE Contingency Summary

Contingency Element	P90 Amount ($x1,000)[4]	Basis	Simplified Contingency Draw Approval Requirements[5]
Projects/Bundles/Functions	$851,648	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty[6]	If less than $100K – Project Manager approves for trending with no contingency draw until accumulated. Then…[7] …If greater than $100K and less than $5M – Project Manager and Project Director approves contingency draw. [8] …If greater than $5M, CCB approves[9]
Program	$854,475	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty	Program Change Control Board ("PCCB")[10]
Board of Directors Controlled Contingency	$800,000	Subjective analysis of unanticipated/uncontrollable items (Vendor default, Labor/political matters, etc.	PCCB + CEO or DR Board Committee[11]
Total Contingency	$2,506,123		

The third column in **Table 1** reflects the DR Project's recommendation for the management of contingency. It should be noted that the Board has not yet provided approval of this process. In determining level of control for contingency, it may also be beneficial for the Board to review contingency at both the P50 and P70 levels. We will provide a comprehensive review of how OPG intends to monitor and use contingency in our Change Management Assessment Report that will be issued later this year.

[4] *See* RQE Total Cost Snapshot 4 October 21, 2015.
[5] Other provisions are in place based on percentage of baseline and for schedule changes impacts.
[6] *See* Campus Plan Exception described earlier in this report.
[7] Change costs are trended and do not result in contingency draw unless the project/bundle/function can't absorb the cost. At that point, approval is based on the amount of accumulated cost impact for the affected project, bundle, or function.
[8] N-MAN-00120-10001 PC-12 "Nuclear Refurbishment Program Change Management Section 6.1.
[9] *Ibid.* Section 6.1. The Change Control Board ("CCB") is comprised of: VP Refurbishment Execution, Director Refurbishment Engineering, Director Refurbishment Operations & Maintenance, Director Refurbishment Planning & Controls, Director Refurbishment Unit Outage, and Director Nuclear Controllership.
[10] *Ibid.* Section 5.13. The Program Change Control Board ("PCCB") is comprised of NR Dir. Planning & Controls, SVP NR, VP Nuclear Finance, VP Assurance, VP NR Engineering, VP Refurbishment Execution and VP Operations & Maintenance.
[11] *Ibid.* Section 6.4.4.

5. Observations and Recommendations

As stated, BMcD/Modus have found the process OPG has utilized for developing contingency to be sufficiently robust to support RQE. However, risk management is not a once-a-year exercise; it should be considered a pillar of project management. Thus, we have made certain recommendations for further enhancing the management of risk and governing the appropriate use of contingency established in the control budget:

- With some exceptions, the DR Team chose to monetize contingency utilizing the experience of the project managers as opposed to developing detailed estimates that were vetted by the OPG estimating team. We recommend that for the Unit 2 Estimate, OPG utilize the same estimating process for the contingency as it does for the base costs.
- OPG should ensure that significant contributors to contingency are justified and well documented. Justification of components such as: a) the broad application of schedule correlation; b) schedule burn rates; and c) levels of management control over contingency should be well documented.
- The infrastructure for identifying and managing risks has been in place for several years, though to a large extent, the program has been relegated to the "important, but not urgent" category as projects and functions focused on day-to-day challenges. While the RQE contingency process required the projects and functions to devote considerable attention to risk and contingency development effort, we observed some of that focus wane as the RQE effort was completed. Momentum and a sense of urgency for risk management needs to be maintained through the Execution Phase. The DR Team should consider making the discussion of risks and risk management a greater priority in its internal communications.
- Consideration should be given to developing information and training sessions that discuss the value of the risk program not only for development of RQE contingency but also the importance of sustained (or increased) efforts in executing and managing the DR Program. (This is also important for documenting and managing internal OPEX).
- OPG needs to increase senior management visibility and risk program advocacy throughout the organization.

Finally, it is important to understand that stochastic processes for developing contingency values do not create conclusive "answers". They serve as statistical tools to inform management regarding a basis for establishing and justifying contingency. These tools do not manage or mitigate risks; only management can do so. Therefore, management focus on risks needs to be strong and ongoing.

E. Remaining Work – Program Level

1. Quality Assurance

The DR Team is in the process of tying-up the remaining loose ends in the RQE submission and is performing quality assurance checks to ensure there are no major data fidelity issues in the control budget. The following are the priorities the team is using to ensure the quality of the RQE submission:

- All costs need to be supported by the documentation necessary to tie all numbers to their source;
- Risk registers need to incorporate any changes that came from NPET reviews; and
- The RFR team must close-out review SNC/Aecon's full Class 2 submission that OPG received on September 18, 2015 to ensure that there are no significant gaps or unresolved issues prior to locking down the target price.

The process for close-out of 4d was not given priority status, which elongated its close-out. The team is putting appropriate focus on close-out of RQE at this time.

2. Schedule

A major component of the Readiness to Execute plan will be developing and finalizing the Unit 2 execution schedule with all work at the appropriate level of detail. The DR Team's original goal of having the full execution schedule completed

for RQE was not met, though as noted, the control budget is supported by a well-defined critical path and windows for non-critical path work have been vetted and considered. We believe that the DR Team has done sufficient schedule work to support RQE, though considerable work remains before the schedule is execution-ready. BMcD/Modus will be providing our comments and recommendations regarding the schedule development as the work progresses.

3. Documentation

The DR Team developed considerable documentation in support of RQE that must be properly archived through a document control process which is directly traceable to the RQE. The team intends to implement a robust Integrated Data Base where the documentation will ultimately reside. The organization of this documentation should consider the future needs of subsequent cost estimates, configuration management, commercial uses and requirements for substantiating the basis of Project costs for regulatory purposes. Once the IDB is set-up, we recommend testing the sufficiency of the organization of the documents to ensure the documents are accessible and comprehensive. The team has put a goal of completing the document archive by the end of 2015.

III. Status of Campus Plan Projects

The outlook for completion of the largest and most significant remaining Campus Plan Projects – D20 Storage and Emergency Power Generator 3 ("EPG3") – had generally improved, though there are significant remaining issues and risks that have impacted both these projects' schedules and cost estimates.

A. D20 Storage

Ellis Don continues working on the foundation for D20 Storage, and SNC/Aecon is preparing to complete the building and perform the mechanical, electrical, HVAC and steel/structural erection. Ellis Don's work must be substantially completed before SNC/Aecon can start its work in the basement of the D2O building. P&M has bifurcated its team to simultaneously focus on Ellis Don's progress and SNC/Aecon's preparation.

Ellis Don's recent progress has ramped up since our last report. As of October 30, 2015, P&M reported Ellis Don to be 83% complete with its foundation work, and had only two walls and one staircase left to pour. Ellis Don's progress has been positively impacted by adding a second shift to increase the volume of work. In addition, the P&M team has benefitted from assigning an experienced project manager to oversee the civil construction and from the Project Controls effort to field verify and report Ellis Don's progress.

The DR Team's Program Status Report dated October 23, 2015 stated that Ellis Don's "concrete placement in the basement is expected to be completed by December 22nd for the north section and 1-2 weeks later for the south section." The current schedule (as of October 30 in OPG's network) shows Ellis Don completing its work on December 26, 2015 however with the increase in production and with good weather, their completion date could move forward. Ellis Don's recent improvement makes completing the foundations in mid-to-late-December much more likely. Turnover of the entire site from Ellis Don to SNC/Aecon will likely miss the contractual date of November 30, 2015. However, Ellis Don is currently working on a recovery schedule so that it will turn over the West Annex Basement on November 30, 2015 and the seismic dyke by December 22, 2015. SNC/Aecon has fallen behind in its pre-fabrication of piping that is on its critical path, and has further indicated that it may accept partial acceptance of the site on November 30th. However, since its piping work and tank setting is on critical path, the value of SNC/Aecon's partial site acceptance may be minimal until it can recover its critical work streams. Due to the fact that both contractors will be working in a confined space, it will be important for OPG to carefully manage this transition. The contractors' schedule progress needs to be accurately recorded and based on recent objective progress so that OPG can document this transition for commercial purposes.

SNC/Aecon has prepared and revised its cost estimate and schedule (which still requires final vetting and disposition of its basis of estimate), and is now producing metrics that are reporting its progress based on quantities of work. These early metrics are showing SNC/Aecon is behind by approximately 2-3 weeks in its procurement and prefabrication of piping. The baseline schedule shows SNC/Aecon's plan to meet all of the project's key milestones; however, as noted these dates are likely to be impacted. Schedule updates from SNC/Aecon need to be properly captured so that an accurate forecast

of any impact can be properly documented and managed. [redacted] SNC/Aecon intends to do so once it has secured agreements with its major structural, civil and HVAC subcontractors. SNC/Aecon has committed to reporting key subcontractor status via earned and actual work hours against its plan, which should provide P&M with enough information to track this key work.

The current SNC/Aecon schedule is based on the D2O project meeting an interim deadline of June 28, 2016 to accept water from Unit 2 so that there is confidence that Refurbishment of Unit 2 can proceed. This deadline was initially set about 1 year ago when the DR Team reviewed the need for a contingency plan for D20 Storage in the event the building could not be completed. We have recommended that P&M and Refurbishment re-examine this milestone if it is able to implement one of the alternatives it is currently reviewing for draining primary heat transport and moderator water from Unit 2. If an effective mitigation strategy can be implemented, it could allow deceleration of some of the work which could potentially reduce the overall risk of construction. However, such a deceleration should only occur if it is supported by objective progress data from field progress that substantially improves the confidence of all concerned that D2O Storage Facility will be available for Refurbishment of Unit 2.

B. EPG 3

OPG has committed to placing EPG 3 in service prior to Unit 2's breaker open. The civil construction is currently approximately 20% complete, and ES Fox intends to set the EPG unit by the end of November. Construction has previously been impacted by issues with plant tie-ins and unforeseen underground conditions. In its Project Status Report issued October 29, 2015, P&M reports that "Corporate milestone "Generator In Place" – Nov 30, 2015 currently at risk." While there is a recovery schedule in place, the Project Status Report currently shows that the Turnover/Available For Service milestone is not forecasted to occur until August 5, 2016 (323 days late), only two months in advance of breaker open. Furthermore, it should be noted that neither the additional forecasted costs ($21.3M over the approved amount of $88.2M) nor the recovery schedule have gone through a gate for final approval. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a schedule that is doable and predictable as soon as possible.

In its Project Status Report, P&M reports that "Engineering holds remain on a number of packages to incorporate design input from LLM Vendors. Holds to be resolved by Dec 2015." These engineering issues should not impact the civil work, though some involve changes to allow the stock generator to meet OPG operational requirements which could impact the installation or in-service date of the EPG unit if they are not resolved in time. The VP of Engineering and Sargent & Lundy have established a process for working through these issues and bringing more timely visibility to engineering issues as they arise on ESMSA (Campus Plan, BOP and Shut-Down/Lay-up) projects.

P&M also identified EPG 3's commissioning as a risk. "This is a first time evolution for these modifications and there is limited commissioning experience with this type of equipment. The risk is that the commissioning of this new system may take longer and be more challenging than anticipated/estimated resulting in numerous work interruptions/clarifications and extension to the schedule or missing AFS (OPEX from Pickering Temporary Emergency Power System)." To mitigate this risk, the DR Team has assigned a dedicated manager to lead the commissioning effort, though the schedule should accommodate the time needed for commissioning with these risks in mind.

P&M's Program Status Report dated October 23, 2015 showed the forecast as $115M, and noted that, "the forecast is expected to increase by an additional $5-10M. The increase is a result of additional costs to recover schedule delays that occurred during excavation and fuel line relocation, design changes based on newly available equipment information, and additional resources and time allotted for commissioning. This cost increase can be accommodated within the available contingency." P&M further noted in the October 27th Project Status Report that, "Significant costs increases are being addressed with contractor. SCRs in place," and "A new gate package will be prepared to identify the new EAC and schedule completion," which P&M anticipates having in 4Q 2015. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a cost estimate and schedule that is doable and predictable as soon as possible.

IV. Readiness to Execute Planning

With the completion of RQE, the DR Team intends to shift its entire focus to the Readiness to Execute plan. The team has developed detailed milestones and has established forums for progressing deliverables. In our review, we believe the Readiness to Execute plan is comprehensive and should provide a solid basis for testing the DR Team's execution planning. There are certain parts of the plan that are intended to deal head-on with key project risks; in future reports, BMcD/Modus intends to focus on certain key aspects of the readiness work, including the following:

- **Procurement:** The DR Team is piloting processes for tracking and overseeing vendor procurement, and is enhancing the warehouse capacity for the storage of materials and equipment. The risks for procurement are well known and documented in the industry, and OPG and its vendors are already experiencing some issues that will need to be managed carefully. Transparent reporting of status and identification of problem areas are the most effective means for mitigating those problems.
- **Project Team Development**: With the DOR in place, the team intends to sort out accountabilities and test its responses to real-time work situations. As part of this exercise, the team needs to review protocols for frequency and timing of key meetings and expectations for key communications.
- **Completion of Construction Work Packages**: Completing CWPs for the remaining work will require substantial effort, and is a necessary prerequisite for developing the schedule. In particular, BOP work packages must be completed by April 2016 to support the schedule and Unit 2 Estimate development.
- **Schedule Development**: The DR Team intends to iterate the baseline schedule two times prior to breaker open. In its Rev. B schedule, the team will flesh out all of the work known for RQE, which will expose certain areas in the schedule that are potentially problematic. During the first half of 2016, the schedule will be further refined, with Rev. C supporting the Unit 2 Execution Phase. In the process of developing the schedule, the DR Team should review lessons learned from the schedules prepared by SNC/Aecon and ES Fox for the Campus Plan Projects. These schedules are a leading indicator of how these vendors will schedule work (if allowed) for the Refurbishment. There are a number of issues with the vendors' current approach ([redacted]) that if not corrected will inhibit the schedule's ability to properly calculate and forecast the work. Not correcting these deficiencies will cause OPG to be reactive throughout the Execution Phase. Moreover, the Campus Plan Projects have also learned the importance of planning commissioning tasks well in advance, so that execution of the work (including physical testing, preparation of a multitude of documents and turnover activities) is performed in a manner that allows for the work to be accepted. These details need attention in the final Rev. C schedule.
- **Reporting and Metrics**: The DR Team has considerable work planned to improve metrics and reporting as part of the Readiness planning. It intends to put in place a new cost tracking system and developing metrics that will provide useful tools for project management. The team is committed to basing these systems on installed quantities which is standard in the industry. Much of the DR Project's current controls suite is based on financial reporting, which has its place but is not appropriate for field execution. In addition, the team needs to define a single source of data so that there is fidelity across all reports. BMcD/Modus will be closely reviewing the team's efforts in developing its reporting regime.
- **Unit 2 Cost Estimate**: The culmination of the Readiness to Execute activities will be the development of the Unit 2 Estimate for the BOD's approval. The work performed for RQE should position the team for this exercise, though it should consider lessons learned from the RQE effort and develop a Unit 2 Estimating Plan. As part of that plan, the DR Team should consider using the same RQE processes and protocols for all of the Unit 2 Estimate. During RQE, a decision was made to vary from the approved estimating process for some of the components of the estimate, including PMT costs, functional costs and the discrete risks. With the goal of the Unit 2 Cost Estimate being to tighten the estimates, the established process used for vetting EPC costs will allow for more formative vetting of these costs, increasing their reliability.

Report to Board of Directors

Board Retreat

October 1-2, 2015

Darlington Nuclear Refurbishment Project

Burns & McDonnell
Modus Strategic Solutions

October 1-2, 2015

I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Report to the OPG Board of Directors ("BOD") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of September 21, 2015. Our main focus continues to be assessing the DR Team's development of the Release Quality Estimate ("RQE"). In this report, we provide the BOD with our view of the current status of RQE and the remaining gaps the DR Team intends to resolve with RQE prior to the next Board Meeting and a look-ahead to the DR Team's post-RQE activities that will be focused on for the preparation of the execution of Unit 2, the first refurbished unit at Darlington. BMcD/Modus will provide its full assessment of RQE as part of its report to the Darlington Refurbishment Committee ("DRC") for the November 12, 2015 meeting.

As part of our ongoing oversight of the DR Team's RQE activities, BMcD/Modus has monitored the development of the vendors' estimates for work, schedules and identification of risks. We have also monitored the DR Team's progress in developing its management team and its plan for Project execution, as well as the performance of key prerequisite "Campus Plan Projects" executed by OPG's Projects & Modifications ("P&M") organization. As we have previously noted, OPG's commitment to pre-planning the Refurbishment Project stems from OPG's strong desire to learn from and avoid the problems that have caused prior CANDU refurbishments to exceed their budgets and schedules. Notably, the DR Team has been committed from the start of the Project's Definition Phase to:

- Complete scoping and design engineering well in advance of execution, which the team recently accomplished;
- Utilize the Recommended Practices provided by the Association for the Advancement of Cost Engineering International ("AACEi") in order to develop detailed sub-project (or "bundle") cost estimates in a progressive manner based on the design, scope and planning as they matured;
- Provide intense focus on the Retube and Feeder Replacement ("RFR") project with the SNC Lavalin/Aecon joint venture ("SNC/Aecon"), including: carefully studying the reasons for the difficulties experienced by past CANDU refurbishments; building and utilizing a full-scale mock-up of the Darlington Units' reactors in order to refine the schedule of the longest portion of the Project's critical path, and; engage in detailed vetting of SNC/Aecon's estimate, which is the largest single cost component in the DR Project; and
- Build over $1B in new facilities needed to support the construction and future operation of the refurbished Darlington station. Some of these required pre-requisite projects, including the Heavy Water Storage Facility ("D20 Storage"), Auxiliary Heating Steam ("AHS") building and Emergency Power Generator 3 ("EPG 3"), have experienced ongoing difficulties that the DR Team is addressing. These projects have also provided lessons learned and operational experience ("OPEX") that will be valuable as the Project moves forward into the DR Project's Execution Phase.

While the DR Project remains a complex and difficult project to execute, the planning effort in the Definition Phase has demonstrably reduced the risk of performance, which should result in greater predictability and therefore reduced overall cost relative to other CANDU refurbishments.

All of the DR Team's efforts during the Definition Phase will culminate in the RQE. Should the BOD accept the RQE, it will form the DR Project's control budget against which the DR Team's progress will be measured for the full, four-unit duration of the DR Project. Additionally, the DR Team is planning to further refine the RQE and present a unit-specific cost estimate and execution schedule to the BOD prior to each unit's execution. The first such estimate for Unit 2 will be presented in August 2016 on the basis of the DR Team's "Readiness to Execute" initiative with each subsequent unitized budget and schedule building upon the experience of the prior units.

From the outset of our engagement, BMcD/Modus has focused on the process the DR Team has employed for developing RQE, rather than on specific cost and schedule outputs. In our experience, the proper cost and schedule will emerge from

a robust process. Our last report expressed concerns over the DR Team's ability to meet the revised RQE submission date, which has subsequently been restored to the original November 12th milestone. Over the last month, the RQE-related components have matured and the DR Team's leadership team (Nuclear Projects Executive Team, or "NPET"), consisting of the SVP of Nuclear Projects, the VP of Execution and their direct reports, has conducted initial vetting sessions focused on each sub-project (referred to also as "bundles"), the OPG functional support groups and the Project's risks and contingency. With more time available, NPET can now complete these initial reviews and perform more detailed vetting of the integrated RQE package.

A major concern in completing RQE was the delay to the preparation of SNC/Aecon's Class 2 Estimate, which arrived 2 ½ months later than planned. SNC/Aecon presented its Class 2 estimate totalling $2.713B, and a schedule upon which OPG can base its critical path for each of the four refurbishment units. The estimate review culminated with a three-month long detailed vetting process in which subject matter experts from SNC/Aecon and OPG collaboratively challenged each work series and component of cost. The resultant estimate and schedule is, importantly, based on the mutual confidence of both teams and will result in a lessening of the overall project duration and associated burn rates. SNC/Aecon's Class 2 estimate should significantly strengthen the Project's outlook. The parties must now conclude the target price negotiations based upon this estimate.

While the majority of the vendor estimates have now been received, there is important work remaining for RQE that will require the entire DR Team's focus until it is completed. The major priorities for completing the work are:

(1) **Quality Assurance** – providing sufficient basis and support to the elements of RQE and closing remaining challenge items;

(2) **Integration** – now that the individual estimate components are substantially complete, the NPET plans to engage in more integrated reviews of contingency, risk, schedule and the like;

(3) **Campus Plan Projects** – while not a large cost item, the DR Team needs to shore up the schedule, costs and fully identify and effectively manage remaining risks so that there is confidence the key pre-requisite projects (D20 Storage, EPG 3) will not threaten Refurbishment; and

(4) **Readiness to Execute Planning** – the DR Team needs to finalize and test its processes for the Execution Phase, optimize its team, complete and vet the integrated Level 3 Execution schedule and develop the Unit 2 estimate.

BMcD/Modus believes that given ample time, the DR Team is capable of providing the Project's RQE with an appropriate level of confidence that would be commensurate with AACEi's recommended practice for a megaproject's control budget. The next 4-6 weeks will be challenging and there is a great deal of work left for the DR Team to do. Our next report will evaluate the basis for RQE and the associated critical path schedule in more detail.

II. DR Project RQE Overview—Status

In our last report to the DRC, we expressed concern that the DR Team would have difficulty completing its RQE activities by the revised October 1-2 date. Subsequently, the original schedule for BOD presentation in November has been restored which should result in a more complete estimate for RQE. Since our last report, the following major developments contributing to RQE have occurred:

- SNC/Aecon met its revised date for submitting its Class 2 Estimate, detailed schedule and agreed risk register. We discuss some of the key points regarding this submission below.

- The DR Team has provided its NPET leadership team with bundle and sub-bundle-specific reports that summarize the bases of estimates, scope, schedule, risks and other details. These initial reports provided a good basis for NPET to begin its reviews but the meetings that were held for their discussion resulted in a significant number of questions, gaps and open items that need resolution before further vetting. NPET also initiated further vetting of the DR Team's functional groups, which makeup approximately 22% of the Project's expected cost. These vetting sessions netted similar challenges that the DR Team is currently addressing.

- An initial "snapshot" was taken of the DR Project's contingency for NPET's vetting. NPET issued a number of challenges based on this presentation that the Project Teams and the risk team are endeavoring to resolve, including another full review of the formulation of the Project's critical path.

- SNC/Aecon has issued its revised schedule and cost estimate for D20 Storage, and the DR Team engaged in a lengthy vetting session with SNC/Aecon to validate its basis. SNC/Aecon should be able to produce meaningful metrics showing its progress on D20 Storage in the near future. In the meantime, P&M has put additional resources over the foundation work for D20 Storage, which must be completed by Ellis Don prior to SNC/Aecon's mobilization, though this work continues to lag 1-2 months behind schedule and has encountered additional field performance problems.

A. Summary of RQE Status

The DR Team has significant work remaining to complete the RQE effort. In general, we see the cost elements for the direct work of RQE coming together. The EPC base cost estimate for each of the bundles has been reviewed by the estimating team, and most of the estimates have been classified pursuant to the AACEi recommended guidelines. Additionally, the risk and contingency development process is robust and if followed with sound inputs, should provide the necessary basis for contingency amounts needed for RQE. However, a "bounding" estimate for RQE must still be supported by the documentation describing the assumptions that have been made as the basis for RQE as an upper limit.

BMcD/Modus sees the following as major focus areas for the DR Team to complete RQE:

- **Quality Assurance**: The DR Team needs to tie-up the remaining loose ends in the RQE submission and perform sufficient quality assurance to show that there are no major data fidelity issues in the submitted product. The DR Team intends to lock-down all submissions on September 30th and devote time to addressing quality issues and ensuring that the documentation necessary to support RQE is in place and that all numbers can be tied to their source. In addition, the RFR team must review SNC/Aecon's full Class 2 submission that OPG received on September 18, 2015 to ensure that there are no significant gaps or unresolved issues prior to locking down the target price. In a product of this size, there will certainly be some quality issues that will not reasonably be caught prior to RQE, though the goal should be to limit those issues to technical compliance needed for maintaining the Project's controls suite and not have issues that would be considered material to the BOD's decision.

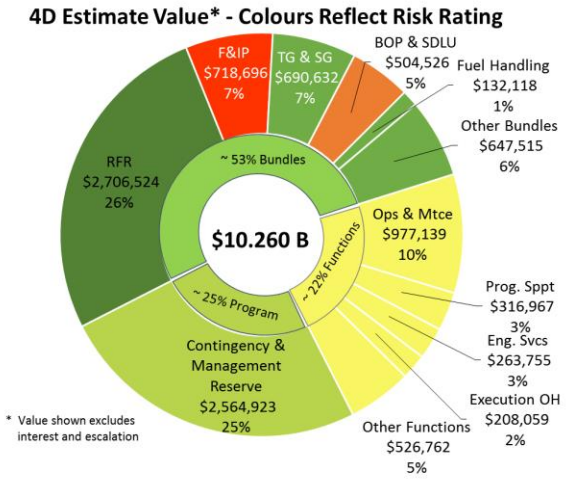
- **Integrated Reviews**: NPET and key stakeholders to the Project need to engage in multiple additional integrated reviews, particularly regarding the Project's overall schedule and basis for contingency in order to fully vet the interrelationships in the work windows for each bundle in the integrated schedule and to identify and evaluate risks that affect multiple bundles and functions. Moreover, NPET needs the time and opportunity to vet the result of any changes (i.e. has the change been properly captured in all of the documentation? Does a change impact other bundles? If a risk is accepted, is there a downstream schedule impact?). Doing so ensures the impact of each successive review/challenge stage has been properly captured. The functions also will require additional attention, with focus on ensuring that the proper division of responsibilities between and among the project teams and functions is well established. We have provided some specific recommendations for these reviews to the team. One gap for RQE that should be noted is the relative immaturity of the BOP and Shut-Down/Lay-Up estimates and schedules. Due to their relative size, this gap can be accommodated through the use of adequate

risk identification and contingency, but there is significant integration work that will need to occur post-RQE with the Project's execution schedule in order to incorporate these work packages once they have been developed.

- **Campus Plan**: While the dollars involved in the Campus Plan Projects do not necessarily have a significant impact to the total amount of RQE, the fact that the schedules (D20 Storage, EPG 3 and potentially others) are a risk for breaker open of Unit 2, and these projects' paths continue to be uncertain, is drawing attention away from readiness for Refurbishment. The P&M team needs to ramp up its management of the contractors' performance in order to obtain realistic and achievable schedules and cost estimates. The recent award of the D20 Storage completion to SNC/Aecon is a positive step but the rest of the work needs similar focus.

- **Readiness to Execute Planning**: As noted, the DR Team intends to use the period from RQE to Unit 2's breaker open in October 2016 to further mature its planning, estimates and schedules, and present a Class 2 unitized estimate and detailed execution-ready schedule in 3Q 2016. The team has developed a "Readiness to Execute" ("RTE") plan through which it will test multiple processes and improvement initiatives with smaller BOP and Shut-Down/Lay-Up packages that need to be performed prior to Unit 2's breaker open. We have recommended to the DR Team that the RTE plan needs a detailed, resource-loaded schedule of activities with assigned owners who are held accountable for their portion of the product. This type of schedule was not deployed for RQE and we believe its absence has resulted in some churn, delays and uncertainty within the Project Team that must be avoided in the future. It will be particularly important for the DR Team to incorporate into the RTE schedule resolving the remaining open issues with the BOP and Shut-Down/Lay-Up work packages as they are completed by the vendors, which will involve closely tracking the vendors' progress.

  A major component of the RTE plan will be developing and finalizing the Unit 2 execution schedule with all work at the appropriate level of detail. The DR Team's original goal of having the full execution schedule completed for RQE was not met, though the critical path durations and windows for non-critical path work have been well-defined. We believe that the DR Team has done sufficient schedule work to support RQE, though considerable work remains before the schedule is execution-ready. BMcD/Modus will be providing detailed assessments of the schedule development as the work progresses.



As with our prior reports, the adjacent **Figure 1** shows the 4d cost estimate values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency (in $2010). We will update this figure to reflect the RQE-based values and percentages of the Project's cost in our next report.

Figure 1 also provides context for the relative size and percentage of each component of RQE. The three largest parts of RQE are: RFR (26%); OPG Functions (22%); and Contingency and Management Reserve (25%). BOP and Shut-Down/Lay-Up (5%), the Turbine Generator project (6%) and Campus Plan Projects (7%) are next largest slices of the budget. Below, we provide a brief update regarding the status of each of the major inputs to RQE.

B. Status of RQE Components

Detailed Engineering:

One of the lessons learned from other refurbishment and other nuclear megaprojects is that the control budget should be based upon completed engineering in order to mitigate the risk of unreliable and uncertain initial cost estimates. OPG met its commitment to substantially complete detailed engineering for Refurbishment well in advance (15 months) of Unit 2's breaker open date. However, there is still considerable engineering effort left for the DR Project throughout the

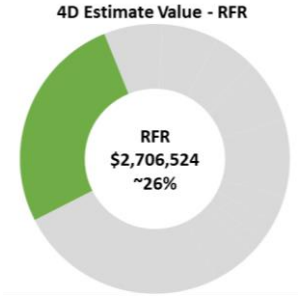
program's lifecycle, including:

- **Procurement Engineering and Support** – the DR Team must ensure that components the vendors are purchasing meet the intent of the specifications and resolve any sourcing issues;
- **Field Engineering** – issues will inevitably arise in the field that will require engineering to address and evaluate;
- **Construction Work Planning** - the development of Construction Work Packages needs to involve engineering, and the Construction Work Packages' accuracy will depend on proper insertion in the "Issued for Construction" engineering plans, those details needed for construction; and
- **Configuration Management** – OPG's engineering team will need to ensure that the work in the field is captured in the plants' permanent documentation record.
- **Detail Engineering** – the engineering packages that were excluded from the Detailed Design Complete milestone, including the RWPB design, needs to be completed, and P&M projects require ongoing engineering support.

Currently, there are very few (less than 15%) of these future engineering tasks that are resource-loaded in the Project's integrated schedule. This needs to be addressed so that the OPG engineering team can be right-sized and critical work effort and milestones are properly assessed within the overall schedule. Moreover, engineering resources should be "projectized" so that the work is properly integrated in the work flow.

Retube and Feeder Replacement:

SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Some notable highlights since our 3Q Report:

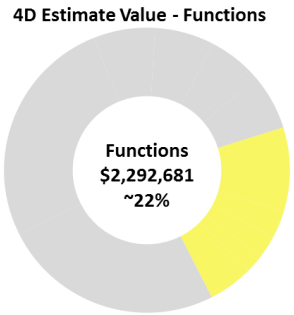


- The final estimate of $2.713 B (2015$) is based on mutually agreed upon project durations and schedule contingency, and encompasses 12.9M work hours, project management, supporting tasks, fee and all other costs.
- As we noted in our last report, the OPG and SNC/Aecon teams reviewing the details of the schedule were given targets (including contingency) for cost ($2.6B) and schedule (1110 days). The "Rev 1." Submission was approximately $110M more than the $2.6B target and 28 days longer (for Unit 2) than the 1110 day target. However, the process utilized to reach these final estimates was robust, which should provide confidence in the level of accuracy.
- The final assessment of risk and contingency in the SNC/Aecon estimate was on the basis of lengthy technical and commercial discussions. The resulting 13.5% contingency totaling $368M is largely based on durations and potential risk items that could impact the work. The OPG team successfully negotiated the SNC/Aecon risk register to omit risks that were considered "business as usual" in nature and agreed to shift a limited number of risks to OPG's responsibility in exchange for reasonable cost reductions.
- SNC/Aecon's Rev 1 Class 2 answered some key questions regarding its estimate of for Units 3, 1 and 4. After significant commercial discussion, the parties decided to leave as-is the successive unit improvement (from 1138 days on Unit 2 to 1095 days on Unit 4) in place. The agreed base duration (which does not include any contingency) of 847 days is identical for the last 3 units though contingency durations drop by 55 days across these units.
- There are some issues that have not been included in the SNC/Aecon's estimate which still need to be resolved totaling approximately $12.5M per unit that the SNC/Aecon has not able to confirm in the Rev 1 estimate.
- While not part of the SNC/Aecon's Class 2 Estimate, completion of the Retube Waste Processing Building ("RWPB") estimate has been hampered to a certain extent by changes in the building's design basis and completion of engineering. These changes have caused the cost estimate to steadily increase by 20-30% to its current estimate of $160 M. With the award of D20 Storage to SNC/Aecon, there should be some economies of scale that could be

achieved that have not, as yet, been quantified.

The DR Team is in the process of finalizing the target price negotiations around SNC/Aecon's Class 2 estimate. SNC/Aecon has resubmitted a full Rev.1 version of the Class 2 Estimate concurrent with the preparation of this report; this submission will require review and vetting by OPG, though the DR Team is confident that the remaining issues with SNC/Aecon over their estimate are relatively small in nature and can be achieved in time to support the RQE submission.

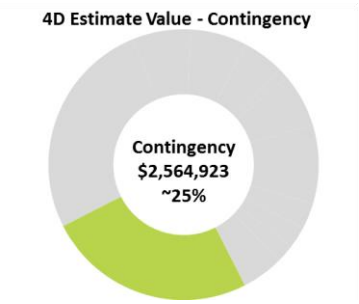
Functional Groups:



The DR Team's intention for RQE with the Functions is to develop a "bounding" estimate that incorporates all necessary staff, roles and responsibilities, and then examine the organization in the Readiness-to-Execute roll-out after RQE. The initial round of NPET reviews of the Functions revealed that there are still many open questions regarding roles, responsibilities and accountabilities that need to be resolved in order to determine whether the RQE estimate is inclusive of all potential costs. Management is also still committed to taking another looking at the integration and management of centre-led resources. While the DR Team's stated goal of developing a bounding estimate for functions should be possible, as these costs are completely in OPG's control, doing so will require additional work and focus by the team.

The final Functional resources and responsibilities will be determined through the RTE exercise.

Risk and Contingency:



Contingency is the third largest category of costs in RQE behind RFR and the Functional Groups. In our last report, we noted that the process the DR Team was using for developing risk and contingency was robust, though we were concerned that the time for vetting the result for RQE would be condensed. Even with additional time, the team will need to stay focused to complete and document all of its risk-based assumptions for RQE.

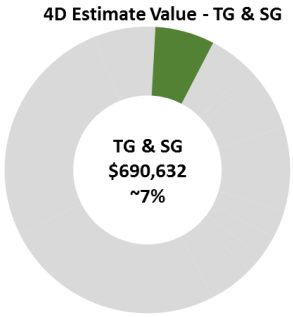
In order to get an idea of the total integrated contingency amount for RQE, the Risk team put together an "initial snapshot" for review by NPET. The initial snapshot of contingency was approximately $1.9B (30% of remaining Estimate to Complete) derived from a combination of contingency for estimating and schedule uncertainties and the discrete risks identified by the DR Team and project bundle teams. Upon review, NPET requested additional vetting of the critical path durations and the contingency amounts set aside for schedule uncertainty, which made-up the largest portion of contingency. These vetting sessions that have been completed to date have resulted in an increased understanding of basis of those estimates and greater confidence in the contingency amounts. However, there is still a lot of remaining work that needs to be done in order to complete the contingency review.

In our view, the most critical remaining work on contingency includes:

- The NPET needs to analyze the results of integrating all the project bundles in order to see if there has been adequate identification of risks;
- The Project Teams should perform quality checking—including integration of the contingency input data for accuracy, reasonableness of all OPEX from past refurbishment projects and completeness – and finalize all descriptions and risk bases;
- Provide greater analysis of Project expected burn rates for more accurate monetization of potential schedule risks;
- OPG's experience with the Campus Plan Projects needs to be fully integrated and accounted;
- OPG's executive management needs to identify any potential management reserves that it may want to maintain over and above the DR Project's contingency.

Related to the last item, the DR Team and management should consider whether the existing processes for management reserve needs adjustment for the DR Project. Once set, the contingency can be carefully monitored and tracked against the original assumptions.

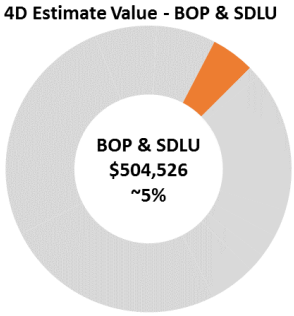
Turbine Generator and Steam Generator:



OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. OPG's approval of those detail estimates is pending final review, though a recently identified issue in finalizing the four-unit estimate has delayed approval.

As with RFR, the OPG and the SNC/Aecon project teams are integrated and working well together. The remaining risks at this time appear to center on completing the Construction Work Packages for execution and finalizing the Unit 3, 1 and 4 detailed schedule. In addition, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. This will be a first time evolution for OPG and will require significantly more planning than the limited scope for Unit 2. The risk profile of the subsequent units is being developed with this in mind, though the results still need to be fully vetted at the NPET level.

Balance of Plant/Shut Down-Lay-Up:

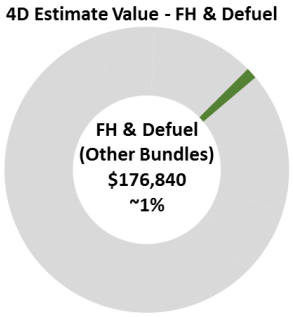


At this time, the focus for BOP and Shut-Down/Lay-Up has been Phase I/II engineering and planning work. The DR Team completed detailed engineering for these projects in time for the August 15, 2015 milestone, with some minor exceptions. The DR Team has provided guidance to ES Fox to improve the development and quality of its related project estimates, and is in the process of characterizing the estimates it has received at this time. Approximately 50% of the BOP and Shut-Down/Lay-Up work estimates are in the Class 4/5 range, which increases the risk of estimating uncertainty for these projects. Moreover, the risk profile of these projects should reflect the risks from ESMSA vendor performance. While the BOP and Shut-Down/Lay-Up project teams have identified discrete risks related to vendor performance NPET will need to decide if the associated contingency has been properly monetized in the DR Project's risk profile.

The initial round of NPET reviews of these projects produced a long list of items that require answers for RQE. These issues must be resolved along with further vetting of costs to increase the confidence level of the BOP and Shut-Down/Lay-Up projects. Notably, the DR Team needs to finalize the risk registers for these projects so that contingency can be properly attributed.

BOP and Shut-Down/Lay-Up will be under significant scrutiny once the DR Team's focus shifts to the RTE plan. ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and development of Construction Work Packages. The DR Team has placed a challenging goal of having all of the BOP projects proceed to their Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. The BOP team has set interim milestone dates with ES Fox for these deliverables which may be too aggressive for the DR Team to receive quality work product.

Fuel Handling/Defueling:

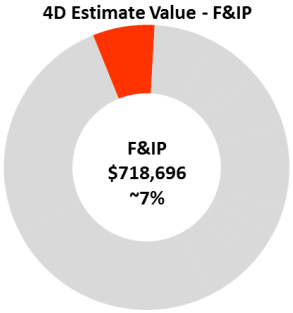


While the total cost estimate for Fuel Handling/Defueling constitutes only about 1% of the total cost of the DR Project, Defueling each of the Project's reactors is the first critical path activity. Furthermore, this is a first time evolution for Darlington. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. The DR Team has been focused on evaluating the past defueling evolutions at other CANDU plants and scrubbing the planned durations to the extent possible.

The current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely is 113 days, and the 90% confidence level duration is 134 days. The Defueling Project Team believes these same durations should be carried for all four units, as the learning curve for performing defuel will have limited value in improving performance over time. The team believes the 90 day best case is strictly a function of reactor physics and cannot be improved, while the worst case is based largely on the potential for equipment failure. In the course of deriving these point durations, the Defueling team has dispositioned OPEX from Bruce Power and Pickering and has consulted with its vendor, GE/Hitachi. The due diligence performed by the Defueling team has greatly improved the DR Team's understanding of this critical duration.

Regarding the Fuel Handling refurbishment, which is needed to support the Project's critical path, cold commissioning is ongoing for Fuel Handling system modifications and vendor progress has dramatically improved overall schedule performance. The recovery plan initiated in 2Q 2015 with GE/Hitachi has also allowed the team to advance plans for testing and training.

Campus Plan Projects:



The most significant Campus Plan Projects – D20 Storage, Auxiliary Heating Steam ("AHS") building, and Emergency Power Generator 3 ("EPG3") – continue to be impacted by ongoing issues with poor initial estimates and scope definition, site conditions, contractor performance and OPG oversight.

- ***D20 Storage –*** Ellis Don is currently working on the foundation for D20 Storage and SNC/Aecon is preparing to complete the building and perform the mechanical, electrical, HVAC and steel/structural erection. Ellis Don's work must be substantially completed before SNC/Aecon can start its work. P&M has bifurcated its team to simultaneously focus on Ellis Don's progress and SNC/Aecon's preparation.

Ellis Don's progress in completing the foundation continues to lag behind schedule. The current schedule shows that Ellis Don is approximately 2 months behind schedule, depending on the outcome of the pour of a wall section that will require rework. The key November 30, 2015 date for turn-over from Ellis Don to SNC/Aecon is a milestone in the SNC/Aecon purchase order which will almost certainly be missed, so forecasting the extent of the delay and mitigating its impacts will be critical for 4Q 2015. The P&M team is currently focused on driving Ellis Don to completing by December 22, 2015 which will require acceleration and reversal of some of its performance trends. P&M has added new field personnel who have been charged with managing Ellis Don's progress and clearing issues. It will be essential for P&M to quickly ascertain the current performance trend so that the date for transfer of the site to SNC/Aecon can be more accurately forecasted.

In accordance with its purchase order, SNC/Aecon has prepared and revised its cost estimate and schedule. The OPG team has vetted the schedule, but still needs to complete its review on the estimate. The schedule shows SNC/Aecon's plan to meet all of the project's key milestones; however, as noted, this plan is based on a turn-over date from Ellis Don that is unlikely to be met. The SNC/Aecon team believes it will experience essentially a day-for-day push should the turnover date be missed. We have reviewed the schedule and it would appear that SNC/Aecon has limited opportunities to recover any upfront delays and will be impacted in some manner as long

as Ellis Don is working on the building. SNC/Aecon has agreed to provide OPG with the necessary metrics from which its progress can be more accurately forecast, which should result in increased confidence once SNC/Aecon has mobilized.

The current SNC/Aecon schedule is based on the D2O project meeting an interim deadline of June 28, 2016 to accept water from Unit 2 so that there is confidence that Refurbishment of Unit 2 can proceed. This deadline was initially set about 1 year ago when the DR Team reviewed the need for a contingency plan for D20 Storage in the event the building could not be completed. We have recommended to P&M and Refurbishment to re-examine this milestone if it is able to implement one of the alternatives it is currently reviewing for draining primary heat transport and moderator water from Unit 2. If an effective mitigation strategy can be implemented, it could allow deceleration of some of the work which could potentially reduce the overall risk of construction.

The OPG team is working on updating the D20 Storage project's risks for RQE and management tracking. We have recommended that P&M assess these risks based on Ellis Don's performance trends and using SNC/Aecon's estimate and schedule. P&M needs to evaluate whether there is sufficient contingency and should also revisit the business case to confirm whether the path chosen for execution is the most prudent course, and whether the team should update its options for temporary storage of Unit 2's heavy water in the event of further schedule delays.

- ***AHS –*** The AHS project, which has been subject to schedule delays and cost increases, is nearing completion though the Available for Service date has slipped to November 15, 2015 due to some commissioning and fit-up issues. P&M's cost projection remains unchanged at $99.5M, which required a contingency draw of $15M over the approved $84.52M budget in 4d. AHS has provided multiple lessons learned that Refurbishment is taking into account in planning of BOP and Shut-Down/Lay-Up work with ES Fox.

- ***EPG 3 –*** This project must be completed prior to Unit 2's breaker open. Construction has previously been impacted by issues with plant tie-ins and unforeseen underground conditions. Currently, the project is being further impacted by incomplete design, issues with rebar supply and installation, and lacks an acceptable schedule or cost estimate for the full execution phase. There are a number of engineering packages that require completion, though P&M has withheld approval pending substantiation of $2.2M in charges. Some of these engineering packages involve modifications to the stock EPG unit so that it will operate in a similar fashion to the existing units.

  ES Fox has prepared a "what-if" schedule that depicts its attempts to recover the time lost due to the various issues that have impacted the project. That schedule shows the building being available for service on August 12, 2016, which is only two months in advance of breaker open. ES Fox also submitted a revised "Estimate at Completion" in mid-June that was initially lacking sufficient back-up. The Estimating Team is now assisting P&M in the review of this estimate. In the meantime, the project missed its September 11, 2015 gate and without an approved schedule and cost estimate, the project is in danger of running out of authorized funds to continue. This project will require an immediate recovery in order to meet the breaker open need date for Refurbishment.

There are other projects within P&M that will require close monitoring as the DR Refurbishment draws nearer and the need to begin using these facilities becomes imminent.

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

In our Initial Project Assessment of August 2013, BMcD/Modus summarized our conclusions and recommendations for the DR Project in a concluding table. Below, we have revisited these initial issues, risks and recommendations as a way for NOC to see the Project's progress since our Initial Assessment.

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	• Continue the process of reducing and optimizing the Project's scope. • Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn. • Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.	• Scope reduction was accomplished via Blue Ribbon Panel review and results were incorporated in 4c Cost Estimate • Scope remains an issue with BOP work – some of the design solutions proposed under ESMSA contracts have been excessively complex • Options Review Board and strengthening of Gating process required to root-out remaining potential scope busts • 4d Cost Estimate may result in another round of required scope reductions
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	• Review strategic considerations for procurement of remaining scope. • Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews • Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.	• Engineering for major bundles (RFR/Turbine Generator/Steam Generator/Fuel Handling) appear to be largely on course • BOP start of detailed engineering is currently as much as 12 months behind plan which may impact accuracy of large portion of RQE • Concerns expressed by BMcD/Modus in August 2013 regarding risks have largely materialized due to late award/start of BOP work • Metrics for tracking engineering earned value need additional work and lack fidelity • Constructability and Planning & Assessing reviews are underway with RFR and Turbine Generator but lagging behind detailed engineering for BOP

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	• As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration. • Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts. • Clarify reporting lines for matrixed Project Controls Personnel. • Actively seek to assemble the Execution Phase team as soon as possible.	• Project team development is progressing though with some notable alignment issues • Refurbishment management for execution has been strengthened and "projectizing" of functions is progressing • P&M is undergoing a fourth leadership transition since July 2013 and stability and direction is urgently required • Project Controls standardization across the entire DR Project is a work in progress and will require significant effort
Schedule Development	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	• Continue development of the C&C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase. • Redirect the Project Controls Team's efforts from the C&C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.	• Refurbishment has corrected early potential faults in the schedule methodology and will utilize a Level 3 schedule for execution that is currently under development • P&M continues to populate the C&C Schedule though the schedules for individual projects require updating and vetting once final scope and engineering is in place
	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	• Clarify and include in commercial contracts OPG's requirements for schedule development by the contractors.	• DR Project chose not to update its contractual requirements though is seeking a high level of definition from contractors, who appear to be in compliance on Refurbishment but not Campus Plan • We continue to recommend that OPG update its commercial arrangements for project controls information that will be propounded by the contractors at the time of finalizing the target price contracts for the Execution

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
			Phase
Risk Management	The current methods for scoring risks are inconsistent and the risk register includes ”issues” or “concerns” that needlessly dilute management efforts.	• Provide consistent characterization and scoring of risks. • “Concerns” as currently defined should be eliminated from the Risk Management Program. • Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking. • Consider revising probability scoring to increase granularity and ranking of risks.	• Risk identification is improving in the Refurbishment organization • Scoring and “business as usual” risks are being addressed • Risk Management Program deficiencies are still present and have not been addressed
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	• Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function. • Review qualifications within the existing risk team. • Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team. • Provide training with a focus on the overall importance of the Risk Management Program	• The DR Project’s risk management team has been strengthened over the intervening year and has new energized leadership in place • Additional training and risk discussion is still necessary • Reporting of risks needs additional clarification and work
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	• IT needs to resolve the outstanding issues as quickly as possible. • Training should include instruction for populating databases. • The AIDA database should be examined and updated if it is to be useful for rate proceedings.	• Database integration issues remain, and still need to be resolved • AIDA still requires examination for usefulness for rate proceedings.

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	• Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.	• AACE guidelines have been addressed in the continued development of the Project's estimates; contractors appear to have a better understanding of the nature of compliance with AACE standards
	Revised planning assumptions for the 2014 Business Plan are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	• Document and characterize the information for the BOD and consider meaningful reporting metrics. • Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts than can be improved based on current OPEX. • Review, capture and document Unit 2 OPEX information so maximum benefit is derived from this revised plan.	• Documentation of major decisions still could be strengthened • Discussion of key commercial agreements (in particular RFR) is pending though have been fully considered by DR Team management • Metrics are still under review for effectiveness, as is earned value system
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	• Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates as far as possible before the date of the RQE. • Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.	• 4d Cost Estimate work is progressing, though we have concerns that it will fall short of a full Project reforecast. BMcD/Modus sees a risk in holding back on full examination of the underpinnings of the 4d Cost Estimate for certain cost centers that have not substantially matured since 4c Cost Estimate • DR Team has appointed a manager of the RQE efforts, who should be engaged to find gaps in 4d Cost Estimate

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
	Contingency calculations need closer alignment with the Risk Management Program.	• Actions summarized above • Create a clear and repeatable process for calculating contingency at all levels and for all program participants.	• BMcD/Modus will be reviewing and vetting the process for contingency identification for 4d Cost Estimate • As the Project matures, our expectation is for the DR Team to move toward deterministic risk and contingency identification with monetization of specific known risks
Management Processes	OPG's new processes and procedures are in some cases conflicting and repetitive.	• Look at reducing the number and optimizing the process map.	• The Project Management Plan remains a work progress • BMcD/Modus recommended each project manager revise the bundle management plans to incorporate changes to management principles
RFR	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	• Consider asking SNC/Aecon to monetize risks at a much earlier stage.	• SNC/Aecon has agreed to provide certain information related to risks for 4d Cost Estimate though the extent to which it is helpful has to be determined
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.	• The difference between SNC/Aecon's Class 4 and Class 3 estimates needs to be properly characterized • The RFR team, with vetting from BMcD/Modus, provided a prescriptive estimating plan for the RFR Class 3 Estimate that clearly defines the deliverables.
	Project maturation	• The Class 3 Estimate	• The Class 3 Estimate addressed

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Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
	specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	preparation should be expedited if possible. • OPG should seek SNC/Aecon's monetizing of PMT costs.	these gaps; however, SNC/Aecon did not utilize time well, creating a substantial effort by SNC/Aecon and OPG in a short window of time • The Class 2 Estimate development must occur at a more predictable pace, as there is less time for SNC/Aecon to prepare it and this estimate will form the basis for target price negotiations.
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	• While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.	• This remains a work in progress. BMcD/Modus believes it is OPG's intent to close needed gaps in the commercial contract prior to the final Execution Phase negotiations.
	There are technical improvements that should be reviewed based on OPEX.	• Study opportunities now that the effort is turning to Darlington.	• This is part of Class 3/2 Estimate effort is and under evaluation for the target price
ThisBOP	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	• Accelerate engineering work as necessary / practicable with the OSS vendors. • Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort. • Change procurement method to a packaged approach (see below). • Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process. • Eliminate unnecessary duplication of effort between OSS vendors and EPC designers.	• MDP preparation was accelerated and was completed ahead of schedule • Detailed engineering for BOP work remains a risk; despite changes to the procurement model, assignment of work to ESMSA contractors continues to be delayed or impacted • DR Team has initiated a collaborative approach to reviewing and approving engineering product that is intended to eliminate delays in approvals and duplicative effort; results need to be monitored

Attachment B

Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
		• Review and eliminate OPG delays in approval of design work.	
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this "competition" is essentially already known.	• Assign work to ESMSA vendors based on qualifications in smaller bundles. • Use the existing ESMSA agreements and eliminate bidding process.	• Procurement process has been changed and Secondary Competition has been eliminated • The direct award process has been hampered by process delays
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	• Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise. • Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.	• ESMSA performance problems with the Campus Plan Projects have persisted • Metrics measuring progress and resource allocation have not been developed • Assignment of BOP work is now capability-based • DR Team has re-assigned work from non-performing contractor's scope
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently anticipated to the BOP work.	• Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders. • Increase visibility of this potential risk.	• Scope defining inspections thus far have resulted in narrowing of the DR Project's scope • Risk of additional work is decreasing
Campus Plan	The D20 Storage Facility work has been delayed and the contractor's performance has been subpar	• Continue to devote adequate resources to recover the D20 Storage Facility's schedule. • OPEX from this project should be used to guide management of the future Execution Phase	• D2O Storage remains a significant threat to Refurbishment • Contractor performance and P&M's failure to actively manage the work have resulted in cost overruns and continued schedule

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Initial Project Assessment – August 2013			3Q 2014
Issue	**Risk/Opportunity**	**Recommendation**	**Update/Status**
		work.	delays • OPEX from D2O Storage has been well-studied and was a significant topic of BMcD/Modus's 2Q 2014 Report • The DR Team is endeavoring to insert lessons learned into BOP work, though this requires close monitoring
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	• Additional management attention is needed to ensure planning and execution of the work	• Management issues with Campus Plan Projects persist
	The Campus Plan's scope is too large	• Continue to review the Campus Plan Scope and eliminate unnecessary projects.	• Some scope in the Campus Plan Projects was cancelled as part of the Blue Ribbon review—further review and scope reduction may be required.
OPG Critical Path	OPG-directed work is 25% of the Critical Path of the DR Project.	• Ensure that this work is given proper focus and resources.	• Defueling and Fuel Handling work appear to be progressing after some early delays in awarding contracts and assigning/splitting work with DNGS station.

BURNS McDONNELL

Report to Darlington Review Committee of OPG Board of Directors

MODUS STRATEGIC SOLUTIONS

Executive Summary

OPG Management's August 11, 2016 report to the DRC affirms the DR Project remains within the overall RQE control budget of $12.8 billion and that the Project's overall P90 schedule duration has not changed. Based on our review, the Independent External Oversight Team (EO Team) found OPG Management's report to the DRC adequately reflects and is generally focused on the DR Project's current key status points and risks. The process OPG used for developing the Execution Phase schedule has followed accepted industry practices and once complete should provide a good baseline for the Project. We have also reviewed recent output from OPG's assurance programs and find them to be effective.

OPG has accomplished most of its planned readiness activities and, at this time, there are no known imminent threats to Unit 2 breaker open; however, there are issues that require attention that could have a significant downstream impact on the Project if they are not addressed:

- Schedule performance and adherence is an ongoing concern;
- While the technical tools are now in place, cost and schedule trending and forecasting are not mature;
- Aspects of key vendors' readiness for execution are a concern; and
- The Risk Management Program has not been fully embraced as an essential day-to-day management tool.

Evaluation of DR Project Status

The EO Team has identified the following key status points that should be considered for purposes of evaluating the DR Project's health as a whole and for the Board of Directors' approval of management's Unit 2 budget and schedule.

Key DR Project Status Indicators	
Schedule Performance	OPG identified the DR Project's current SPI of 0.91 which equates to being approximately 9-10% behind the Project's P50 schedule (though should not impact the P90 range). The impacts of these delays include late finalization of the Unit 2 Execution Phase schedule, procurement and field preparation that will need to be recovered or mitigated prior to field need dates. The vendors' ability to meet their procurement schedules is a concern. OPG has increased visibility and management attention to resolving outstanding vendor and internal issues.
Cost Performance	Based on all of the available information, the overall Project control budget of $12.8 Billion has been maintained, though the EO Team identifies three caveats: ❖ The final Unit 2 Execution Phase schedule will be completed in mid-September. Until that schedule is completed, issues can materialize that could impact the final Unit 2 budget. OPG Management has reserved the possibility of making changes to the Unit 2 budget until the schedule is closed-out. ❖ Since RQE, $61M of contingency has been drawn and allocated, which translates to a rate of approximately $10 Million/month. While we believe this is largely due to finalizing and updating the Unit 2 cost estimate, this velocity of change would be a concern if it continues past the locking-down of the Unit 2 budget. ❖ Risk and contingency calculations for Unit 2 may change as a result of recent additions to the DR Project's risk register. For example, within the last month, certain technical risks have materialized that could have significantly impacted the Project's critical path. While these issues

	were resolved without additions to the base schedule. This underscores the potential for discovery of changes while a project undertakes a detailed baseline schedule review.
Vendor Performance	[redacted]
Risk Management	Since RQE, OPG has identified a number of new program and project risks. Many of these new risks appear to have been added without benefit of the rigor established during RQE and required Management attention. Key technical risks were identified or revised during the Execution Phase schedule preparation, which are under consideration for Unit 2 contingency calculations.
Safety and Quality	OPG's assurance activities have included identifying adverse safety or quality trends and have been adequate to date.

Project and Program Assurance

The EO Team believes the activities performed by the Project and Program assurance teams have been appropriate and their findings have positively influenced behaviors. The DR Team's Performance Assurance Group (PAG), Enterprise Risk Management and OPG Internal Audit have developed and are executing robust plans for assurance activities. The DR Project's quality and safety trends are being reviewed, tracked and monitored and the Project Team has identified and pursued course corrections.

Effectiveness of OPG Project Team

OPG's Project leadership is displaying its commitment to identifying issues and increasing accountability across all work groups. The OPG Execution Team has revised processes based on the Readiness to Execute and its own OPEX that, on paper, should be effective but must be proven. Ensuring that the vendor and OPG commitments are kept and lines of authority are maintained will be a key contributor to success for the Project.

Strategic Considerations

Based on our independent review of the current DR Project's status, the EO Team offers the following analysis of certain forward-looking risks and strategic considerations as the Project advances to Unit 2's Execution Phase. As a part of our analysis, the EO Team has reviewed and assessed OPG's assurance activities to identify any potential gaps. The risks described below have the potential to challenge the DR Project's ability to maintain the P90 schedule and/or cost.

Risk Area	EO Team Observations
Cost and Change Management	OPG's Internal Audit verified that the DR Team has put into place the tools needed to maintain and analyze cost trends; it is now the Project Team's responsibility to properly use these tools. The Project Team has not been utilizing a consistent process for forecasting the impacts caused by deviations from the plan to overall cost and schedule of any particular project. Moreover, critical information needed from the vendors to prepare accurate forecasts has been suspect or missing. As an example, the DR Team has identified mitigation plans for the late finishing F&IP Projects (D2O Storage Facility, EPG3, CFVS and STOP). Analyzing the full impact of these delays requires the vendors

	to provide accurate information and for OPG to validate that information for its cost and schedule forecasts. The current documented status of these projects suggests a high likelihood that OPG will need further draws against contingency due to extended costs and/or recovery of delays, though the vendors' information (or lack thereof) makes accurate analysis of the extent of delays more difficult. Without robust forecasting, projects have limited ability to estimate the impact of current progress on future completion and, thus, no basis for timely or effective corrective action. On a large and complex project like Refurbishment, this could have a significant impact on the cost and schedule. Going forward, improving the accuracy of cost and schedule forecasts will depend upon the Project Team's use of the available tools, verification of the work in the field and ensuring it is receiving timely and accurate data from the vendors.
Risk Management	Since RQE, the EO Team has seen a broad range of risks added by the Project Team to the risk register. The program and structure is well established and functional. Discrete risks have been clearly identified and represent significant aggregate exposure which must be addressed. However, the Project Team's focus should be aimed at building effective mitigation strategies that can be successfully tracked and executed. The EO Team acknowledges that the OPG assurance teams have identified a number of concerns regarding the Project Team's use of the risk program as a management tool. However, the fact this issue continues to come up is evidence that the Project Team has not fully embraced the Risk Management Program as an essential day-to-day working tool. In our opinion, risk management is just as important to project success as methods used to control cost and schedule.
Vendor Capability and Readiness	To date, the vendors have struggled performing the F&IP projects and in meeting some of their commitments during the Refurbishment Project's Definition Phase. This raises several concerns with respect to the Refurbishment Project, [redacted] Based on our review of the vendor's performance over time, we have made the following observations that could have a significant impact on cost and schedule: ❖ The OPG Project Team has a tendency to "help" the contractors resolve issues in a manner that imposes unanticipated demands on OPG staff. Care must be taken to ensure that the contractors do not unnecessarily rely on OPG and shift contractual responsibilities. ❖ OPG's ability to effectively manage the vendors and anticipate issues depends largely on the quality of the data the contractors provide to OPG. As an example, OPG has not consistently compelled the contractors to provide performance data for its second and third-tier contractors or contractor actual hours, also known as their "burn rates." Such data is critical for assessing the contractor's true performance, assessing productivity and finding troubled areas. ❖ OPG has allowed the contractors to re-sequence their projects, which is generally an indicator of either poor performance or poor baseline scheduling. Accountability suffers when a project loses sight of its original baseline. OPG needs to ensure that the contractors are meeting schedule commitments as the Project moves into the Execution Phase and hold them accountable when the schedule slips. Changing a baseline schedule also makes forecasting much more difficult. ❖ OPG has requested changes to the key vendors' project management teams which the vendors have honored. It will be important to monitor these changes for their effectiveness. OPG's commercial management team is currently understaffed. OPG is in the process of finalizing an RFP process to retain an outside vendor to assist in this regard, to keep pace with the volume of potential commercial issues, which it anticipates will increase after breaker open.

Executive Summary

Breaker Open and the start of the Darlington Refurbishment Project ("DR Project") Execution Phase occurred on schedule. OPG Management's November 10, 2016 report ("Management Report") to the DRC affirms the DR Project remains within the overall RQE control budget of $12.8 billion and that the DR Project's overall P90 schedule duration of 112 months is not challenged. The Management Report to the DRC adequately reflects the status of the Project and is generally focused on the DR Project's current key status points and risks. Over 3Q 2016, OPG's assurance programs have been effective at identifying issues. The DR Team has established a number of critical initiatives intended to improve work flow, accountability and overall management of the work in the field, the success of which will be monitored.

Looking forward, the Burns & McDonnell/Modus External Oversight Team ("EO Team") has identified certain issues that could have an impact on the Project if they are not addressed, including:

- The schedule for non-critical path work needed for reactor vault turnover being performed simultaneously with Defueling requires a significant ramp-up of resources, and the vendors' capability to support the schedule will require monitoring in light of past performance trends.
- While reporting has improved, OPG's method for verifying quantities of work performed and tracking of productivity would benefit from a focus on contractor direct work (or "wrench") hours and regular verification of contractors' actual hours performed by work package;
- Functional staffing levels remain below target; with ongoing efforts to fill the open positions, there are short-term needs to close resource gaps and meet challenges to integrate new hires into the DR Team;
- Contract Management activities need to progress while OPG implements a long-term strategy.

Evaluation of DR Project Status

The EO Team has identified the following key status points as of October 28th that should be considered for purposes of evaluating the DR Project's health as a whole.

Key DR Project Status Indicators	
Schedule Performance	OPG's work is on the critical path for a planned 167 days from Breaker Open to turnover of the vault to SNC/AECON on March 30, 2017 ("Segment 1"). The DR Team met its first challenges in the first week following Breaker Open and has responded well to issues as they developed. While the critical path Defueling work is currently on schedule, other non-critical path work is tracking behind the Project's P50 Schedule. While we see no current risk to the P90 Schedule, there has been a reduction of available schedule float for non-critical path work. Focusing solely on construction progress, as of Breaker Open, the DR Project had completed 10.3% of field work (including station pre-requisite projects) against a planned 12.3%, yielding an SPI for construction activities of 0.84. In August, management evaluated the priorities for Breaker Open and moved some non-critical pre-requisite work into Segment 1. Performance of other preparatory and pre-requisite work will require a ramp-up of resources and improved performance, as discussed below in Vendor Performance.
Cost Performance	The DR Team has maintained the 4-unit Project control budget of $12.8 billion through completion of the Unit 2 Estimate. The final Unit 2 Execution Phase schedule was baselined on September 16, 2016, resulting in minor changes to internal cost categories within the Unit 2

	budget, but with no impact on the control budget or the P90 schedule. There were some contingency draws, notably for the Shut-down Layup ("SDLU") bundle, totaling $25M for Unit 2 and $80M overall, which were based upon ES Fox's updated estimates that included added scope and work forecasts since RQE. The Unit 2 budget is $3.4 billion with $677 million contingency.
Vendor Performance	Within Segment 1, the major contractors have non-critical path work needed to prepare the vault for turn-over on or before March 30, 2017. ❖ SNC/Aecon's new Site Director has initiated a number of positive changes, and the RFR team has identified potential performance improvements that could improve both cost and schedule. SNC/Aecon is also addressing resource gaps and optimizing its organization for execution. SNC/Aecon's progress on the Reactor Waste Processing Building ("RWPB") remains on schedule. SNC/Aecon's scope has increased in Segment 1 to incorporate the unit islanding and support tasks which will be required for vault turnover, though this is simply a transfer of existing scope and the overall Unit 2 cost is unchanged. ❖ [redacted]
Project Controls and Risk Management	The Project Controls Team has implemented systems for managing and controlling the work that are representative of industry best practices. The team is currently performing quality control checks to ensure full cost and schedule reporting alignment, which may take several more weeks or months, though this effort is essential to ensure that the reports generated are accurate. With respect to Risk Management, in our August report we identified that certain technical performance risks were added post-RQE. The DR Team is reporting that it is managing these risks. In addition, the DR Risk Team is providing increased focus on risk mitigation and is receiving support from DR Management and Corporate Enterprise Risk Management.
Safety and Quality	The DR Team has identified an increase in safety events, and as a result the DR Team has increased its focus on identifying controls and field processes in order to increase risk-based oversight of the vendors' activities as appropriate. OPG has established a number of field protocols aimed at monitoring the contractors' work which, if effective, should enhance tracking of performance and mitigate safety and quality issues, though these processes need to be tested in the field.
Construction Checkout and Testing	The DR team is increasing focus on vendor performance associated with Construction Checkout and Test ("COAT") and Construction Completion Declaration ("CCD"). Properly performing the COATs and assembling and reviewing all associated documentation is a comprehensive effort that can impact the schedule if not addressed timely. Completing COAT and CCD activities for the Breathing Air System presents a critical near term opportunity to measure performance and adjust processes.

Project and Program Assurance

The DR Team's Performance Assurance Group ("PAG"), Enterprise Risk Management and OPG Internal Audit have developed and are executing robust plans for assurance activities. Within the quarter, PAG prepared a root cause assessment of vendors' CWPs development, identifying negative trends and repeated issues. In response, the DR Team introduced oversight initiatives focused on improving communications, increasing accountability and changing some of the outage-based behaviours. These initiatives have promise though their impact on the work will need to be proven.

OPG Project Team

OPG's Project leadership has implemented the Division of Responsibility for all work groups and a number of new processes focusing on improving accountability that grew out of OPEX from the Readiness to Execute period. The DR Team and the vendors have had multiple field readiness reviews/challenges to ensure the workers have the necessary tools, equipment and support to effectively execute the work, in order to enhance schedule and budget performance.

OPG remains under-staffed based on its U2EE projections. The current plan calls for OPG to add resources from its current level of 778 to 1,058 in Q1 2017. OPG's ability to hire, train and integrate these new hires into the current staff will be a challenge in the coming months.

Project Risks and Strategic Considerations

The EO Team offers the following analysis of certain forward-looking risks and strategic considerations that could impact the P90 schedule. OPG's assurance providers (including our team) have encouraged the DR Team to move from an outage to a construction mindset; the DR Team's leadership agrees that there is a need to implement more of a traditional Project execution model. To that end, the following are opportunities for improvement:

Risk Area	EO Team Observations
Performance Reporting	Performance reporting relies upon the vendors to accurately report progress and the owner's validation. As noted, OPG has the systems and resources in place to support performance reporting; however, OPG Management should consider the following improvements to more accurately analyze and measure the DR Project's status and craft labour productivity: ❖ The DR Team's focus on daily scheduled task completion, which is an outage trait, needs to be paired with a focus on the resource hours needed to perform the direct work (aka "wrench hours") and percent completion of work over time. This transition is in progress. ❖ OPG needs its vendors to report their actual field execution hours in a method consistent with how they report earned value progress. OPG management is addressing this with its vendors. However, until this gap is corrected, OPG will lack a powerful tool to hold the vendors accountable to their work estimates.
Commercial Management	OPG is currently assessing a company-wide enterprise approach to commercial management. In the meantime, there will be a significant increase in the volume of work associated with

	documenting and tracking potential commercial issues, including: initiating, responding and tracking correspondence with vendors; tracking contractual milestones; monitoring schedule and performance issues; providing prompt notice of vendor deficiencies; and assisting in supporting the OEB case. The current Contract Management team has capable leadership, though the planned out-sourcing of the resources to fill this function needs to be progressed.
Vendor Performance	The performance by some of the vendors to date presents risks to Segment 1 and beyond if not mitigated. ❖ As noted, for the current Segment 1 work, from September to November 2016, ES Fox will need to ramp-up its weekly earned value production to meet the schedule and then maintain that level of progress through the first half of the Unit 2 DR Project. [redacted] Based on performance trends to date, the EO Team sees a risk that BOP and SDLU work could place greater demands on management's time and could impact key project milestones. This trend should be monitored closely. ❖ SNC/Aecon is currently preparing for vault turnover, unit islanding work and completing the RWPB, all of which support its critical path retube and feeder replacement work. SNC/Aecon is also performing rehearsal work in the vault mock-up with the goal of testing and improving its performance. [redacted]. SNC/Aecon's new site leadership has instituted changes and increased accountability within the organization to address these issues.

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J2.10 Attachment 2, Page 1 of 5

Refiled: 2021-05-28
EB-2020-0290
Exhibit L-D2-02-CME-019
Attachment 42, Page 1 of 5

BURNS McDONNELL

Independent Oversight Report on the Darlington Refurbishment Project

SUBMITTED TO:

Darlington Refurbishment Committee of the Board of Directors for Ontario Power Generation

March 9, 2017

Executive Summary

OPG Management's March 9, 2017 report ("Management Report") to the DRC affirms its forecast for the Darlington Refurbishment Project ("DR Project") remains within the overall RQE control budget of C$12.8 billion and P90 schedule duration of 112 months. The Unit 2 portion of OPG's high-confidence budget is C$3.417 Billion (including C$677 million of contingency) based on an execution duration of 40 months. The DR Project's Execution Phase is currently nearing conclusion of Segment 1, during which the Unit 2 vault is being prepared for its rehabilitation. As of this writing, the DR Project is a net +5 days ahead of the working schedule's critical path since Breaker Open on October 15, 2016. After OPG's Defueling gained 26 days to critical path, 21 days have been lost [redacted] OPG's schedule metrics have significantly improved, allowing the DR Team to identify and mitigate issues, and OPG has increased field oversight in light of early performance, safety and quality trends. Assurance groups continue to be effective in identifying issues.

The Burns & McDonnell/Modus External Oversight Team ("EO Team") has identified certain issues that could have an impact on the Project if they are not addressed, including:

- SNC/Aecon's issues with vault preparation work need to be understood so that lessons learned can be incorporated in future work evolutions;
- [redacted]
- OPG's project controls focus since Breaker Open has been tracking schedule earned value; the team is refocusing on cost forecasting, including tracking the velocity of contractor costs and adverse performance trends, the effectiveness of which needs to be assessed;
- Commercial challenges in Refurbishment and F&IP projects have arisen early in the DR Project which could impact the contractors' momentum and distract OPG's and the vendors' management teams.

It should be noted that the data cut-off date for our report is February 17, 2017. While the Management Report to the DRC accurately reflects the status of the DR Project as of January 31, 2017, some data points differ from those used by the DR Team, as they reflect performance for the first 3 weeks in February.

Evaluation of DR Project Status

Key DR Project Status Indicators

Schedule Performance

	Planned	Complete	Ahead/Behind	SPI	CPI
Total Project	23.4%	19.0%	(123,876)	0.81	N/A

OPG defueled the reactor 26 days ahead of the working schedule though the post-defueling activities resulted in the DR Project losing 21 of those 26 days to date, and performance trends suggest that the bulkhead installation may further challenge the schedule. While the critical path is as of this writing, 5 days ahead, near or non-critical path work has fallen behind by 123,876 hours, with the current composite execution SPI at 0.81; RWPB, as discussed below is the largest contributor. SNC/Aecon will likely drive the critical path schedule until the reactor is fully refurbished in 1Q 2019.

Weekly schedule adherence metrics have shown a persistent problem, with causes ranging from field productivity, late construction work packages, field initiated changes and late reporting of earned value. The DR Team has instituted additional oversight of the critical path work to validate readiness with a goal of raising weekly adherence to 90% of scheduled activities.

Cost Performance	The DR Team has not exceeded the 4-unit Project control budget of $12.8 billion or the Unit 2 budget of $3.4 billion (including $677 million of contingency). Overall, the DR Project is underspent by $59 million which is split between OPG functions (-$32M) and contractor performance (-$27M). To date, contingency draws have totaled a net $32 million. Though OPG remains resolute in doing so, the vendors' actual hours are not currently being collected for purposes of forecasting based on field productivity.
Vendor Performance	<table><tr><th>Vendor</th><th>Planned</th><th>Complete</th><th>Ahead/Behind</th><th>SPI</th><th>CPI</th></tr><tr><td>SNC/Aecon (RFR)</td><td>20.6%</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td></tr><tr><td>ES Fox (BOP/SDLU)</td><td>29.7%</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td></tr><tr><td>SNC/Aecon (TG)</td><td>40.7%</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td><td>[redacted]</td></tr></table>
SNC/Aecon *Critical Path or Near Critical Path Work*	[redacted] SNC/Aecon's initial critical path work has been affected by discovery work, equipment and field execution issues. The bulkhead installation began on January 27 and is currently scheduled to complete on March 22, which is a key milestone. [redacted]. From August 2016 to February 2017, the RWPB has lost [redacted] and approximately [redacted] against its target price estimate. Engineering, which was planned to complete in 3Q 2016, is ongoing and has [redacted] of remaining work. In mid-November, OPG challenged SNC/Aecon to identify its recovery plan for RWPB. [redacted] SNC/Aecon's milestone for completing RWPB is July 31, 2017 is at risk, and further slippage could impact the critical path for Refurbishment. [redacted] SNC/Aecon's work on the Turbine Generator has generally tracked to its schedule and is not a concern at this time.
ES Fox *Critical Path or Near Critical Path Work*	[redacted] ES Fox's management has implemented an improvement plan that addressed all aspects of its performance—safety, quality, schedule management and resources. While ES Fox recovered its schedule, it was not without added cost. With Segment 1 concluding, this is an opportune time to examine future work to ensure that ES Fox can sustain this improvement within budgeted cost and schedule.
Project Controls and Risk Management	The OPG Project Controls team's improved reporting has increased visibility to problem areas. [redacted] The DR Team now is increasing its cost focus to bolster its forecasting. The team is rolling-out additional cost tracking functionality and increasing its use of EcoSys as a forecasting tool. A critical

	component to accurate forecasting depends on obtaining vendors' actual hours and capturing field productivity rates. Obtaining this data will greatly increase the efficacy of OPG's cost forecasting. Risk Management activities are proceeding well with increased senior management support and visibility to successful mitigation of risk events. Contingency tracking and forecasting based upon outstanding risk needs to be validated. The EO Team has some concerns which management is addressing regarding the roll-up of contingency information from the granular to the summary level, which we will address prior to the next DRC report. The risk team is currently improving its ability to forecast potential future contingency draws in order to analyze the remaining contingency.
Construction Checkout and Testing	Vendor performance of the Construction Completion Declaration ("CCD") process and turnover for OPG commissioning/return to service is improving through consolidating turnover packages, performing early reviews of CCD documentation, and assisting vendor conformance. Attention is currently focused on near term (2 week) CCD and turnover requirements with the objective of expanding readiness to a 4+ week window.

Project and Program Assurance

The DR Team's Performance Assurance Group ("PAG"), Enterprise Risk Management and OPG Internal Audit ("IA") are executing robust plans for assurance activities. PAG and Quality Assurance are currently focused on increasing vendor focus on field supervision, safety and quality, and interacting directly with vendors to instruct them on avoiding safety and quality issues. ERM and IA continue to focus on program-level risks and vendor performance. IA is currently planning to audit barriers to field performance through direct surveillance.

OPG Project Team

The DR Team has reacted to the early challenges to critical path by increasing pre-critical path validation and preparation. OPG management has instituted more granular pre-execution reviews with the vendors and integration with key OPG personnel. OPG has also initiated a program to improve accountability which focuses on communications, teamwork, and expectations. This program's focus is on understanding responsibilities, schedule adherence, stakeholder interfaces, and increasing visibility of safety requirements and the potential consequences of non-compliance.

Project Risks and Strategic Considerations

The EO Team offers the following analysis of certain forward-looking risks and strategic considerations that could impact the P90 high-confidence schedule.

Risk Area	EO Team Observations
Performance Reporting	[redacted] The OPG team now needs to increase focus on cost reporting so that Estimates at Completion ("EAC") are accurate, impact costs are transparent and adverse trends are timely identified. Currently, cost forecasting is a *following,* rather than a *leading* indicator as it relies

	on receipt of actual invoices weeks after the work has been performed. The most critical cost trend on the DR Project requires forecasting the number of craft workers needed to accomplish the work, which is calculated based on the vendors' actual hours compared to their budgeted hours. The DR Team's forecasting needs this data to accurately track field productivity trends and to fully utilize the EcoSys cost toolset. Taking these steps will further enhance the accuracy of impacts of newly-identified risks, ongoing commercial issues or other factors that influence EAC. While the weekly progress metrics have improved such that OPG now has clear line of site into performance issues, cost impacts are not being concurrently assessed with the same rigor. Without this balance, OPG's management focus is weighted towards schedule over cost. That may be appropriate at this time, particularly since the critical path is a greater risk, but OPG needs to arrive at a balance of cost and schedule considerations to inform its decisions going-forward.
Commercial Management and Change Management	Effective commercial management involves ensuring the company's contractual position is maintained and asserted as necessary, while also protecting the project management team's focus on the work in the field. Doing so requires having sufficient talented resources in place and a high-level of efficiency in systems used to manage this effort. As anticipated, there has been a significant increase in the volume of work associated with documenting and tracking potential commercial issues. The DR Team currently lacks a formalized or standard way to initiate, respond to and track correspondence notices with vendors; track contractual milestones; monitor schedule and performance issues; or provide prompt notice of vendor deficiencies. Management should address establishing a methodology for bounding potential outcomes for commercial claims and disputes. The Change Management process is in place and seems to be working—however it is not currently automated, which is standard practice for a project of this size and complexity so that there is visibility to in-process changes. We note that the VP of Commercial Management has recognized many of these gaps and has initiated changes in processes and added resources to meet these challenges.
SNC/Aecon Performance	[redacted]
F&IP Projects	The Emergency Power Generator 3 ("EPG3"), Containment Filter Venting System ("CFVS") and D2O Storage Facility each continue to miss targeted schedule dates and cost projections. These projects continue to drain resources from Refurbishment, OPG/vendors' management attention and threaten to utilize additional program contingency for their completion. Moreover, there are trends observed in the vendors' management of those projects and other past F&IP projects that must be eradicated in Refurbishment.

CME Interrogatory #20

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 10

With respect to the D20 Storage Project, OPG stated "One of the other alternatives that scored well was to split the refurbishment storage from the operational improvement storage, but that alternative was ultimately rejected as more expensive and less practical than the current project location. The workshop concluded that the current project location was the preferred site."

(a) Please provide the forecast cost of the split refurbishment storage solution.
(b) Please provide the forecast cost of the other alternatives that scored well but were ultimately rejected.

Response

a) The Value Engineering Workshop did not develop forecast costs for the alternatives (Ex. D2-2-10, pp. 42-43). Instead, an order-of-magnitude cost estimate based on the then current state of knowledge about the project (in April 2011) was assumed. The order-of-magnitude cost estimate assumed was $200M consisting of $150M in construction and other direct project costs ("direct project costs") and $50M in overhead costs. The direct project cost assumption was based on construction occurring at the current site of the D2O Storage Project facility. The costs of alternatives were evaluated based on assumed differences to the $150M. The cost of the split solution alternative (refurbishment storage at an alternative site and the remaining storage and operations at the site of the current facility) was assumed to have order-of-magnitude direct project cost difference of $13M for an assumed total direct project cost of $163M.

b) Using the methodology described in the response to part a, all of the alternatives considered had assumed order-of-magnitude direct project cost estimates of between $150M and $167M, with the top three being between $150M and $164M.

CME Interrogatory #21

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 3

Bates and White states "RSMeans is the standard source for routine construction cost data throughout North America. The RSMeans online cost database was our primary source of cost data. This database provided the Canadian dollar denominated prices for the materials and parts, as well as typical union labour rates in the Toronto metropolitan area for late 2019. For items not priced in the RSMeans database, we obtained vendor prices from vendors' online sites."

a) Please provide the RSMeans score for Toronto, as well as other cities in Ontario, including Oshawa and the surrounding cities (as available).
b) With respect to OPG's contractor productivity, please provide the studies listed at footnote 24.

Response

Part a) of the response was prepared by Bates White:

a) The RSMeans weighted average cost index in 2020 for Toronto was 111.9, where 100 equals the average for 30 U.S. cities. Due to the proprietary nature of the RSMeans database, available only by paid subscription and subject to a licensing agreement, we cannot provide a comprehensive set of cost indices.

b) See:
- Attachment 1, for the Rigden Lhawang, Pratheep Srikantha, Mihai Balan, and Fatimah Al Ubaid, Wrench Time Analysis Study: 1st Site Visit Report, Nuclear Design Laboratory Faculty of Energy Systems and Nuclear Science, University of Ontario Institute of Technology, Oshawa, Canada, April 2018;
- Attachment 2, for the Faithful+Gould, Ontario Power Generation Darlington NGS Heavy Water Management Building Estimate Report, January 2012; and
- Attachment 3, for the "Wrench Time D2O.R1," data as of August 2018.

Wrench Time Analysis Study: 1st Site Visit Report

courtney -
copy to DRS
MHA

By:

Rigden Lhawang
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Fatimah Al Ubaid

Nuclear Design Laboratory
Faculty of Energy Systems and Nuclear Science
University of Ontario Institute of Technology
Oshawa, Canada

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

Friday, April 6th, 2018

Introduction

Trial Date was on Feb 9, 2018

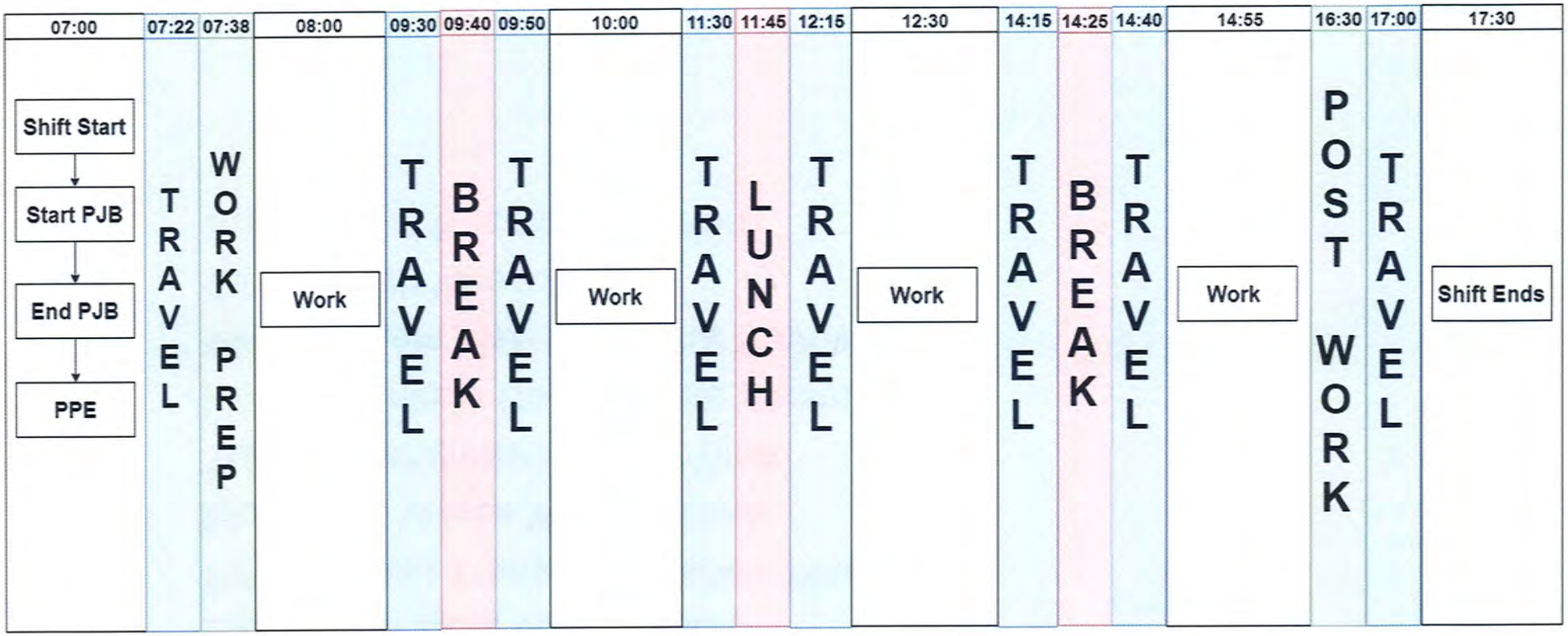
Study conducted between Feb 16 – Feb 23, 2018

- 24 Wrench Time measurements taken
- 5 Critical Path Wrench Time measurements taken

Outline

1. Value Stream Map for Crew Based Work
2. Example of Data Visualization
3. Primary Heat Transport Wrench Time
4. Moderator Valves Wrench Time
5. Turbine/Generator Wrench Time
6. Line 15/ Unique Components Wrench Time
7. Value Stream Map for Critical Path Work
8. Critical Path Wrench Time
9. Summary of Recommendations

Value Stream Map for Crew Based Work

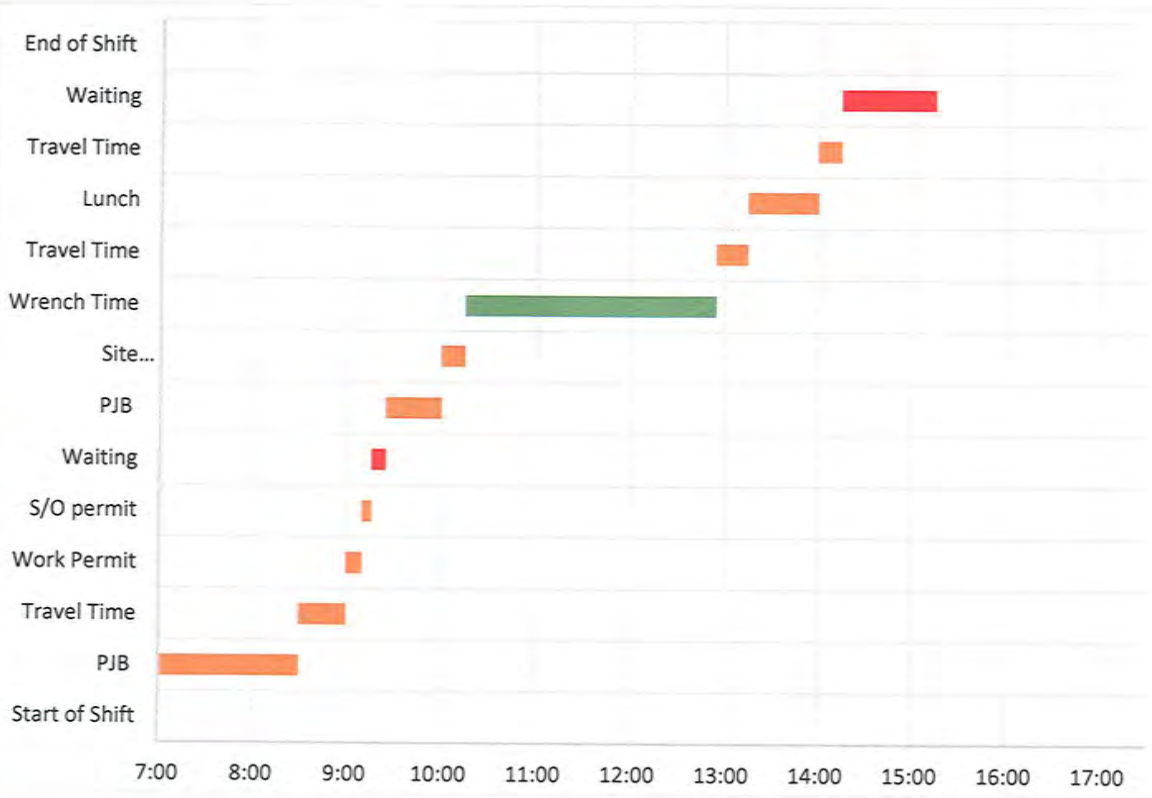


Data Visualization (DV)

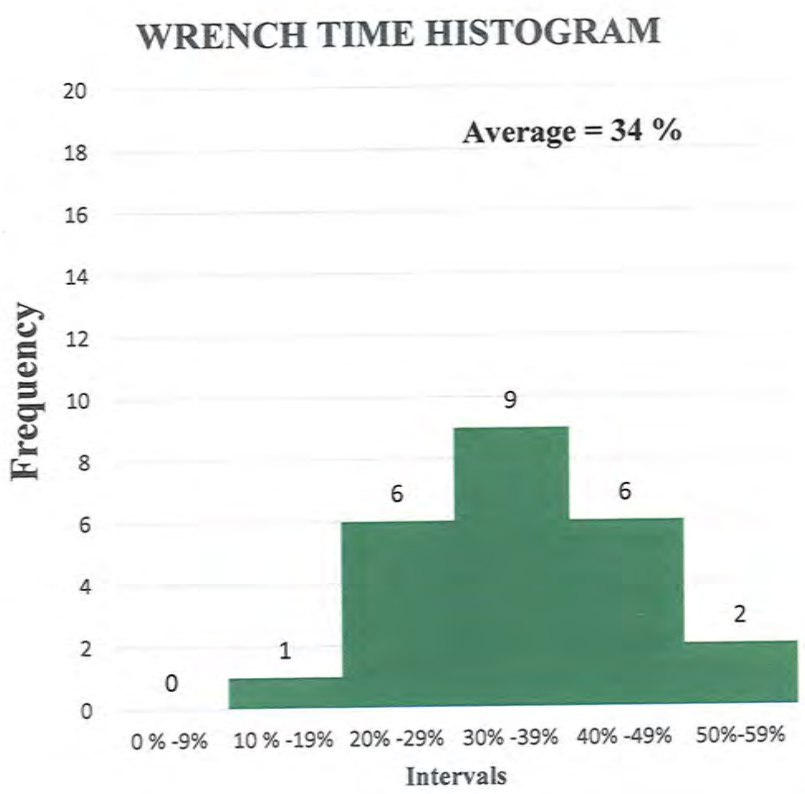
This is a typical DV graph for a sample that obtained for the Primary Heat Transport (PHT) system during the trial day, and it is 1 out of 24 samples.

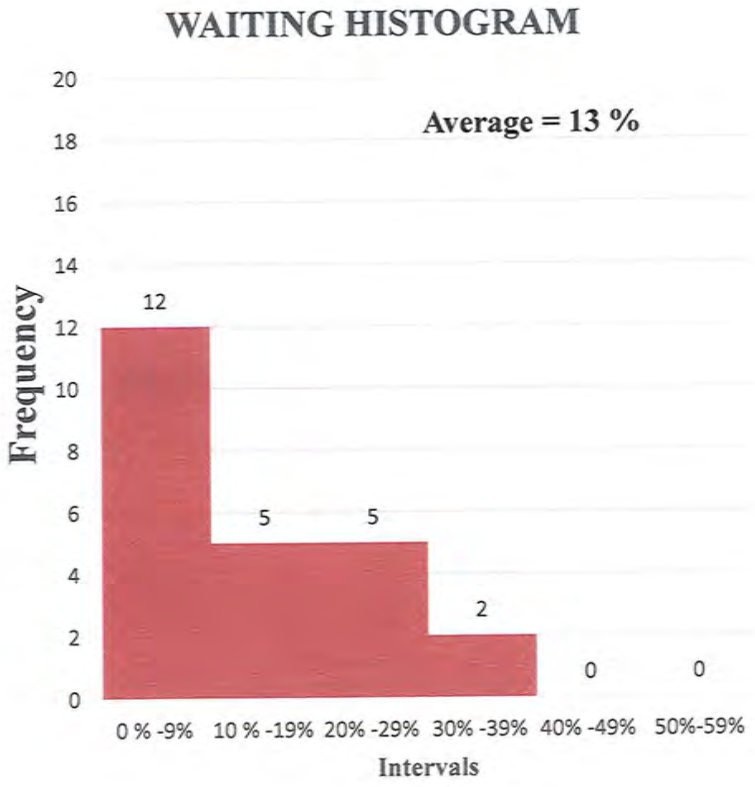
Activity	Start	Duration
Start of Shift	7:00	0:00
PJB	7:00	1:30
Travel Time	8:30	0:30
Work Permit	9:00	0:10
S/O permit	9:10	0:06
Waiting	9:16	0:09
PJB	9:25	0:35
Site Preparation	10:00	0:15
Wrench Time	10:15	2:40
Travel Time	12:55	0:20
Lunch	13:15	0:45
Travel Time	14:00	0:15
Waiting	14:15	1:00
End of Shift	15:15	0:00

Row Labels	Sum of Duration	
Lunch	45	9.1%
S/O permit	6	1.2%
Start of Shift	0	0.0%
Travel Time	65	13.1%
Waiting	69	13.9%
End of Shift	0	0.0%
Work Permit	10	2.0%
Site Preparation	15	3.0%
Wrench Time	160	32.3%
Grand Total	**495**	100.0%

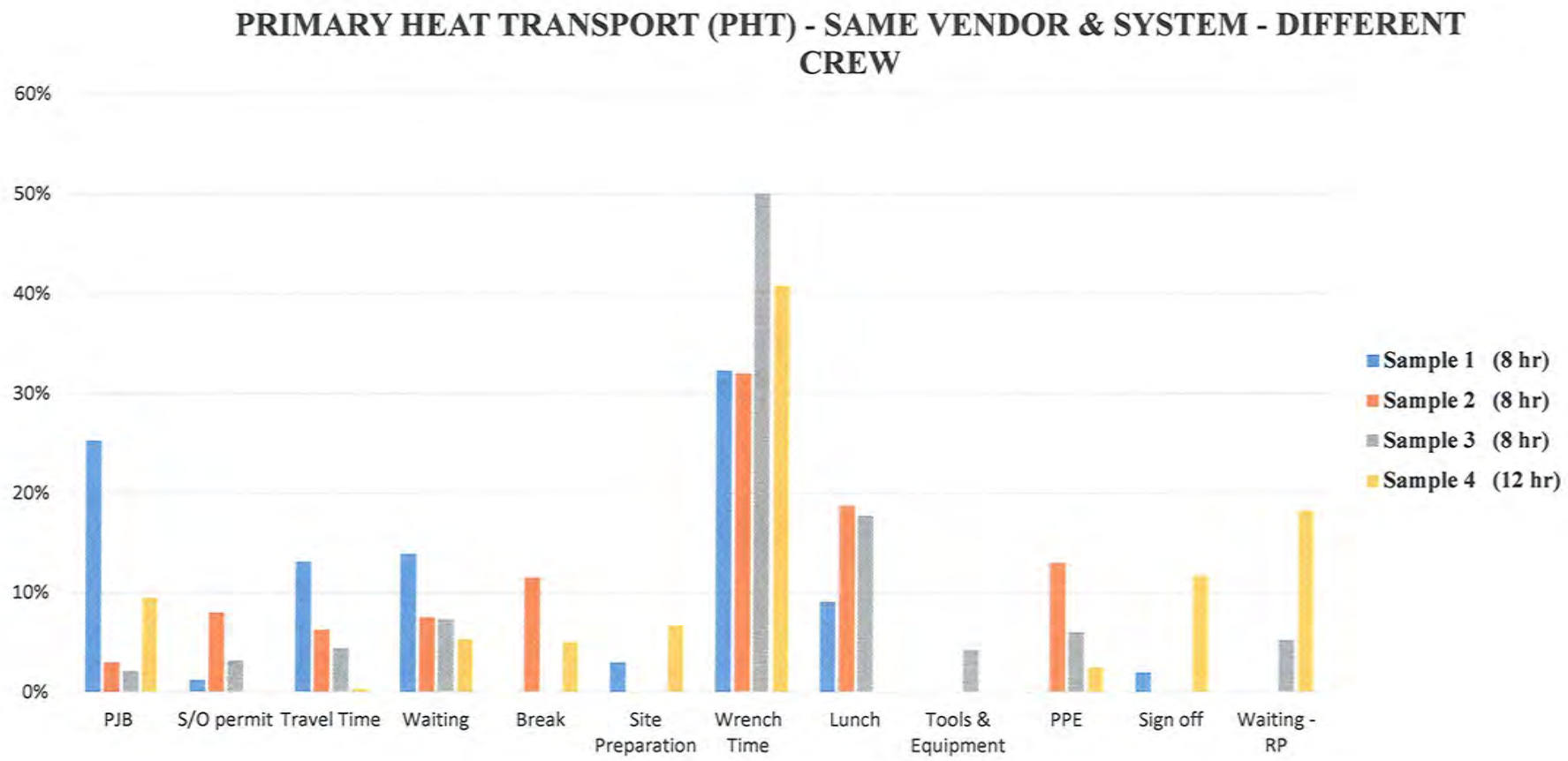


Wrench Time & Waiting Histograms





Primary Heat Transport (PHT) Work



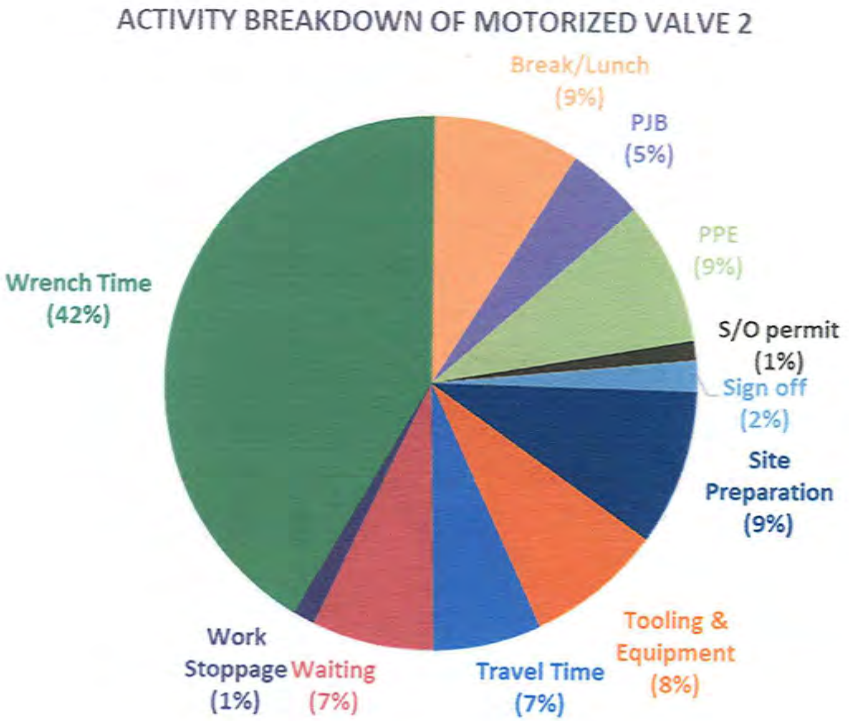
Performance Barriers – Primary Heat Transport (PHT)

- Long waiting time (~ 1 hour)
    - Long lunches
    - Confusion regarding schedule
- Hold point sign offs (~ 1 hour)
- Early end of shifts (~ 1 - 2 hour)

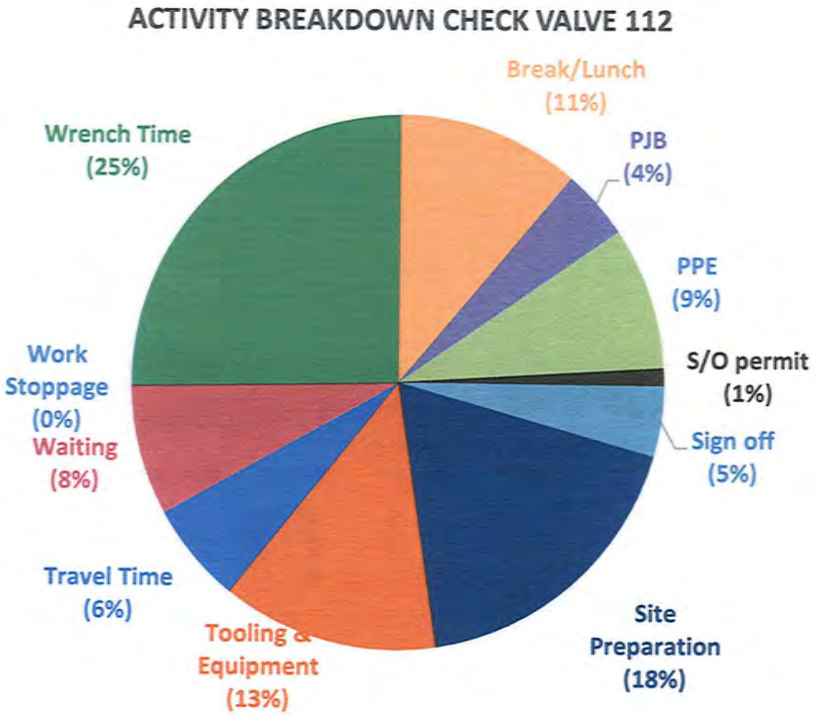
Recommendations

- More emphasis on pre-job brief to avoid confusion regarding the schedule
- More supervision regarding lunch hours

Cumulative Wrench Time

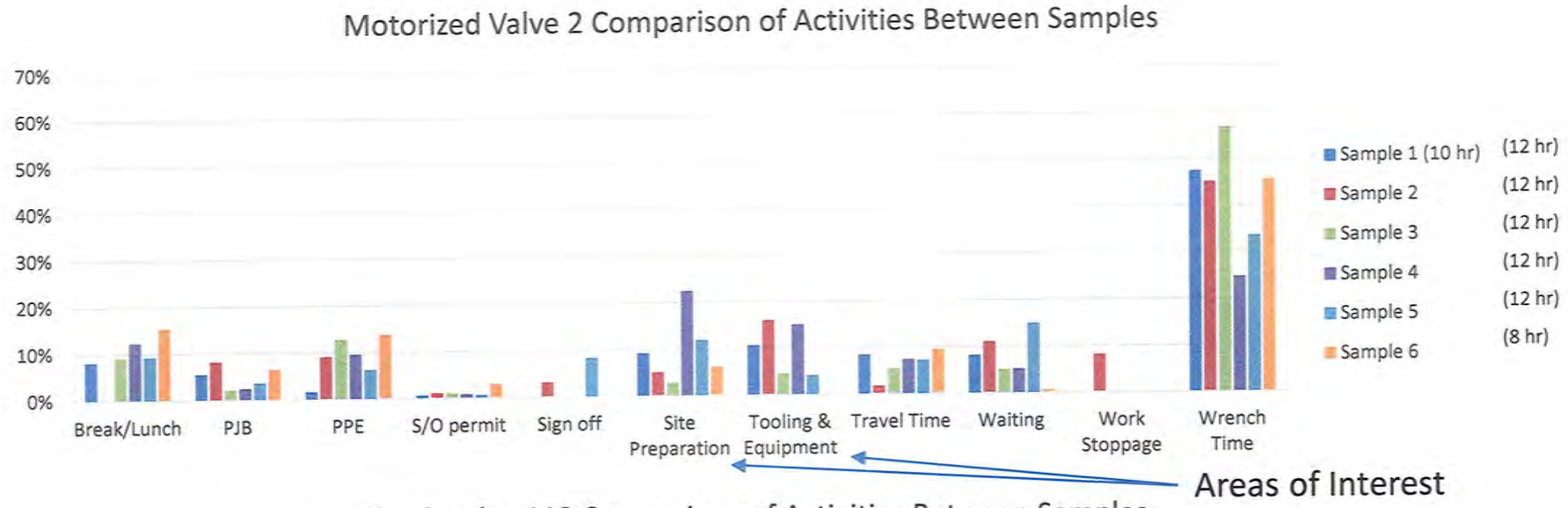


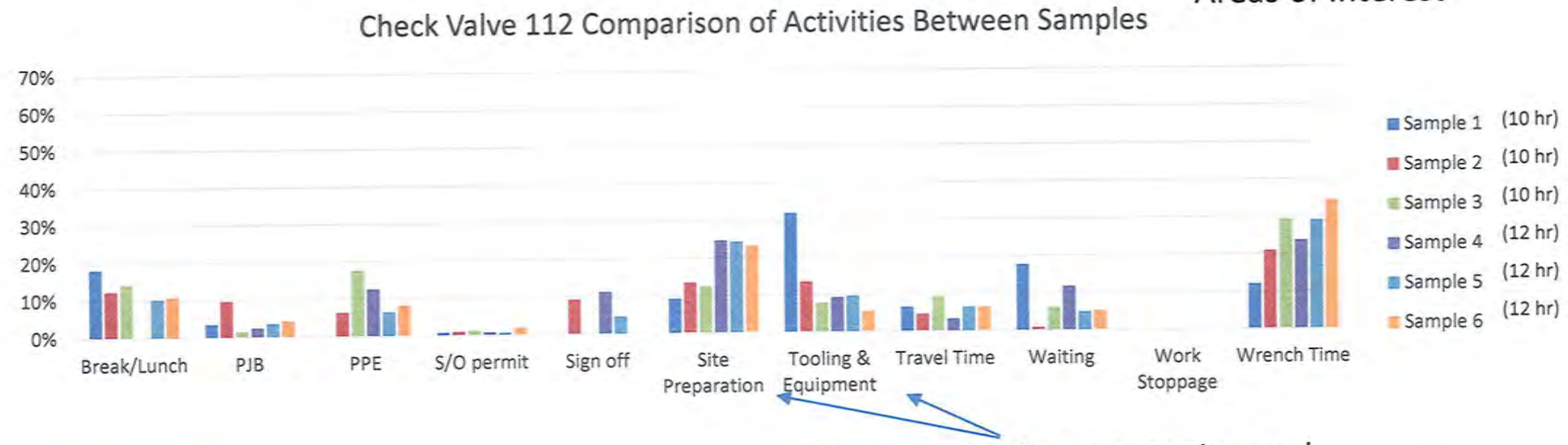
Motorized Valve 2 consists of 6 data points



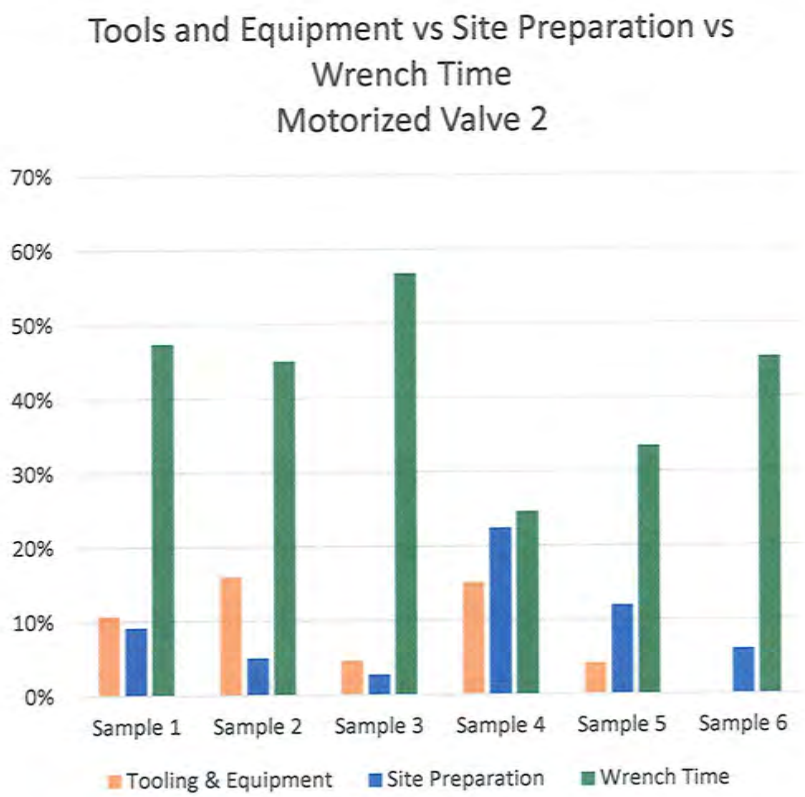
Check Valve 112 consists of 6 data points

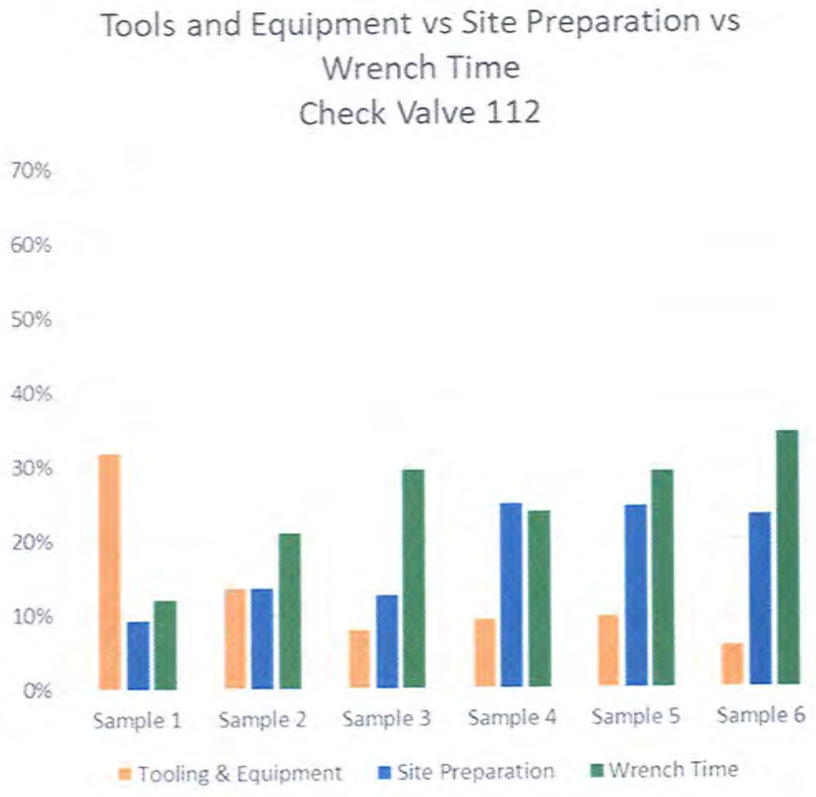
Comparison of Activities





Tools & Equipment and Site Preparation





Performance Barriers – Moderator Valves

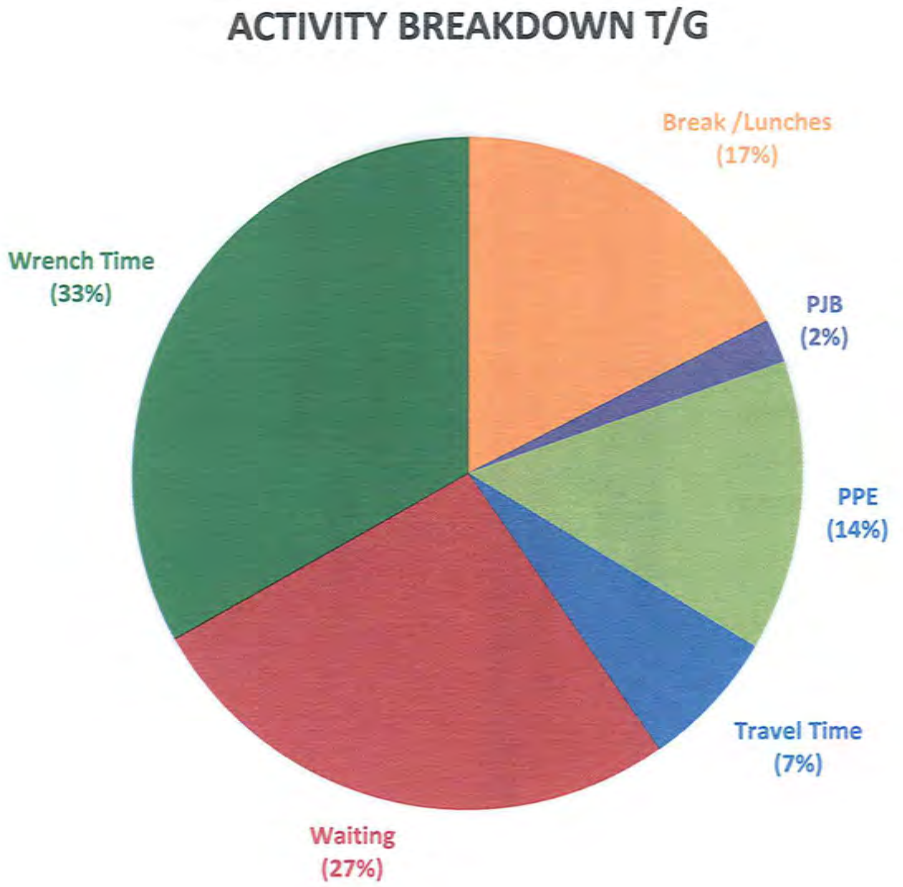
- RP scheduling issues exist (~ 0.5 hours)
- Multiple faulty equipment (~ 1 - 2 hours)
- Badges at different locations (~ 10 minutes)
- Lack of urgency (~ 1 hour)

Recommendations

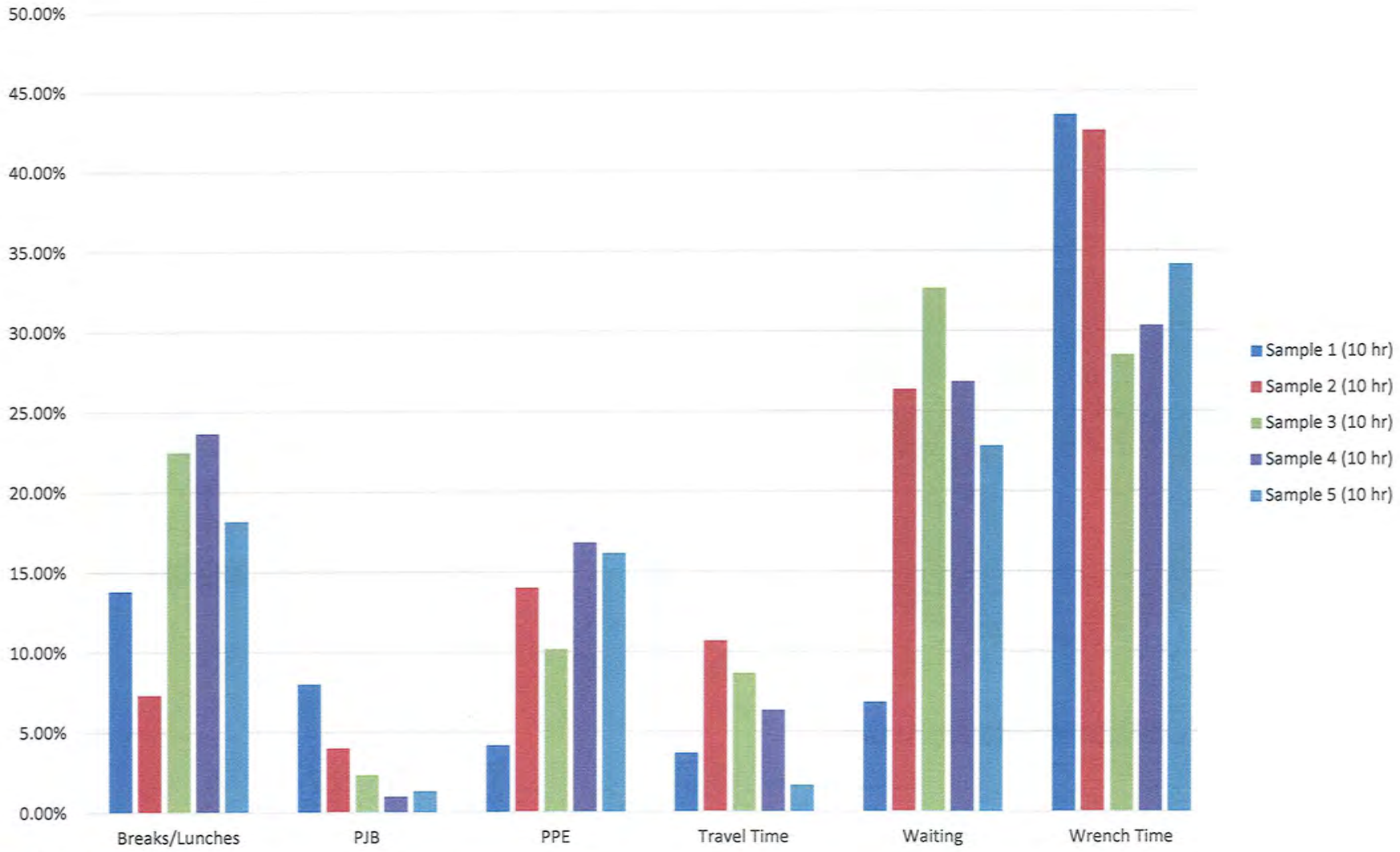
- Communication devices for workers inside containment to communicate with foreman in the event of issues with tools and equipment
- RP enter the moderator rooms to take tritium samples. By enabling RP to perform gas tests, site preparation can be reduced collectively.

Turbine/Generator Work

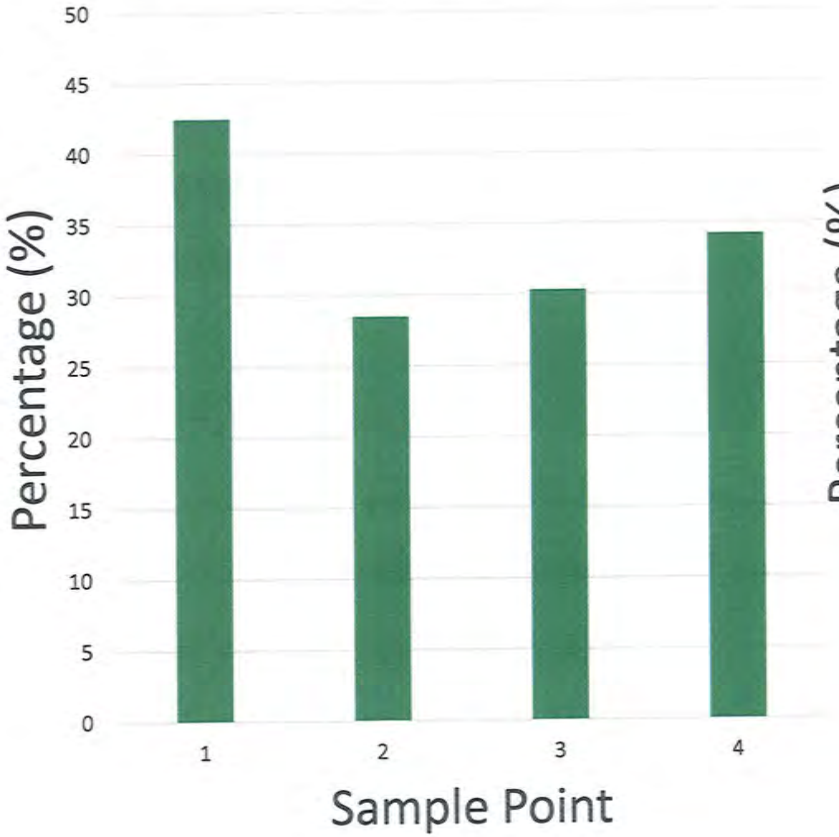
- Five studies completed
  - One data point – Turbine Work
  - Four data points – Generator Work

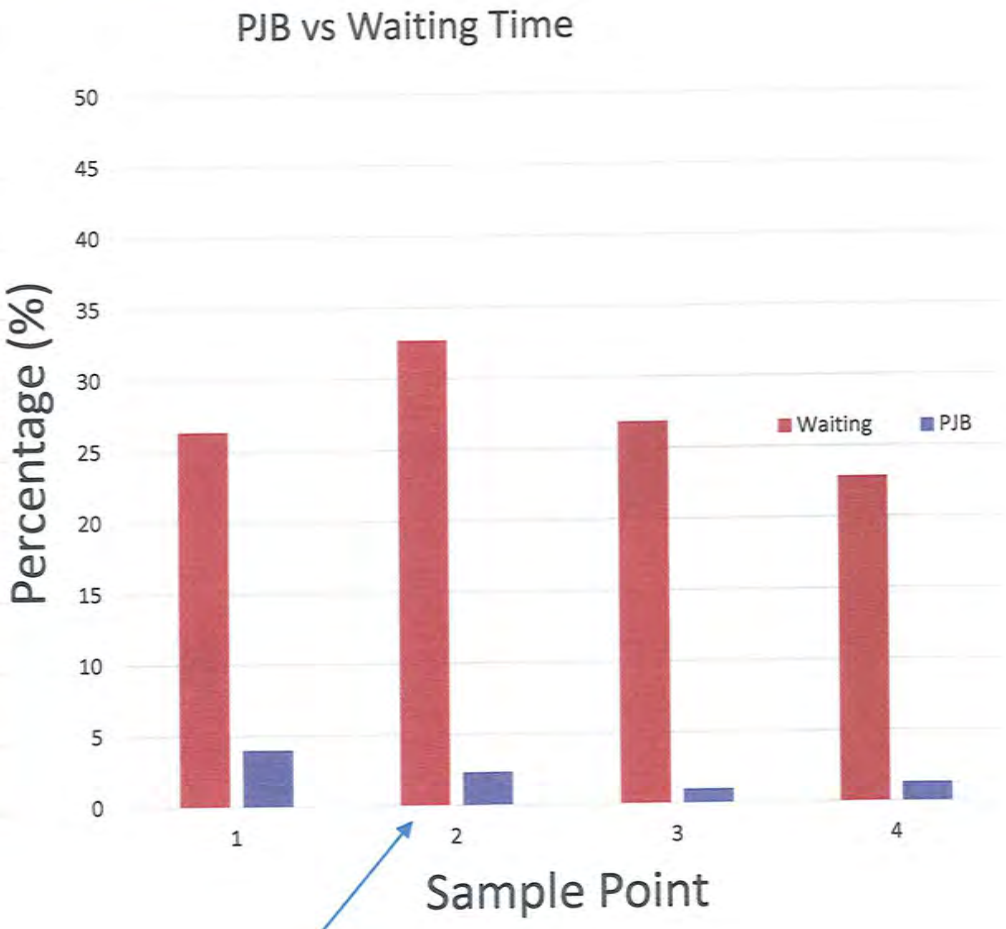


T/G Comparison of Activities Between Samples



Results – Generator Project





As pre-job brief decreases while waiting time increases. This is associated with scaffolding issues.

Performance Barriers – T/G Project

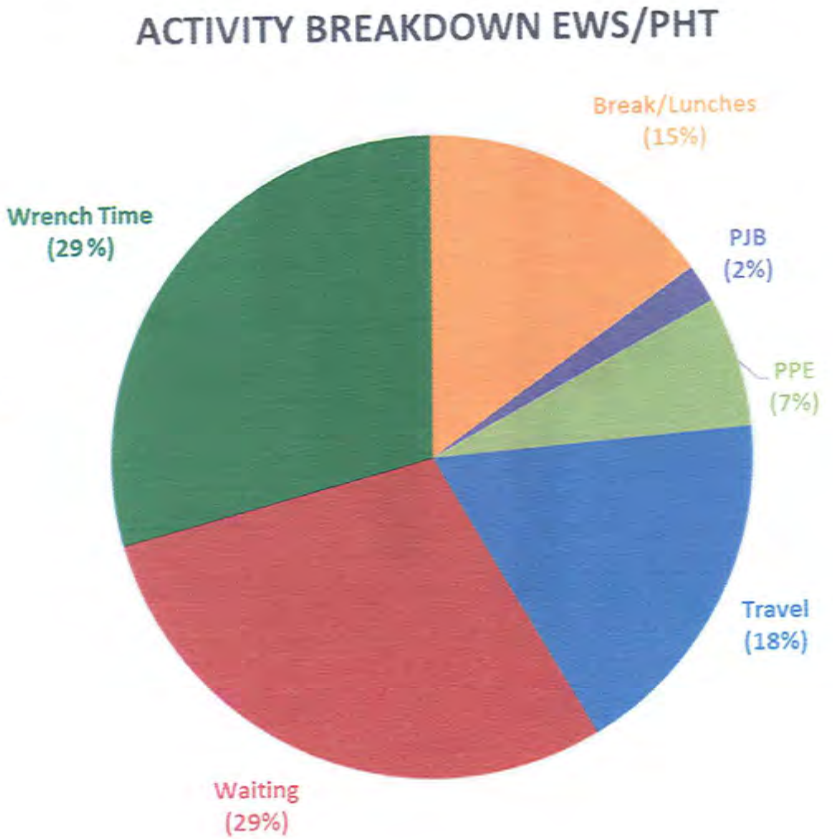
- Late starts (~ 10 minutes)
- HOR (~ 10 minutes)
- Scaffolding Adjustments (~ 1.5 hours)
- Lunches taken off site (~ 2 hours)
- Early Finishes (~ 2 hours)

Recommendations

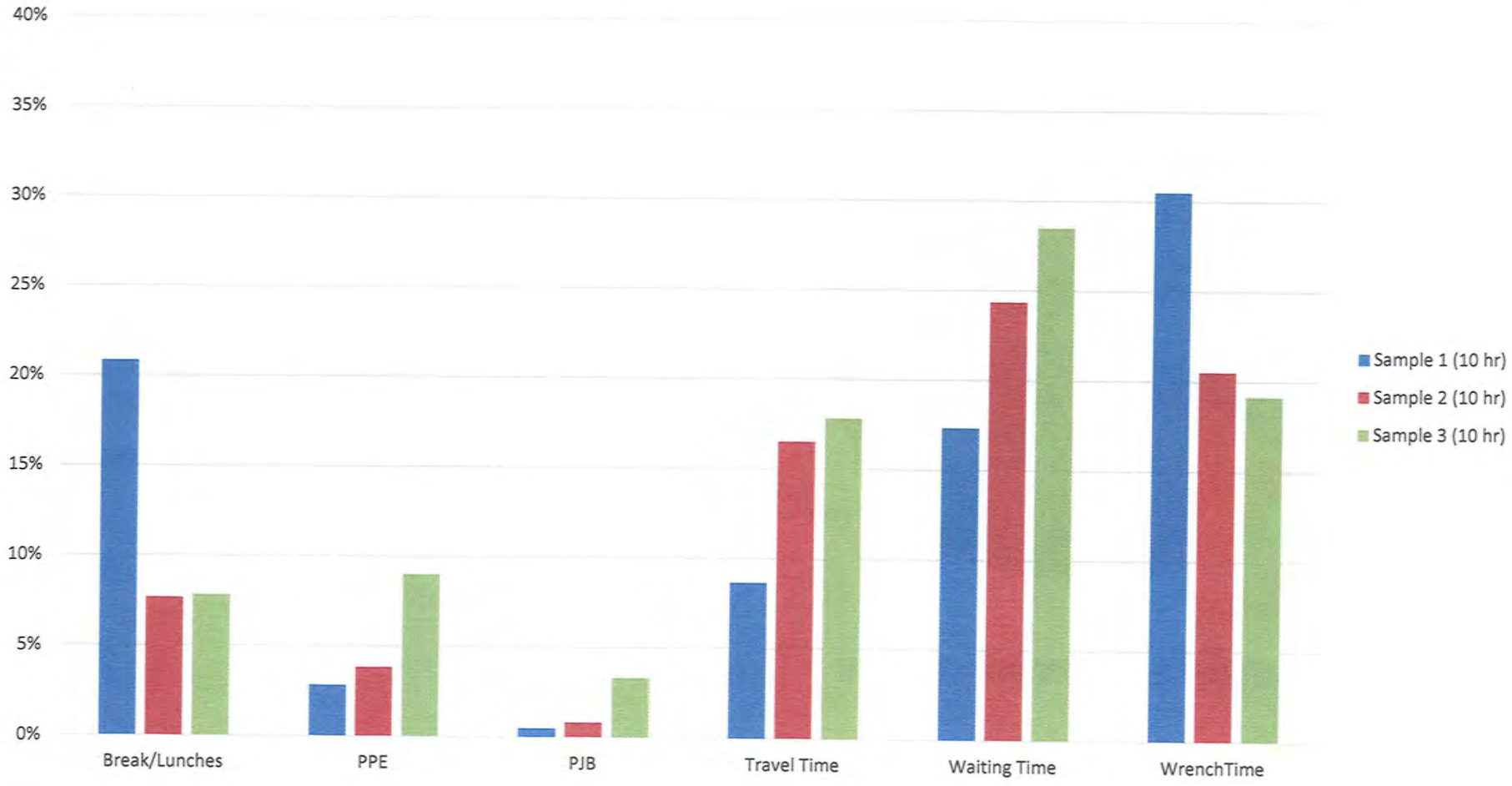
- More emphasis on the PJB
- More emphasis on oversight

Line 15 / Unique Components Work

- Three studies completed
  - One data point – L15 Work
  - Two data points – Unique Components Work



PHT / EWS Comparison of Activities Between Samples



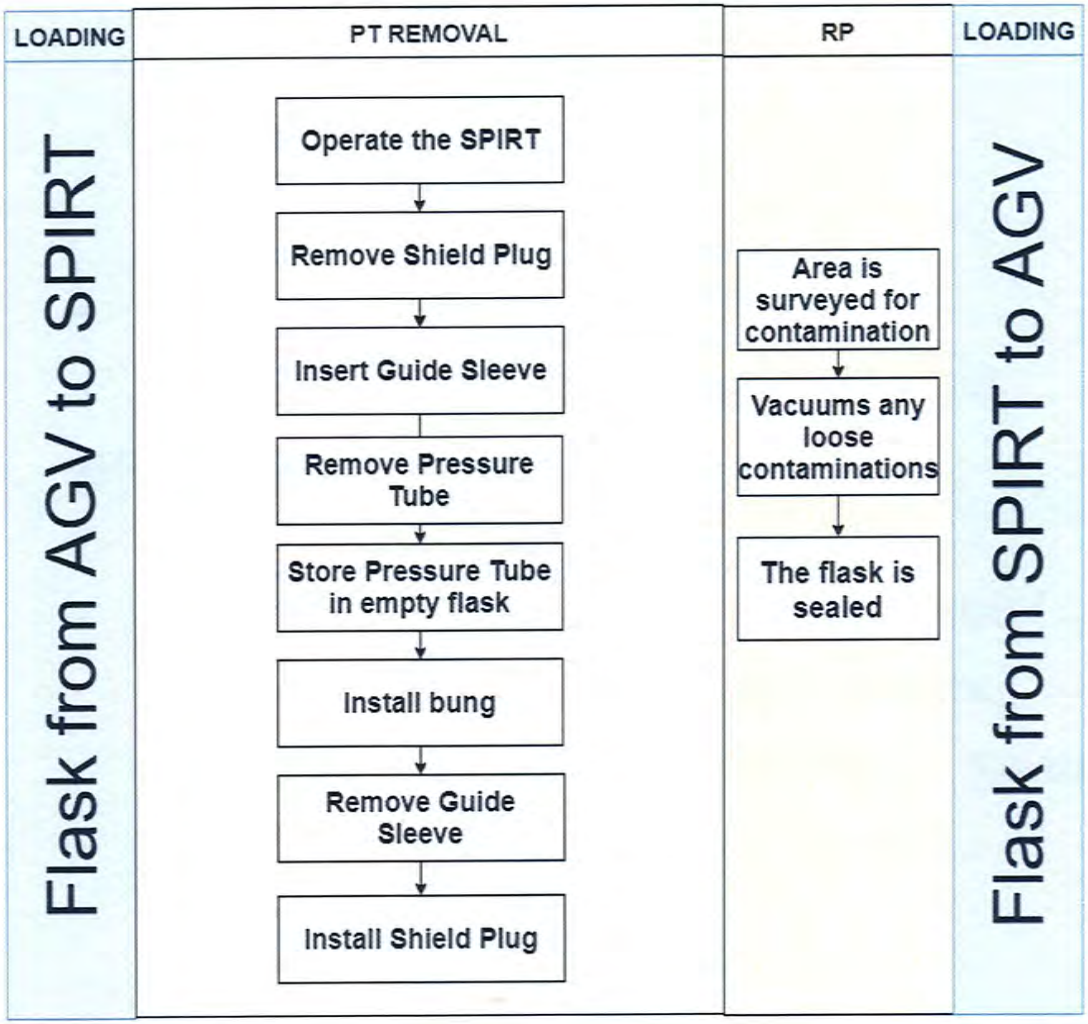
Performance Barriers– L15 / Unique Components

- Waiting around for most of the day
  - Unsynchronized lunches (~ 20 minutes)
  - Equipment retrieval (~ 1 hour)
- Confusion in the work to be executed (~ 10 minutes)

Recommendations

- More front end planning from vendor
- More urgency from the crews

Value Stream Map for Critical Path Work



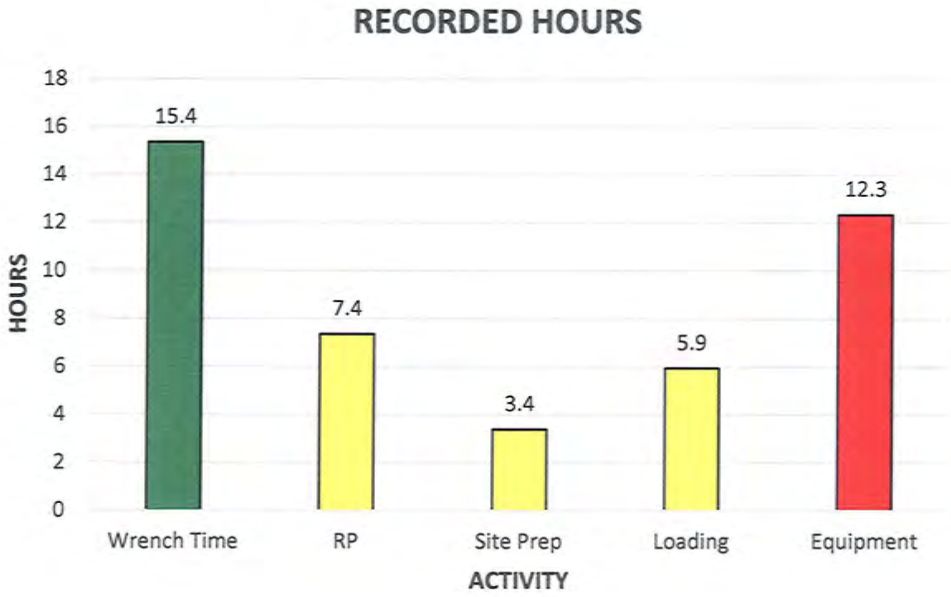
AGV = Automated Guided Vehicle

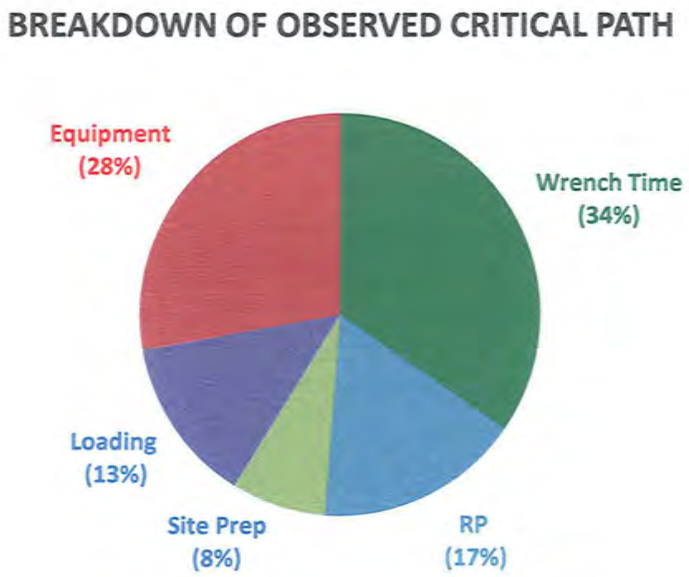
SPIRT = Shield Plug Installation and Removal Tool

Modified the Wrench Time Algorithm to follow the work instead of the crew

This algorithm was used to assess work performance for pressure tube removal

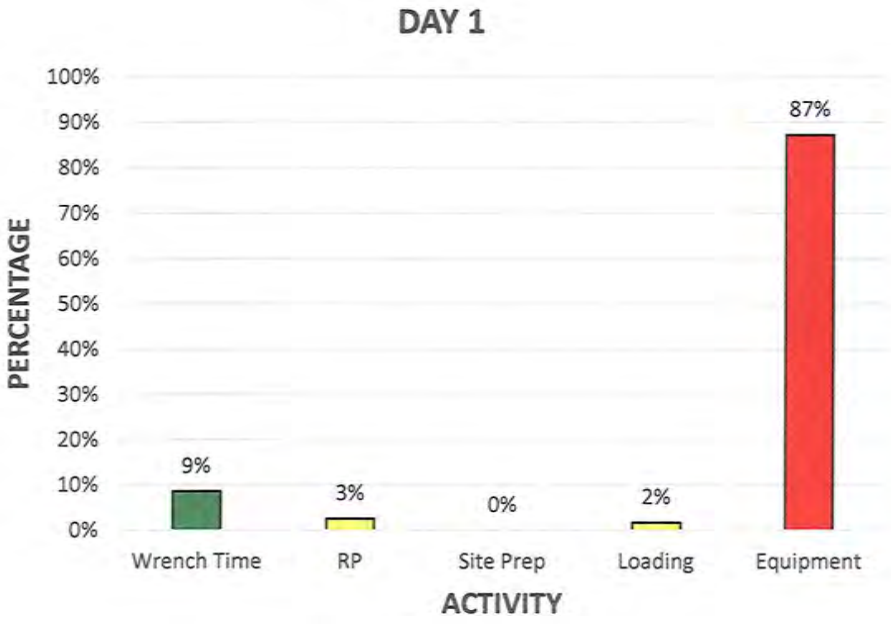
Critical Path (Pressure Tube Removal) Data Overview



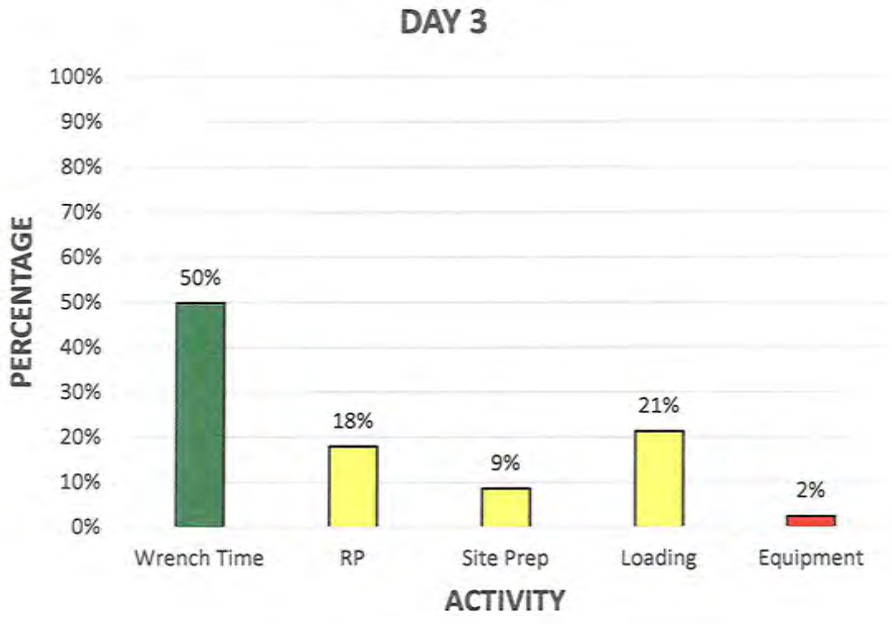


*5 Measurements

Critical Path (Pressure Tube Removal) Best Case VS Worst Case

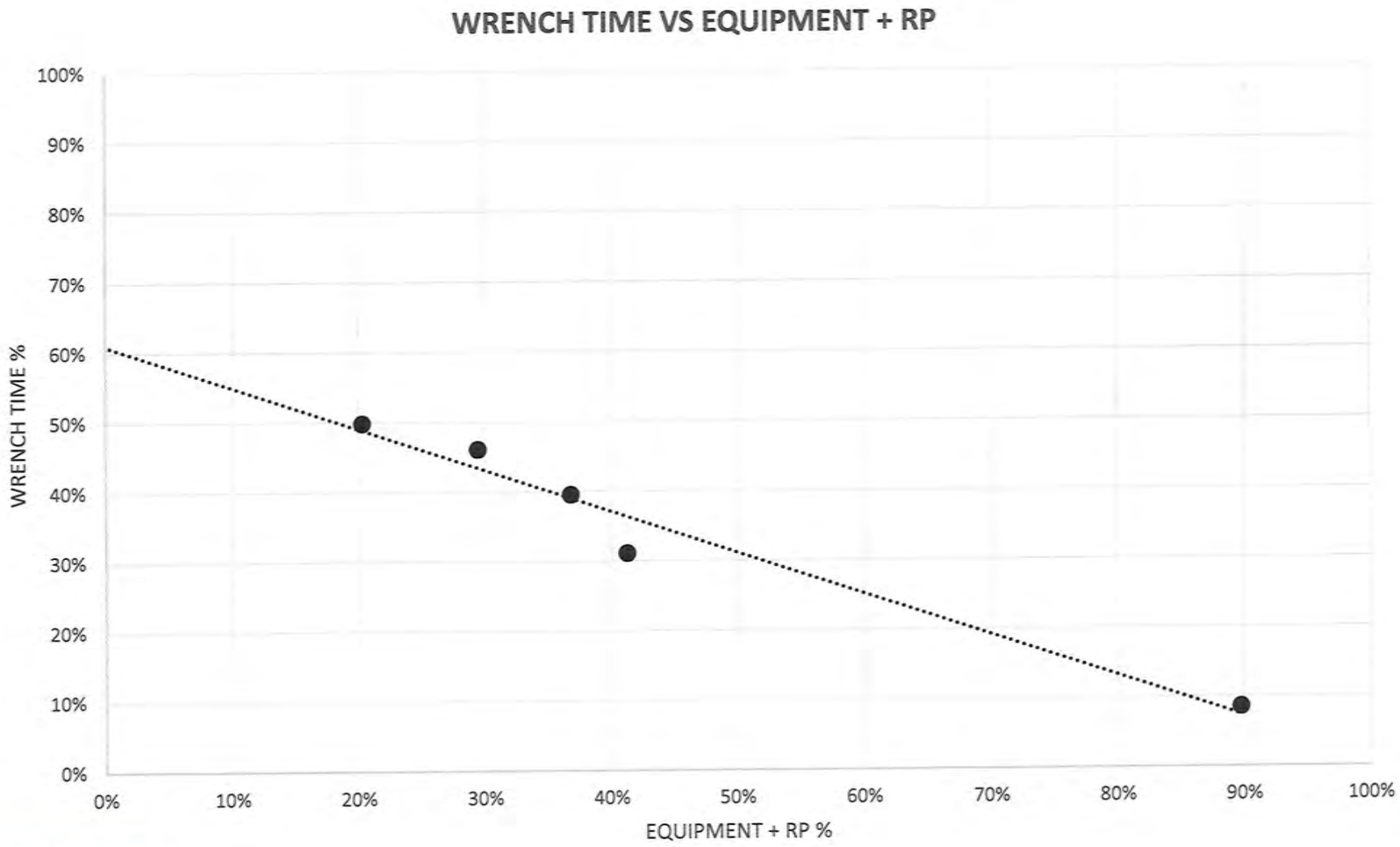


Only 1 Pressure Tube Removed



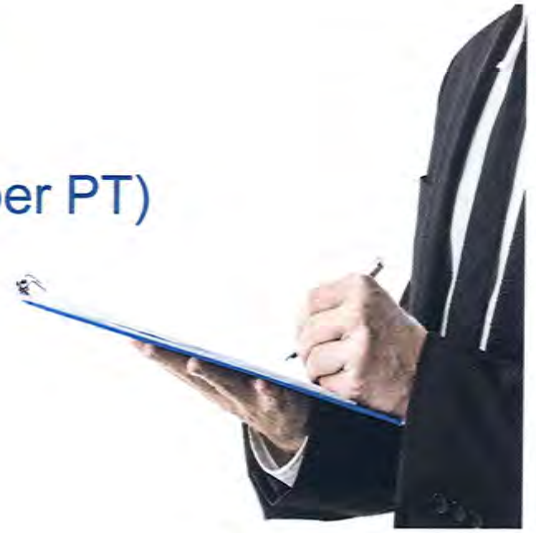
9 Pressure Tubes Removed

Critical Path (Pressure Tube Removal) Impact on Wrench Time



Performance Barriers – Critical Path

- Equipment unavailability/failure (~ 3 hours)
- Software issues (~ 15 minutes per PT)
- Frustrations with RP process (~ 10 minutes per PT)



Recommendations

- Understanding equipment failure causes
- Changing RP process

Summary of Recommendations

Primary Heat Transport

- More emphasis on pre-job brief to avoid confusion regarding the schedule
- More supervision regarding lunch hours

Moderator Valves

- Communication devices in the event of equipment failure
- Enabling RP to perform gas tests for efficient site preparation

Turbine/Generator

- More emphasis on the PJB
- More emphasis on oversight

L15/Unique Components

- More front end planning
- More urgency from the crews

Critical Path

- Understanding equipment failure causes
- Changing RP process

Acknowledgements

We would like to express our sincere gratitude to Mr. Hanrahan for providing us the opportunity to conduct this wrench time study at OPG.

We would also like to thank our professors Dr. Harvel and Dr. Sankaranarayanan for all the support they have provided.

NDL

Thank You for Attending!

NDL

Questions?

ONTARIO POWER GENERATION

Darlington NGS

Heavy Water Management Building

Estimate Report

January 9, 2012

Prepared for
Ontario Power Generation

Prepared by
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FAITHFUL GOULD
CONSTRUCTIVE EXPERTISE

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Synopsis

Faithful+Gould has been commissioned by Ontario Power Generation (OPG) under PO 00187402 Release 021 dated 22 November 2011 to provide estimating services for OPG Scope of Work 16-31555 D2O Storage Facility External Cost Estimate Preparation, for the Darlington Nuclear Generating Station.

Disclaimer

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Project ID: F+G Estimate Number: 100025545							
REV	**DESCRIPTION**	**ORIGINATOR**	**REVIEWER**	**F+G APPROVAL**	**DATE**	**CLIENT APPROVAL**	**DATE**
1	Initial submission to client	CJ	KN	TG	1/9/2012		

DNGS Heavy Water Management Facility
External Cost Estimate

Estimate Report

1 Executive Summary

This Estimate Report is in support of Darlington D_2O Heavy Water Management and Drum Handling Project for partial release and full release BCS and is based on the design information provided by OPG, which is detailed in Appendix A.

The original brief for the estimate was to produce an estimate to an accuracy level in compliance of AACE Class 3 based on the information provided. The methods we have employed to develop the estimate are consistent with those of a Class 3 estimate, being a detailed line-item level build-up. However the information available to derive rates and quantities is not consistent with the information required to develop a Class 3 estimate and has required a number of assumptions regarding to be made regarding design and specification. This is particularly true for the building structure, which accounts for approximately half of total construction cost.

Based on this assessment and on our understanding of the AACE Classification system we believe this estimate should be classified as Class 4 (see Appendix H). In order for this estimate to be classified as Class 3 we would require further information in addition to that currently available, such as specification and data sheets, general equipment arrangement drawings, civil drawings and structural drawings.

This report and associated estimate describes the estimate Business Case Summary release funding to complete the following scopes:

Partial BCS Release:

- Issue contract with a design agency for completion of scope definition, modification planning, detailed design
- OPG to start procurement of long lead items
- Construction/installation/commissioning planning
- Issue RFP for construction/installation of new facility, and select preferred vendor
- Preparation for full BCS release

Full BCS Release:

The partial BCS release will ask for sufficient funding to cover the cost of future activities:-

- Finalise construction/installation/commissioning planning
- OPG to continue procurement of long lead materials
- OPG to procure all other materials
- Issue a contract with a construction company to construct/install the new facility

- Commissioning of new facility and equipment
- Final AFS of new facility
- Design close-out
- Lessons learned report

It has been indicated by OPG that detailed Engineering will not be performed by the Contractor chosen to construct this project and is therefore excluded from the estimate. Interest, escalation and contingency are also excluded.

OPG have also indicated that procurement will be performed by OPG, rather than employing an EPC relationship with the Contractor. The OPG 'oversight' cost includes an allowance for procurement of all construction materials, including long lead and specialist items.

At all times during the establishment of this estimate, F+G were required to use their best efforts to secure independent cost information and this has been achieved with only one exception. Due to time restrictions the exception is that we have utilized the quotations for tanks which were previously provided directly to OPG. Based on our knowledge of the current market we believe these quotations are sufficiently recent to represent a current market value.

2 Estimating Scope of Work

The Project Scope of Work is the DNGS Heavy Water Management Building and to support the project strategy Faithful+Gould (F+G) utilised best practice estimating techniques to develop a release quality estimate for the identified contract strategy.

The F+G independent estimate includes for:-

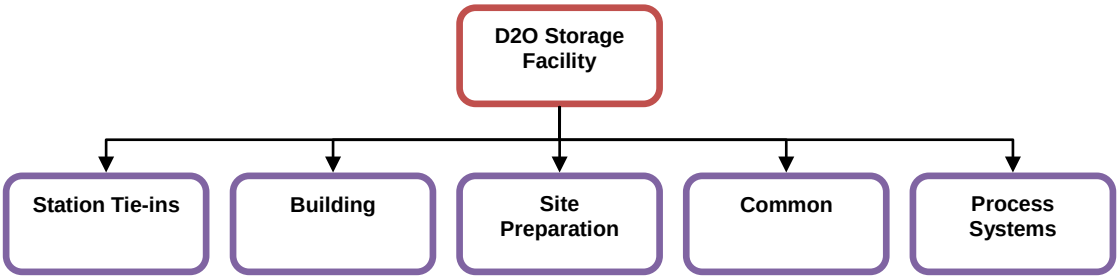
- OPG Costs including project management and supervision oversight, and procurement of all construction materials, including long lead and specialist items
- Construction labour, materials and equipment costs
- Commissioning
- Project close out cost
- EPSCA costs relating to the Principal Agreement between OPG and the Canadian Union of Skilled Workers
- SAVH allowances are included within the rate build-up of the individual craft labour rates
- CMO charges of 1.25% (percentage advised by OPG Project and Modifications) relating to the project cost

Principal Exclusions include interest, escalation, contingency, risk and historic project costs.

3 Estimate Methodology and Basis

3.1 Project Breakdown Structure (PBS)

The DNGS Heavy Water Management Building estimate has been constructed around the following Project Breakdown Structure (PBS). This structure was provided by OPG and has been used to summarise costs within the estimate:



3.2 Estimating Techniques

3.2.1 General

This project benefited by use of the latest agreed New Rules of Measurement for Order of Cost Estimating and Elemental Cost Planning as issued by the Royal Institution of Chartered Surveyors. This method of measurement ensures consistent assumptions across all building elements and provides structure to the estimate and clarity on the scope of work contained in each element.

In addition to the scope of work provided by OPG meetings were held with relevant OPG stakeholders to clarify and agree the detailed scope of work for the project, and to supplement the formal information provided.

Labour norm hours were established by use of the F+G library of past project experience for activity duration and costs and for expected deliverables. The F+G installation norm library is extensive and continues to grow, and this will be used for future sustainable estimating. Where norm hours were not available or not applicable all-in rates have been used based on industry data and experience from previous projects.

All F+G estimated contractor rates are inclusive of preliminaries to cover the anticipated costs for contractor management and staff, insurance, safety, health, welfare, impact for site agreements, protection of the works, security, small plant and tools, existing site regulations, etc.

3.2.2 Specific Estimating Method

Design reports and drawing information provided by OPG was used to produce detailed quantity and dimension measurement of the building structures and process and equipment layouts where possible. From available dimensions, all identified activity scopes per trade were measured using either imperial dimensions or the equivalent metric value.

The applied rules of building measurement were those established under Royal Institution of Chartered Surveyors New Rules of Measurement, 2010.These quantified measures were then allocated a labour norm from internationally accepted publications. The resultant base hours were then factored using a prepared Productivity Factor aligning to OPG practice and procedure (see Appendix E).

These productivity factor hours were then taken against an anticipated crew strength, taken from F+G knowledge, per category of work, to provide the total cost of each activity.

Costs for materials were realised in the general by utilising F+G data libraries and past experience, and supplemented in certain instances by contacting vendors. Rates for storage tanks were taken from the quotations previously provided to OPG and have been validated as representing current market value.

The structure of the construction works estimate follows a logical construction sequence as follows, and includes references to New Rules of Measurement and PBS to allow costs to be grouped differently if required:

- External works
- Site investigation
- Works to existing structures
- Substructures
- Superstructure

- Staircases
- Windows and external doors
- Internal walls and partitions
- Elevators, lifts and hoists
- Building services
- Miscellaneous metalwork
- Internal fittings, furnishings and equipment
- Process equipment
- Electrical control systems
- Specialist equipment

The estimate to be produced by F+G was intended to be at an AACE Class 3 level of detail. The characteristics of a Class 3 estimate are as follows:

End Usage: Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase control estimates against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.

Estimating Methods Used: Class 3 estimates usually involve more deterministic estimating methods than the stochastic methods that would be used for Class 4 of Class 5 estimates. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project.

Expected Accuracy Range: Typical accuracy ranges for Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

In conclusion from the foregoing, F+G believe that the Heavy Water Management Building estimate meets the Scope of Work requirement of +50% -30% and could be classified as overall meeting AACE Class 4 +30% -20% (low).

3.2.3 Stakeholder meetings

An initial meeting was held with OPG on Monday November 14th to introduce the project and discuss requirements. A formal kick-off meeting and site walk-down was then held on Tuesday November 22nd to discuss the scope of the project and to identify the physical location of activities on site.

Further meetings were also held on Tuesday December 20th and Thursday December 23rd with the OPG Project Team and Field Engineering, to obtain further clarification of scope and specification, to discuss progress and to clarify client requirements.

A final was convened on Friday January 6th to present the findings of the estimate and discuss final amendments before issue.

The purpose of the Stakeholder Meetings was to review the assumptions made in the Scope of Works and to verify installation scope parameters. This in turn established the confirmation of the

client requirements for the intended scope of work and/or provided an opportunity to review or revalidate previous assumptions.

3.2.4 Walk-down

The purpose of Heavy Water Management Facility site walk-down held on November 22nd 2011 was to identify and develop physical constraints, topography, site access, security requirements, material delivery and lay-down, constructability of the proposed concept scopes, confirm constraints within the installation areas, radiation protection measures, temporary power supply and service constraints, the route of safe access/egress in construction islands, existing road and ditches, demolition scopes and existing site conditions as access at height, overhead obstructions, etc. Representatives from the Project Team and the TRF attended.

The findings of the walk-down together with the assumptions made provided the F+G estimators with a degree of clarity to the proposed concepts, strategy and construction impact.

4 Estimate Assumptions

4.1 Developmental Current and Full BCS Releases

4.1.1 General

1. Norm hours have been established using F+G libraries of past experience of construction activities and as supplemented by stakeholder meetings.
2. Partial release and full release project management, procurement and close-out scope hours are as established / agreed on the relevant Scope ID Sheets.
3. All construction works are based on a single 10 hour shift, 5 days per week. This is based on a base 40 hour week, therefore an allowance is included for 2 hours overtime per day at the time-and-a-half rate. Labour rates are inclusive all burdens, overheads and profit.
4. No additional allowance has been made for extended weekend or premium time working beyond that identified above.
5. Allowance has been made for construction plant such as scaffolding, lifting platforms, excavators, generators, etc during construction.
6. Appointed Architect/Engineer design vendor will provide all issued final design with an approved Professional Engineers stamp and signature.
7. All construction areas are assumed to be classified as ‘un-zoned’ with the exception of final tie-ins and commissioning works which are Zone 3.
8. No allowance has been made for site security (other than temporary fencing).
9. No special allowance has been made for achieving LEED certification.
10. The estimate does not include costs associated with expediting procurement of long lead items. i.e. it assumes that all required materials are ready for incorporation into the works in accordance with the schedule.
11. Snow removal services are excluded and assumed to be provided by OPG.
12. Maintenance of the facility and decommissioning at end of life is excluded.

4.1.2 External Works and Site Investigation

1. There is assumed to be no asbestos or other hazardous material within the existing temporary office buildings.
2. The number and location of existing service to be removed and relocated are assumed to be as identified on information provided by the Project Team and Field Engineering. No allowance has been made for dealing with unidentified services.
3. Allowance has been made for hand excavation within a 1m width either side of identified existing services, the remained of the bulk excavation is by mechanical excavator.
4. Location and temporary diversion of identified (as advised by Field Engineering) existing underground electrical, telephone, fire hydrant and black water services. Note- permanent reinstallation is not included.
5. Allowance has been made for existing asphalt road surfaces to be removed in the area of the excavation, asphalt and kerbs are to be replaced along the two main roads on completion.
6. An allowance of 3nr portacabins for 24 months has been made to accommodate staff from the existing temporary buildings which are being removed as part of this project.
7. A CAT scan to locate existing buried services has not been included, this is assumed to be carried out by OPG.

4.1.3 Substructure

1. Earthwork support for basement excavations is assumed to be achieved using soldier piles and caisson walls, 450mm diameter concrete filled piles with waterproofing
2. Water table is assumed to be at the 97m level, dewatering has been included utilising two pumps, holding tanks, filter bags, generator set, and a 300m pipe run to dispose arisings to the intake.
3. Bulk excavation has been assumed to 84m level, with 1m being in rock. Rock anchors have been included.
4. Dike walls are assumed to be 1.5m thick.
5. There is assumed to be no interference to substructure construction activities due to inclement or winter weather conditions, although based on the proposed schedule we anticipate the impact to be minimal.
6. The total excavation volume is approximately 15,000m3; 50% of excavated material is assumed to be contaminated. Treatment of contaminated excavated material is excluded. Double handling is included for all excavated material to allow for monitoring in temporary stockpile prior to final disposal.
7. Although the volume of the tanks can be contained within a smaller volume the dike walls are assumed to continue to the 100m level. Dike walls utilise nuclear grade concrete and 150kg/m^3 epoxy coated reinforcement. Foundations for tanks include reinforcement at 120kg/m^3.

4.1.4 Superstructure

1. No allowance has been made for freight or passenger elevators
2. External walls above 100m level are assumed to be insitu concrete to 5m height, with insulated sheet metal cladding above. Concrete columns have been included to support the structural steel columns for the upper structure.

3. 6nr intermediate columns have been included from the 87m level to support the floor above.
4. 18nr columns have been included on the 100m level (center and perimeter) to support the floor above.
5. Slab thickness on the 100m level is assumed to be 400mm to allow sufficient support for loading bay and drum handling activities above. Suspended slab at 107m level is assumed to be 300mm thick.
6. Allowance has been made for the platform of open grid flooring at the 94m level for tank inspection, with 2nr steel spiral staircases for emergency access/egress.
7. Gross floor areas are: Storage area 1010m2; Drum handling 530m2; Cleanup and down graded tanks 100m2; Offices 250m2; Electrical room 250m2; HVAC room 350m2.
8. Perimeter walls to offices are assumed to be concrete filled blockwork, with acoustic drywalls within, and acoustic ceilings.
9. Concrete pavers have been included at roof level for access to HVAC units, with hand-railings at roof perimeter.
10. A two-coat epoxy floor finish is included to storage, HVAC, electrical, drum handling and cleanup areas.
11. Wall finishes in storage area are assumed to be two-coat epoxy coated, no allowance has been made for any additional specialist material for containment of D2O.
12. Floor finishes are assumed to be: Office area, carpet tiles; Washrooms, ceramic tiles.
13. The existing loading bay has been demolished and a temporary loading bay included complete with dock leveller and rolling shutters.
14. Concrete grade for all concrete works is assumed to be M35mpa.
15. A lightning arrester has been included for the main structure.

4.1.5 Building services

1. The new building includes fire detection and alarm capability as well as public announcement.
2. New offices have been provided with a dedicated HVAC system, other areas on a common system.
3. All required services to the new building and temporary site accommodation are assumed to be available for tie-in within 10m of the new structures.

4.1.6 Process systems

1. Option B tanks have been assumed, as per the conceptual design report.
2. Tank sizes are 10% greater than the required storage capacity.
3. Process pipework is assumed to be stainless steel.
4. Cathodic protection is included on all tanks.
5. One demineralised water tank of 1000 litre capacity is included as per our discussions.
6. Block heaters are provided to the storage area.
7. 2nr stack monitors have been included at a rate of $275,000 as advised by OPG, ductwork is measured separately.

4.1.7 F+G Independence

1. F+G have produced this estimate in an independent manner and have not made reference to previous estimates produced for or by OPG for this scheme. All pricing has been produced independently from knowledge of the industry and similar projects and using recognised published data, with the exception of the tank quotations which have been provided by OPG.

4.2 Productivity Factor Calculation

Productivity factors are incorporated into the estimate to allow for the conversion of norms and costs from outside the OPG site to be utilised for pricing of works within the site. These factors are based on past experience and a detailed knowledge of OPG working practices. They are heavily influenced by OPG processes and procedures and by Union Agreements. The majority of work on this project has been classified as being carried out within 'unzoned' area, with a smaller amount being within Zone 3.

The resultant productivity factors are 1.70 for unzoned areas (5.87 productive hours from a 10 hour shift), and 2.33 for Zone 3 areas (4.28 productive hours from a 10 hour shift). A detailed build-up of productivity factors is attached in Appendix E.

4.3 Crew Rates

The labour rates utilised within the estimate are based on the latest information from tendered rates received by OPG and are available for individual trades types and qualification levels. These rates have been built up into crews for each particular type of work using our experience of OPG working practices and Union requirements (see Appendix F). The resultant crew rates are applied to each estimate line item, together with the productivity factor and quantity, to arrive at a total labour cost for each activity.

Rates are based on EPSCA schedules and are inclusive of union burdens and main contractor burdens such as CPP, EI and EHT, and are inclusive of

5 Other Estimate Details

5.1 SAVH

All SAVH allowances are included the labour rates.

5.2 CMO

CMO costs are included as allowance of 1.25% on total Project Cost within the F+G submitted overnight estimate.

5.3 Escalation

Escalation is excluded from the F+G submitted overnight estimate.

5.4 Contingency

Escalation is excluded from the F+G submitted overnight estimate. These costs will need to be determined from a robust Risk Management process.

5.5 Interest

Interest is excluded from the F+G submitted overnight estimate. To be determined based on project cash flows from P6 schedule.

5.6 EPSCA

EPSCA costs are included within the labour rates in the F+G submitted overnight estimate.

5.7 Engineering Documents

Engineering costs are excluded from the F+G submitted overnight estimate.

5.8 Request for Instructions

We confirm that we have incorporated the effect of all OPG responses contained within RFIs 1 and 2, including the following specific items:

- RFI 001
    - Item 1: Disposal of excavated material – We confirm that we have included for 50% of excavate material to be disposed as contaminated waste, and 50% as uncontaminated waste.
    - Item 4: Epoxy coated rebar – We confirm that we have incorporated epoxy coated reinforcement within the seismic dike (see estimate line item 133)
- RFI 002
    - Item 18: LEED certification – We confirm that as per verbal instruction we have made no special allowances for achieving LEED certification.

6 Recommendations and Conclusion

6.1 Recommendations

a) All assumptions made should be closely monitored against any revised engineering, design development or site conditions.

b) A Risk Review should be performed to determine the appropriate level of contingency against the assessed probability of success.

c) Several assumptions have been made regarding the design and specification of the substructure and superstructure. These should be reviewed in development of contingency.

d) The estimate assumes that groundwater arising from the dewatering operation can be pumped to the inlet works for disposal. We recommend that this assumption is checked with waste management as there could be a significant cost impact if water needs to be tinkered to an alternative location.

e) The provision of spares is excluded from the estimate. We recommend that a spares list be developed which can be individually priced.

f) The estimate currently assumes that all materials are to be procured by OPG and free issued to the contractor. We would recommend however that OPG procurement be limited to long lead and specialist materials and that the contractor be responsible for procurement of general materials such as concrete, reinforcement, steelwork and cladding. The contractor

should be able to offer this service more cost effectively than OPG and may obtain preferential rates from their suppliers.

g) The estimate assumes that excavation around existing buried services is performed using vacuum excavation. We are aware that there has been difficulty in the past obtaining authorisation from waste management to utilise this technique due to the difficulty in monitoring waste material for contaminations. We recommend authorisation is sought from waste management to utilise this technique, otherwise a more costly and time consuming hand excavation will be required.

h) We have included in the estimate spreadsheet a brief summary of some life cycle costing considerations. These amount to approximately $1.2M at current day prices however we recommend that a more thorough life cycle costing exercise is carried out if these costs are required for project approval. These costs are not included in the total project cost.

i) Approximately half of the total project cost relates to excavation and substructure construction. However if the project were to be constructed above ground there would be a very substantial increase in cost for seismically qualified tanks. If OPG wishes to explore these options then more detailed value engineering exercise should be performed, taking into account construction costs, waste disposal issues and risk.

6.2 Conclusion

a) Estimates were completed for the DNGS Heavy water Management Building as summarized in Executive Summary showing a total estimated cost of $64,600,973.

b) Project scope activities and durations were established from F+ G library of past OPG projects as supplemented by stakeholder meetings. This provides a sustainable basis for Business Case submission.

c) Based on the level of design information available for estimation this estimate has been classified as AACE Class 4. However with a suitable contingency allowance derived from the estimate assumptions it should allow OPG to progress with funding approval. These costs can be further revised alongside with further developed scope and specification.

7 Appendix A – Document Register

7.1 Documents provided by OPG

The following documents were provided by OPG for use in production of this estimate:

Ref	Title
	000 Table of Contents.doc
N-FORM - 11056- R002*	00a Engineering Prejob Briefing.doc
N-FORM - 11056- R002*	00a N-FORM-11056 Eng Pre-Job Brief - Projects.pdf
N-FORM - 10958 R009*	03 N-FORM-10958 Modification Outline.doc
N-FORM - 10853 R002*	04 N-FORM-10853 PSR Determination.doc
N-FORM - 10853 R002*	04 N-FORM-10853 PSR Determination.docx
N-FORM - 10369 R011*	05 N-FORM-10369 CNSC Approvals and Notifications.doc
N-FORM - 10528 R001*	06 N-FORM-10528 Pressure Boundary Designer's Checklist.doc
N-FORM - 10560 R002*	07 N-FORM-10560 Chemistry Design Change Checklist.docx
N-FORM - 10287 R003*	09 N-FORM-10287 Fire Protection Impact Evaluation R01.docx
N-FORM - 10959 R010*	10 N-FORM-10959 Design Scoping Checklist.doc
N-FORM - 10521 R014*	12 N-FORM-10521 Document Scoping Checklist.docx
N-FORM - 10529 R002*	13 N-FORM-10529 Reactor Safety Designer's Checklist.doc
N-FORM - 10580 R005*	14 N-FORM-10580 Identifying Human Factors Level of Activity.doc
N-FORM - 10580 R005*	14 N-FORM-10580 Identifying Human Factors Level of Activity.pdf
N-FORM - 10422 R006*	15 N-FORM-10422 Environmental Impact Worksheet.doc.docx
	BOE.pdf
R00	D2O Storage Building SOW_21NOV11pdf.pdf
	Full Schedule.pdf
	Level 1 Schedule.pdf
N-FORM-10007 R016*	N-FORM-10007 (COMS Screen).docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 FINAL.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 1.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 2.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958 Part 3.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet for N-FORM-10958.docx
N-FORM-11109 R000*	N-FORM-11109 Comment and Disposition Sheet.doc
NK 38-DR000-10001	NK38-DR-38000-10001 R000 Preliminary Design Requirements for the

Ref	Title
	Darlington Heavy Water Management Building West Annex Sigend.pdf
NK 38-REP-0971-02650	NK38-REP-09701-0265054 Darlington Refurbishment D2O Facility Evaluation.pdf
NK 38-REP-10002	NK38-REP-38000-10002 Conceptual Design Report for the Heavy Water Management Building West Annex Signed.pdf
NK 38-REP-10000	N-REP-38000-10000 OPG Heavy Water Storage Management and Drum Handling.pdf
K-015634-REP-0001-R00	OPG D2O Storage Facilities Costing-K-015634-REP-0001-R00 - final.pdf
N-PCH-09701-1001	Project Charter N-PCH-09701-10001-R001.pdf
	Scope ID Worksheet_D2O Storage Building_23NOV11.xlsm
NK38-SOW-38000-10003	NK38-SOW-38000-10003 R001.pdf
	SCOP-PROC-TP-002 - Scope Identification Worksheet V 2 1 (Full Implementation) _ Original (2)_29n0v2011.xlsm
2011-005 rep	2011-005 rep DNGS D20 Storage Facility VE Final Report 20110519.pdf
	Additional Activities_09dec2011.xlsx
	Full Schedule.pdf
	Level 1 Schedule.pdf
NK38-DR-38000-10001 R000	NK38-DR-38000-10001 R000 Preliminary Design Requirements for the Darlington Heavy Water Management Building West Annex Sigend.pdf
NK38-REP-09701-0265054	NK38-REP-09701-0265054 D2O Storage Facility Evaluation.pdf
N-REP-38000-10000	N-REP-38000-10000 OPG Heavy Water Storage Management and Drum Handling.pdf
N-PCH-09701-10001-R001	Project Charter N-PCH-09701-10001-R001.pdf
	SCOP-PROC-TP-002 - ScopeID WS - Full V 3 2 (2)_05dec2011.xlsm
	SCOP-PROC-TP-002 - ScopeID WS - Full V 3 2_original_07dec2011.xlsm

8 Appendix B – Cost Summary

DNGS Heavy Water Management Building - Summary

Item	Cost		
OPG Project Management and Engineering Oversight and Procurement	$ 4,352,301	9.5% of DFC	[Benchmark: 5% to 10% DFC]
Project Management (including indirects, site based)	$ 9,120,825	20.0% of DFC	[Benchmark: 15% to 25% of DFC]
Engineering	Excluded		[Benchmark: 15% to 25% of DFC]
Construction Costs	$ 45,604,124		
Commissioning & Close out	$ 4,726,180	8.0% of TIC	[Benchmark: 4% to 8% of TIC]
Spares	Excluded		
Profit	Included		
SAVH	Included		
CMO	$ 797,543		
TOTAL	**$ 64,600,973**		

Construction Cost Summary	Cost	Labour	Materials	Construction Equipment	DFL Hours
EXTERNAL WORKS	$ 574,918	$ 171,253	$ 308,304	$ 95,361	3,216.0 hrs
SITE INVESTIGATION	$ -	$ -	$ -	$ -	-
WORKS TO EXISTING STRUCTURES	$ 33,411	$ 17,116	$ 8,225	$ 8,070	284.7 hrs
SUBSTRUCTURE	$ 11,691,224	$ 4,774,118	$ 2,534,689	$ 4,382,417	117,123.5 hrs
SUPERSTRUCTURE	$ 5,439,089	$ 3,684,953	$ 1,061,322	$ 692,814	93,998.5 hrs
STAIRCASES	$ 124,450	$ 37,335	$ 74,670	$ 12,445	555.2 hrs
WINDOWS AND EXTERNAL DOORS	$ 65,952	$ 19,786	$ 39,571	$ 6,595	327.4 hrs
INTERNAL WALLS AND PARTITIONS	$ 735,260	$ 425,016	$ 197,323	$ 112,921	10,671.0 hrs
ELEVATORS, LIFTS AND HOISTS	$ 28,602	$ 8,581	$ 17,161	$ 2,860	142.0 hrs
BUILDING SERVICES	$ 2,899,011	$ 934,863	$ 1,652,159	$ 311,989	14,937.9 hrs
MISCELLANEOUS METALWORK	$ 364,956	$ 109,487	$ 218,974	$ 36,496	1,628.2 hrs
INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT	$ 687,844	$ 220,930	$ 398,660	$ 68,255	3,623.3 hrs
PROCESS EQUIPMENT	$ 22,840,586	$ 4,586,536	$ 15,395,039	$ 2,859,011	96,310.4 hrs
ELECTRICAL CONTROL SYSTEMS	$ 104,179	$ 26,210	$ 51,075	$ 26,894	390.9 hrs
SPECIALIST EQUIPMENT	$ 14,643	$ 1,464	$ 11,714	$ 1,464	21.8 hrs
TOTAL	**$ 45,604,124**	**$ 15,017,646**	**$ 21,968,887**	**$ 8,617,592**	**343,230.9 hrs**

Construction Cost Summary by PBS	Cost	Labour	Materials	Construction Equipment	DFL Hours
Bldg 4.1.1.1	$ 338,003	$ 101,401	$ 202,802	$ 33,800	1,515.1 hrs
Bldg 4.1.1.2	$ 41,453	$ 17,072	$ -	$ 24,381	422.7 hrs
Bldg 4.1.1.5	$ 472,501	$ 141,750	$ 283,500	$ 47,250	2,077.4 hrs
Bldg 4.1.1.6	$ 104,179	$ 26,210	$ 51,075	$ 26,894	390.9 hrs
Bldg 4.1.2.1	$ 397,250	$ 119,175	$ 238,350	$ 39,725	1,746.6 hrs
Bldg 4.1.3.1	$ 142,649	$ 90,889	$ 32,405	$ 19,355	2,108.5 hrs
Bldg 4.1.3.2	$ 21,761	$ 6,528	$ 13,057	$ 2,176	95.7 hrs
Bldg 4.1.3.4	$ 54,367	$ 16,310	$ 32,620	$ 5,437	239.0 hrs
Bldg 4.1.3.5-O	$ 16,344	$ 4,903	$ 9,806	$ 1,634	71.9 hrs
Bldg 4.1.3.6-O	$ 63,560	$ 19,068	$ 32,870	$ 11,622	279.5 hrs
Bldg 4.1.3.8-O	$ 6,068	$ 1,820	$ 3,641	$ 607	26.7 hrs
Bldg 4.1.5.1	$ 79,164	$ 17,289	$ -	$ 61,875	428.1 hrs
Bldg 4.1.5.2	$ 250,025	$ 75,008	$ 150,015	$ 25,003	1,099.3 hrs
Bldg 4.1.5.2-O	$ 4,086	$ 1,226	$ 2,452	$ 409	18.0 hrs
Bldg 4.1.5.3-O	$ 54,076	$ 16,223	$ 32,445	$ 5,408	237.8 hrs
Bldg 4.1.6.1	$ 78,202	$ 23,460	$ 46,921	$ 7,820	359.9 hrs
Bldg 4.1.9.1	$ 100,906	$ 30,272	$ 60,544	$ 10,091	443.7 hrs
Bldg 4.2.1.10-O	$ 69,259	$ 20,778	$ 41,555	$ 6,926	304.5 hrs
Bldg 4.2.1.4	$ 15,460	$ 4,922	$ 8,708	$ 1,830	74.1 hrs
Bldg 4.2.10.1	$ 93,967	$ 28,190	$ 56,380	$ 9,397	407.9 hrs
Bldg 4.2.10.2	$ 4,859	$ 2,458	$ -	$ 2,402	62.5 hrs
Bldg 4.2.10.3-O	$ 10,487	$ 3,146	$ 6,292	$ 1,049	45.5 hrs
Bldg 4.2.2.1	$ -	$ -	$ -	$ -	-
Bldg 4.2.2.5	$ 374,550	$ 112,365	$ 224,730	$ 37,455	1,859.4 hrs
Bldg 4.2.2.7-O	$ 41,744	$ 12,523	$ 25,046	$ 4,174	181.2 hrs
Bldg 4.2.4.1	$ 120,000	$ -	$ -	$ 120,000	-
Bldg 4.2.4.3	$ 14,643	$ 1,464	$ 11,714	$ 1,464	21.8 hrs
Bldg 4.2.6.2	$ 24,245	$ 6,784	$ 12,258	$ 5,203	114.2 hrs
Bldg 4.4.1.1	$ 4,703,549	$ 2,807,545	$ 285,449	$ 1,610,555	75,533.6 hrs
Bldg 4.4.1.2	$ 2,677,230	$ 1,561,662	$ 122,317	$ 993,251	42,252.2 hrs
Bldg 4.4.1.3	$ 2,452	$ 735	$ 1,471	$ 245	10.9 hrs
Bldg 4.4.2.2	$ 41,983	$ 26,098	$ 947	$ 14,938	717.1 hrs
Bldg 4.4.2.2-O	$ 43,090	$ 30,786	$ -	$ 12,304	846.0 hrs
Bldg 4.4.3.1	$ 1,316,833	$ 397,007	$ 778,821	$ 141,005	6,022.5 hrs
Bldg 4.4.3.2	$ 34,398	$ 10,319	$ 20,639	$ 3,440	153.5 hrs
Bldg 4.4.3.3	$ 211,776	$ 63,533	$ 127,065	$ 21,178	946.2 hrs
Bldg 4.4.3.3-O	$ 12,461	$ 3,738	$ 7,477	$ 1,246	61.9 hrs
Bldg 4.4.3.4	$ 154,169	$ 46,251	$ 92,501	$ 15,417	684.0 hrs
Bldg 4.4.3.5-O	$ 97,815	$ 29,345	$ 58,689	$ 9,782	457.0 hrs
Bldg 4.4.5.1	$ 409,483	$ 124,581	$ 241,503	$ 43,398	2,159.6 hrs
Bldg 4.4.5.3	$ 43,458	$ 13,037	$ 26,075	$ 4,346	215.7 hrs
Bldg 4.4.6.1	$ 56,436	$ 16,931	$ 33,861	$ 5,644	280.2 hrs

Bldg 4.4.6.13-O	$ 180,041	$ 68,588	$ 93,978	$ 17,474	1,159.6 hrs
Bldg 4.4.6.14	$ -	$ -	$ -	$ -	-
Bldg 4.4.6.14-O	$ 92,006	$ 27,602	$ 55,204	$ 9,201	430.1 hrs
Bldg 4.4.6.15-O	$ 48,022	$ 43,373	$ -	$ 4,649	1,212.7 hrs
Bldg 4.4.6.1-O	$ 6,644	$ 1,993	$ 3,986	$ 664	33.0 hrs
Bldg 4.4.6.2	$ 28,876	$ 8,663	$ 17,326	$ 2,888	143.4 hrs
Bldg 4.4.6.2-O	$ 20,626	$ 6,188	$ 12,376	$ 2,063	102.4 hrs
Bldg 4.4.6.3	$ 179,538	$ 55,085	$ 106,594	$ 17,860	931.9 hrs
Bldg 4.4.6.3-O	$ 25,887	$ 12,010	$ 6,458	$ 7,419	286.7 hrs
Bldg 4.4.6.4	$ 12,422	$ 3,727	$ 7,453	$ 1,242	61.7 hrs
Bldg 4.4.6.4-O	$ 27,810	$ 8,343	$ 16,686	$ 2,781	138.1 hrs
Bldg 4.4.6.5	$ 198,852	$ 59,656	$ 119,311	$ 19,885	873.8 hrs
Bldg 4.4.6.6	$ 264,416	$ 217,967	$ 3,931	$ 42,519	6,020.9 hrs
Bldg 4.4.6.7	$ 28,602	$ 8,581	$ 17,161	$ 2,860	142.0 hrs
Bldg 4.4.7.1	$ 41,828	$ 11,666	$ 30,162	$ -	336.7 hrs
Bldg 4.4.8.1.3	$ 13,832	$ 13,832	$ -	$ -	342.5 hrs
Bldg 4.7.2.1	$ 117,182	$ 34,449	$ 55,764	$ 26,969	603.3 hrs
Bldg 4.7.2.3	$ 40,951	$ 12,285	$ 24,570	$ 4,095	182.7 hrs
Bldg 4.7.2.4	$ 96,600	$ -	$ 96,600	$ -	-
Bldg 4.7.2.5	$ 10,845	$ 2,532	$ 7,229	$ 1,085	40.2 hrs
PROC 4.2.1.1	$ 2,697,734	$ 2,502,172	$ -	$ 195,563	61,172.4 hrs
PROC 4.2.1.2	$ 159,202	$ 15,565	$ -	$ 143,637	381.2 hrs
PROC 4.2.1.3	$ 490,288	$ 177,992	$ -	$ 312,296	4,378.1 hrs
PROC 4.2.1.7	$ 280,574	$ 84,172	$ 168,344	$ 28,057	1,217.9 hrs
PROC 4.2.2.4	$ 73,182	$ 3,407	$ -	$ 69,775	83.3 hrs
PROC 4.2.5.4	$ 17,201,938	$ 1,168,757	$ 14,499,371	$ 1,533,810	17,005.0 hrs
PROC 4.2.2.6	$ 824,691	$ 247,407	$ 494,815	$ 82,469	3,659.0 hrs
PROC 4.3.5.1	$ 624,250	$ 187,275	$ 374,550	$ 62,425	2,709.7 hrs
SPRP 4.1.8.1	$ 6,810	$ 2,043	$ 3,405	$ 1,362	29.9 hrs
SPRP 4.2.12.1	$ 20,430	$ 6,129	$ 10,215	$ 4,086	91.1 hrs
SPRP 4.3.8.1	$ 3,405	$ 1,022	$ 1,703	$ 681	14.8 hrs
SPRP 4.4.7.1	$ 4,084,141	$ 1,545,505	$ 1,529,268	$ 1,009,367	38,450.0 hrs
SPRP 4.4.7.2	$ 139,787	$ 50,476	$ 55,690	$ 33,621	892.9 hrs
SPRP 4.4.7.4	$ 3,802,843	$ 2,116,207	$ 665,273	$ 1,021,363	49,046.4 hrs
SPRP 4.4.8.1	$ 15,116	$ 9,070	$ 1,512	$ 4,535	154.9 hrs
SPRP 4.7.1.2	$ 174,400	$ 34,880	$ 34,880	$ 104,640	595.8 hrs
SPRP 4.7.1.3	$ 193,620	$ 4,086	$ 8,172	$ 181,362	69.8 hrs
SRP 4.2.12.1	$ -	$ -	$ -	$ -	-
SRP 4.4.7.1	$ -	$ -	$ -	$ -	-
SRP 4.4.8.1	$ -	$ -	$ -	$ -	-
STIE 4.1.7.4	$ 13,350	$ 9,345	$ 2,002	$ 2,002	137.0 hrs
STIE 4.2.1.1	$ 12,348	$ 9,404	$ 460	$ 2,484	229.9 hrs
STIE 4.2.11.1	$ 532,906	$ 201,708	$ 64,098	$ 267,100	4,721.3 hrs
STIE 4.2.11.2	$ 5,841	$ 2,336	$ 2,336	$ 1,168	39.9 hrs
STIE 4.3.7.2	$ 13,350	$ 9,345	$ 2,002	$ 2,002	137.0 hrs
TOTAL	**$ 45,604,124**	**$ 15,017,646**	**$ 21,968,887**	**$ 8,617,592**	**343,230.9 hrs**

Subtotal (Office Costs Only)	**$ 803,682**	**$ 306,750**	**$ 399,154**	**$ 97,777**	**5,820.5 hrs**

9 Appendix C – OPG Cost Summary

DNGS Heavy Water Management Building - OPG Costs

Total Project Estimate Costs **4,352,301**

Department	Hours	Rate	Cost
IT	446		74,117
Admin	202		11,880
CMO	3,017		277,908
Department Manager	737		98,257
Design Team Leader	1,994		176,470
Project Design	10,890		987,195
Field Engineer	5,332		445,346
Station support	3,852		330,771
Project Management Office	3,912		362,567
Design Project	16,274		1,520,391
Trades	0		0
Total	**46,656**		**4,284,901**

[From US Cost Export]

DNGS Heavy Water Management Building - OPG Costs

Project : D2O STORAGE FACILITY

Code	Description	Hours	Rate	Labor Cost
EM_DTSIN	DesignContract_Technical_Specialist_Intermediate	226	155.22	35,002
EM_DTSSR	DesignContract_Technical_Specialist_Senior	221	177.39	39,114
Design Contract Total		446	**Rate**	74,117
EM_OADAS	Administrative Assistant	202	58.93	11,880
Clerical Support		202	**Rate**	11,880
EM_OCMCA	Contract Administrator	1,803	100.26	180,729
EM_OCMCM	Contract Monitor	1,058	77.04	81,539
EM_OCMFM	FLM Modifications CMO	156	100.26	15,641
CMO Total		3,017	Rate	277,908
EM_ODPMR	Department Manager	737	133.32	98,257
Department Manager Total		737	**Rate**	98,257
EM_OEDTL	Design Team Leader	1,994	88.48	176,470
Design Team Leader Total		1,994	**Rate**	176,470
EM_OEELE	Electrical Engineer	309	88.48	27,362
EM_OEICE	Instrumentation and Control	330	88.48	29,236
EM_OSMTC	Section Manager - Technical	735	97.76	71,854
EM_OEMME	Mechanical Engineer	417	88.48	36,901
EM_OESRE	Engineer Others	7,881	88.48	697,311
EM_OESTE	Structural/Civil Engineer	386	88.48	34,114
EM_OESMR	Engineer ing Section Manager	832	108.68	90,417
Project Design Total		10,890	**Rate**	987,195
EM_OFECV	Field Engineering Civil	1,274	77.04	98,149
EM_OFEEL	Field Engineering Electrical	884	77.04	68,125
EM_OFEFM	FLM Modifications FE	1,489	100.26	149,258
EM_OFEME	Field Engineering Mechanical	1,685	77.04	129,814
Field Engineering Total		5,332	**Rate**	445,346
EM_OMTFM	FLM Maintenance	996	100.26	99,820
EM_OOPFM	FLM Operations	835	100.26	83,747
EM_ORADT	Radiation Technician	560	68.29	38,208
EM_OSTCM	Control Maintainer	677	78.72	53,300
EM_OSTMM	Mechanical Maintainer	53	79.03	4,189
EM_OSTNO	Nuclear Operator	403	76.87	30,979
EM_OSTCV	Civil Maintainer	328	62.51	20,528
Station Support Total		3,852	**Rate**	330,771

DNGS Heavy Water Management Building - OPG Costs

EM_OPCMST	Cost and Schedule Technician	362	77.37	28,011
EM_OPCSA	Cost and Schedule Analyst	3,550	94.24	334,556
Project Managemnet Office Total		3,912	**Rate**	362,567
EM_OPRL1	Project MP4	8,314	88.48	735,648
EM_OPRL2	Project MP5	4,712	88.48	416,874
EM_OPRMR	Design Projects Project Manager	3,248	113.26	367,868
Design Project Total		16,274	**Rate**	1,520,391
				0
Trades Total		0		0
LABOR TOTAL		**46,656**		**4,284,901**

EQUIPMENT		
ZEXPEN	General Expenses	60,900
ZTRAVL	Travel Expenses	6,500
ZCMO_DNG	CMO Allocation	
EQUIPMENT TOTAL		**67,400**

MATERIAL		
MATERIAL TOTAL		**0**

EPSCA		
EPSCA TOTAL		**0**

10 Appendix D – Construction Cost Estimate

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
	[formulas >>>]							-						-	-		-	$ -		$ -		-	$ -
	EXTERNAL WORKS																						
	Remove existing surfaces							-						-	-		-	$ -		$ -		-	$ -
1	Clearing of Site / Site strip; 250mm deep	8.1.1.1	SPRP 4.4.7.1	56.00	30.50		1.00	1,708.00	m2		m2	PP-DMCDF	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
2	Remove existing Conc Curbs & Dispose	8.1.2.3	SPRP 4.4.7.1	150.00			1.00	150.00	m	0.02	m	CEpg364	Unzoned	1.70	5.10	Groundworks	58.54	$ 298.56	3.50	$ 524.70		-	$ -
3	Remove existing Asphalt pavement and dispose	8.1.2.3	SPRP 4.4.7.1	80.00	7.00		1.00	560.00	m2	0.03	m2	CEpg419	Unzoned	1.70	28.56	Groundworks	58.54	$ 1,671.96	10.43	$ 5,839.68		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Ground investigation							-						-	-		-	$ -		$ -		-	$ -
4	Trial trenches, 3m deep; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1				6.00	6.00	nr	3.18	nr	CEpg419	Unzoned	1.70	32.44	Groundworks	58.54	$ 1,898.87	42.27	$ 253.64		-	$ -
5	Trial trenches, 3m deep, commencing from 3m depth; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1				6.00	6.00	nr	3.18	nr	CEpg419	Unzoned	1.70	32.44	Groundworks	58.54	$ 1,898.87	42.27	$ 253.64		-	$ -
	Temporary services							-						-	-		-	$ -		$ -		-	$ -
6	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminaries		Bldg 4.7.2.5				4.00	4.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	External Lighting	64.38	$ -		$ -		-	$ -
7	Lunchroom Trailers and Washroom Trailers 22ft * 7ft 6" c.w Drying Racks, Lockers, Tables, Seating, heaters, Microwave, etc. Including transportation @$1200/mnth		Bldg 4.7.2.4				28.00	28.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
8	Temporary Offices - 3 - 20' office trailers for 28 months rental @ $750 ea per month including furniture, mobilisation and demobilisation		Bldg 4.7.2.4				28.00	28.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Site access road							-						-	-		-	$ -		$ -		-	$ -
9	Temporary road to new site	8.2.1.1	Bldg 4.7.2.1	120.00	7.00		1.00	840.00	m2		m2	ARpg429/430	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
	Temporary car parking							-						-	-		-	$ -		$ -		-	$ -
10	Car parking alternatives	8.2.1.3	Bldg 4.7.2.1	6.00	3.00		20.00	360.00	m2		m2	CEpg579	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
	Temporary Fencing, Railing and Walls							-						-	-		-	$ -		$ -		-	$ -
11	Fencing, OPG Standard Security height, 2.4m; Corner posts braced, intermediate posts at 3m centres, 1.2m set in ground, concrete surround.	8.4.1.1	Bldg 4.7.2.3	220.00			1.00	220.00	m		m	PP-DMCDF	Unzoned	1.70	-	Fencing	67.24	$ -		$ -		-	$ -
12	Pedestrian access around new site		Bldg 4.7.2.1	120.00	5.00		1.00	600.00	m2	0.02	m2	Cepg 289	Unzoned	1.70	20.40	Roadworks Crew	58.54	$ 1,194.26	0.67	$ 402.00	6.05	9.98	$ 5,989.50
13	Gates (3.6 Mx1.175 H)	8.4.1.3	Bldg 4.7.2.1				4.00	4.00	nr		nr	CE pg 336	Unzoned	1.70	-	Fencing	67.24	$ -		$ -		-	$ -
	Street Furniture							-						-	-		-	$ -		$ -		-	$ -
14	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminnaire	8.7.9.2	SPRP 4.4.7.2				5.00	5.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	External Lighting	64.38	$ -		$ -		-	$ -
15	Bollards; permanent bollard; non illuminated; galvanised steel removable and lockable pattern	8.4.4.3	SPRP 4.4.7.2				40.00	40.00	nr	0.80	nr	CEpg441	Unzoned	1.70	54.40	Concrete	62.13	$ 3,380.06	19.02	$ 760.98	131.26	216.58	$ 8,663.16
16	Turnstiles		SPRP 4.4.7.2				4.00	4.00	nr		nr	PP-WESB	Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
17	Directional signage		SPRP 4.4.7.2				10.00	10.00	nr	0.09	nr	ARpg401	Unzoned	1.70	1.53	Concrete	62.13	$ 95.06		$ -	250.00	412.50	$ 4,125.00
18	Removal of one Light post incld UG cable		SPRP 4.4.7.2				1.00	1.00	nr	0.61	nr	CEpg365	Unzoned	1.70	1.04	External Lighting	64.38	$ 66.76	68.24	$ 68.24		-	$ -
	External drainage							-						-	-		-	$ -		$ -		-	$ -
19	Sewer line connections to main line		STIE 4.2.11.2	40.00			1.00	40.00	m		m	PP-DMCDF	Zone 3	2.33	-	Groundworks	58.54	$ -		$ -		-	$ -
20	Storm water connections to main line		STIE 4.2.11.2	110.00			1.00	50.00	m		m	Rate Buildup	Zone 3	2.33	-	Groundworks	58.54	$ -		$ -		-	$ -
21	Manholes/Access chambers; 750 x 700 chamber 1500 depth to invert; includes excavation, support, backfilling and disposal, concrete base, brickwork chamber, concrete cover slab, concrete benching and channels, step irons, access cover and frames	8.6.1.5	SPRP 4.4.7.2				6.00	6.00	nr		nr	CEpg229	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
22	Valve Chambers; 1.2m diameter x 2.5m depth	8.6.1.5	SPRP 4.4.7.2				4.00	4.00	nr		nr	CEpg390	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
23	Weeper tiles (perforated pipe in drainage under slab on grade c/w Geotextile membrane and stone surround (600mm Dia)		SPRP 4.4.7.1				155.00	155.00	m					-	-	Groundworks	58.54	$ -		$ -		-	$ -
24	Excavation in rock for weeper tile (1mx1mx1m)		SPRP 4.4.7.1	155.00			1.00	155.00	m3	0.80	m3	CEpg169	Unzoned	1.70	210.80	Groundworks	58.54	$ 12,340.65	49.19	$ 7,623.91		-	$ -
	Connection to existing services							-						-	-		-	$ -		$ -		-	$ -
25	Main water line connections	8.7.1.1	Bldg 4.2.1.4	40.00			1.00	20.00	m		m	ARpg158	Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
26	Fire Hydrants		Bldg 4.2.10.2				2.00	2.00	nr	7.50	nr	MEpg253	Unzoned	1.70	25.50	Plumbers	66.47	$ 1,694.99		$ -	727.76	1,200.80	$ 2,401.61
27	CCTV cameras		Bldg 4.1.3.6-O				16.00	16.00	nr		nr	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
28	Buried Services - Appendix - F - Standby Generator Cable Duct		SPRP 4.1.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
29	Buried Services - Appendix - F - Service water - Low pressure		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
30	Buried Services - Appendix - F - Cables 500 below Ground		SPRP 4.1.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
31	Buried Services - Appendix - F- 12" Steam & 3" Condensate return		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
32	Buried Services - Appendix - F- 6" Air		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
33	Buried Services - Appendix - F- 8" Water		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
34	Buried Services - Appendix - F- Inactive Drainage		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
35	Buried Services - Appendix - F- Misc Fire Line		SPRP 4.3.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
36	Buried Services - Appendix - F-Fire Protection		SPRP 4.3.8.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
37	Buried Services - Appendix - F-Helium		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
38	Buried Services - Appendix - F- Oxygen		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
39	Buried Services - Appendix - F-Argon		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
40	Buried Services - Appendix - F-Nitrogen		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
41	Buried Services - Appendix - F-Box Drain Sump		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
42	Buried Services - Appendix - F-600 mm Dia Corrugated Steel Pipe CSP Yard Drainage		SPRP 4.2.12.1	1.00			1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
43	Relocate Existing Cable Duct from Standby Generators OIL Tanks # 1 & 2		SPRP 4.2.12.1	50.00			1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
44	Relocate existing Low Pressure Service Water open system piping.		SPRP 4.2.12.1	30.00			1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
	Demolition/removal of existing structures							-						-	-		-	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
45	Demolition of existing building (Offices)	9.2.1.1	SPRP 4.4.8.1	7.00	3.00	2.50	3.00	157.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
46	Demolition of existing underground services (Offices)	9.2.1.2	SPRP 4.4.8.1	7.00	3.00	0.50	3.00	31.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
47	Temporary Terminating of services	9.4.1.2	Bldg 4.7.2.5				4.00	4.00	nr		nr	MEpg226	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Asphalt road							-						-	-		-	$ -		$ -		-	$ -
48	Reinstatement of Asphalt road (incld roadbase)		SPRP 4.4.7.2	40.00	4.00		1.00	160.00	m2		m2	ARpg429/430	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
49	New Kerbs at roads (reinstated road portions)		SPRP 4.4.7.2	64.00			1.00	64.00	m		m	CE pg 80	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
50	Line painting;Continuous line in reflectorised white 200mm wide		SPRP 4.4.7.2	160.00			1.00	160.00	m		m	CEpg439	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
51	Road signs		SPRP 4.4.7.2				4.00	4.00	nr		nr	ARpg155	Unzoned	1.70	-	Roadworks Crew	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 24,540.05**		**$ 15,726.79**			**$ 21,179.27**
	SITE INVESTIGATION																						
52	CAT scan of existing buried services and other obstacles	9.5.3.1	SPRP 4.4.7.1				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	WORKS TO EXISTING STRUCTURES																						
53	Remove existing Loading bay and Dock	7.1.1.1	SPRP 4.4.8.1	6.00	5.50	2.50	1.00	82.50	m3		m3	CE pg162	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
54	Cut and patch at new openings for pipes	7.1.1.2	SPRP 4.4.7.2				50.00	50.00	nr		nr		Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
55	New door for Access to new building	7.1.1.2	Bldg 4.4.6.1				1.00	1.00	nr		nr	ARp141	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Minor building works							-						-	-		-	$ -		$ -		-	$ -
56	Repairs to existing building after Ramp removal	8.8.1.1	SPRP 4.4.7.2	25.00	5.00		1.00	125.00	m2		m2	ARp489	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
57	Repairs to existing building after Loading dock removal	8.8.1.3	SPRP 4.4.7.2	5.00	5.00		1.00	25.00	m2		m2	ARp489	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	SUBSTRUCTURE																						
	EXCAVATION							-						-	-		-	$ -		$ -		-	$ -
	Bulk excavation							-						-	-		-	$ -		$ -		-	$ -
58	Vacuum Excavation (uptp 2.5 M) at buried services (4 weeks@$40,000/week		SPRP 4.7.1.2				4.00	4.00	wks					-	-	Groundworks	58.54	$ -		$ -		-	$ -
59	Hand Excavation around buried services		SPRP 4.4.7.1	25.00	0.30	0.30	4.00	9.00	m3	3.15	m3	CE pg 183	Unzoned	1.70	48.20	Groundworks	58.54	$ 2,821.43		$ -		-	$ -
60	Bulk excavation for tank farm; 10-15m max depth		SPRP 4.4.7.1	24.50	50.00	12.50		15,312.50	m3	0.29	m3	CEpg169	Unzoned	1.70	7,549.06	Groundworks	58.54	$ 441,937.22	17.79	$ 272,363.44		-	$ -
61	Extra over for excavation in rock; 1.0-2.0m maximum depth		SPRP 4.4.7.1	24.50	50.00	1.00		1,225.00	m3	0.80	m3	CEpg168	Unzoned	1.70	1,666.00	Groundworks	58.54	$ 97,530.97	49.19	$ 60,253.46		-	$ -
62	Disposal of excavated material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4	15,312.50				15,312.50	m3	0.05	m3	CEpg171	Unzoned	1.70	1,301.56	Groundworks	58.54	$ 76,196.07	4.22	$ 64,680.00		-	$ -
63	Disposal of excavated rock material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.06	m3	CEpg171	Unzoned	1.70	124.95	Groundworks	58.54	$ 7,314.82	5.08	$ 6,225.45		-	$ -
64	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.23	m3	CEpg171	Unzoned	1.70	478.98	Groundworks	58.54	$ 28,040.15	22.23	$ 27,226.24		-	$ -
65	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	7,656.25				7,656.25	m3	0.22	m3	CEpg171	Unzoned	1.70	2,863.44	Groundworks	58.54	$ 167,631.36	21.25	$ 162,710.63		-	$ -
66	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper; ADDITIONAL for contaminated sludge		SPRP 4.4.7.4	7,656.25				7,656.25	m3		m3	CEpg171	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
67	Disposal of excavated material from temporary spoil heap to licensed tip; Un-contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	7,656.25				7,656.25	m3	0.22	m3	CEpg171	Unzoned	1.70	2,863.44	Groundworks	58.54	$ 167,631.36	21.25	$ 162,710.63		-	$ -
68	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	15,312.50				15,312.50	m3	0.12	m3	CEpg171	Unzoned	1.70	3,123.75	Groundworks	58.54	$ 182,870.57	8.81	$ 134,918.44		-	$ -
69	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	1,225.00				1,225.00	m3	0.20	m3	CEpg171	Unzoned	1.70	416.50	Groundworks	58.54	$ 24,382.74	14.70	$ 18,009.34		-	$ -
70	Contaminated waste disposal fees (766 loads x 10 = 7660 M3)		SPRP 4.4.7.4	765.63				765.63	loads			not included	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Detailed excavation							-						-	-		-	$ -		$ -		-	$ -
71	Detailed excavation for 100Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	3.14	9.00	1.50	19.00	805.82	m3	0.80	m3	CEpg169	Unzoned	1.70	1,095.91	Groundworks	58.54	$ 64,156.95	49.19	$ 39,635.39		-	$ -
72	Detailed excavation for 50Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	3.14	6.25	1.50	2.00	58.90	m3	0.80	m3	CEpg169	Unzoned	1.70	80.11	Groundworks	58.54	$ 4,689.84	49.19	$ 2,897.32		-	$ -
73	Detailed excavation for 25Mg tanks; in rock	1.1.1.1	SPRP 4.4.7.1	3.14	5.06	1.50	4.00	95.43	m3	0.80	m3	CEpg169	Unzoned	1.70	129.78	Groundworks	58.54	$ 7,597.53	49.19	$ 4,693.66		-	$ -
74	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	24.50	1.70	1.00	2.00	83.30	m3	0.80	m3	CEpg169	Unzoned	1.70	113.29	Groundworks	58.54	$ 6,632.11	49.19	$ 4,097.24		-	$ -
75	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1	50.00	1.70	1.00	2.00	170.00	m3	0.80	m3	CEpg169	Unzoned	1.70	231.20	Groundworks	58.54	$ 13,534.91	49.19	$ 8,361.71		-	$ -
76	Excavation for Inspection pit	1.1.1.1	SPRP 4.4.7.1	5.50	5.50	13.00	1.00	393.25	m3	0.29	m3	CEpg169	Unzoned	1.70	193.87	Groundworks	58.54	$ 11,349.67	17.79	$ 6,994.74		-	$ -
77	Excavation for Inspection pit ; in rock	1.1.1.1	SPRP 4.4.7.1	5.50	5.50	3.00	1.00	90.75	m3	0.80	m3	CEpg169	Unzoned	1.70	123.42	Groundworks	58.54	$ 7,225.25	49.19	$ 4,463.67		-	$ -
78	Detail Excavation for Weeper Tiles in Rock	1.1.1.1	SPRP 4.4.7.1	172.00	0.40	0.35	1.00	24.08	m3	0.80	m3	CEpg169	Unzoned	1.70	32.75	Groundworks	58.54	$ 1,917.18	49.19	$ 1,184.41		-	$ -
79	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4	25.50	0.40	15.00	2.00	306.00	m3	0.22	m3	CEpg171	Unzoned	1.70	114.44	Groundworks	58.54	$ 6,699.78	21.25	$ 6,503.11		-	$ -
80	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4	51.00	0.40	15.00	2.00	612.00	m3	0.22	m3	CEpg171	Unzoned	1.70	228.89	Groundworks	58.54	$ 13,399.56	21.25	$ 13,006.22		-	$ -
81	Disposal of excavated rock material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.06	m3	CEpg171	Unzoned	1.70	135.48	Groundworks	58.54	$ 7,931.53	5.08	$ 6,750.32		-	$ -
82	Disposal of excavated material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4	393.25				393.25	m3	0.05	m3	CEpg171	Unzoned	1.70	33.43	Groundworks	58.54	$ 1,956.84	4.22	$ 1,661.09		-	$ -

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
83	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.23	m3	CEpg171	Unzoned	1.70	519.36	Groundworks	58.54	$ 30,404.21	22.23	$ 29,521.67		-	$ -
84	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4	393.25				393.25	m3	0.22	m3	CEpg171	Unzoned	1.70	147.08	Groundworks	58.54	$ 8,610.09	21.25	$ 8,357.35		-	$ -
85	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	393.25				393.25	m3	0.12	m3	CEpg171	Unzoned	1.70	80.22	Groundworks	58.54	$ 4,696.41	8.81	$ 3,464.93		-	$ -
86	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4	1,328.28				1,328.28	m3	0.20	m3	CEpg171	Unzoned	1.70	451.61	Groundworks	58.54	$ 26,438.44	14.70	$ 19,527.70		-	$ -
87	Contaminated waste disposal fees	1.2.1.2	SPRP 4.4.7.4	39.33				39.33	loads	0.22		CEpg171	Unzoned	1.70	14.71	Groundworks	58.54	$ 861.01		$ -		-	$ -
	Earthwork support							-						-	-		-	$ -		$ -		-	$ -
88	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter cast-in-place piles; 20N/mm2 concrete; nominal reinforcement	8.8.3.1	SPRP 4.4.7.1			14.00	504.00	7,056.00	m		m	CEpg453	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
89	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter empty bores	8.8.3.1	SPRP 4.4.7.1			14.00	504.00	7,056.00	m		m	CEpg453	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
90	Trimming material other than topsoil, rock or artificial hard material; using D4H dozer, tractor loader or motor grader average rate to sides of caisson walls; 45-90° to horizontal	8.8.3.1	SPRP 4.4.7.1	149.00		12.50	1.00	1,862.50	m2	0.06	m2	CEpg170	Unzoned	1.70	189.98	Groundworks	58.54	$ 11,121.52	2.06	$ 3,841.41		-	$ -
91	Trimming rock; using D6E dozer; vertical to sides of caisson walls	8.8.3.1	SPRP 4.4.7.1	149.00			1.00	149.00	m2	1.06	m2	CEpg170	Unzoned	1.70	268.50	Groundworks	58.54	$ 15,718.41	39.55	$ 5,893.02		-	$ -
92	Steel in Caissons (Soldier Piles) IPN 280 @ 54Kgs/LM; 203 x 203 mm; length 15m		SPRP 4.4.7.1				30.00	30.00	nr		nr	CEpg267	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
93	Waterproofing to sides of wall (inside face); Bituthene 4000; lapped joints; at any inclination	1.3.1.1	SPRP 4.4.7.1	149.00		15.00	1.00	2,235.00	m2	0.08	m2	CEpg479	Unzoned	1.70	303.96	Groundworks	58.54	$ 17,794.43	2.16	$ 4,830.95	12.84	21.19	$ 47,350.71
94	Shoring for inspection pit	8.8.3.1	SPRP 4.4.7.1	28.00		16.00	1.00	448.00	m2				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Dewatering							-						-	-		-	$ -		$ -		-	$ -
95	Dewatering equipment (rental 3months)	9.3.1.1	SPRP 4.7.1.3				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
96	Holding tanks and filter bags(rental 3months)	9.3.1.1	SPRP 4.7.1.3				1.00	1.00	item				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
97	75mm pipes for temp dewatering - 2 lines for 300m length discharge to Intake		SPRP 4.7.1.3	600.00			1.00	600.00	m				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
98	Pumps rental (3 months) 600 V - 2 ea		SPRP 4.7.1.3				6.00	6.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
99	Diesel Genset for Pumps rental (3 months)		SPRP 4.7.1.3				6.00	6.00	mnths				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
100	Diesel fuel (50 liters daily for 60 daysx2 ea)		SPRP 4.7.1.3	1.00	1.00	1.00	6,000.00	6,000.00	litres				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	BELOW GROUND CONSTRUCTION							-						-	-		-	$ -		$ -		-	$ -
	Slab on grade							-						-	-		-	$ -		$ -		-	$ -
101	Level and compact bottoms of excavations	1.4.1.1	Bldg 4.4.7.1	21.50	47.00		1.00	1,010.50	m2	0.08	m2	CEpg170	Unzoned	1.70	137.43	Groundworks	58.54	$ 8,045.31	29.85	$ 30,161.91		-	$ -
102	Formwork to sides of slab on grade; plane vertical; width 0.3m	1.4.1.1	Bldg 4.4.1.1	137.00		0.30	1.00	41.10	m2	0.70	m2	CEpg 192	Unzoned	1.70	48.91	Concrete	62.13	$ 3,038.89	13.41	$ 551.34	9.47	15.63	$ 642.21
103	Reinforcement to insitu concrete slab; 100kg/m3; deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.4.1.1	Bldg 4.4.1.2				30.50	30.50	MT	6.15	Tonne	CEpg196	Unzoned	1.70	318.88	Concrete	62.13	$ 19,812.98	149.94	$ 4,573.03	682.96	1,126.88	$ 34,369.76
104	Insitu concrete slab on grade; Grade C40 cement; 300mm thick	1.4.1.1	Bldg 4.4.1.1	21.50	47.00	0.30	1.00	303.15	m3	0.18	m3	CEpg190/187	Unzoned	1.70	92.76	Concrete	62.13	$ 5,763.75	19.06	$ 5,777.28		225.00	$ 68,208.75
105	Less: Pad foundations for tanks	1.4.1.1	Bldg 4.4.1.1				(80.00)	(80.00)	m3	0.18	m3	CEpg190/187	Unzoned	1.70	(24.48)	Concrete	62.13	$ (1,521.03)	19.06	$ (1,524.60)		225.00	$ (18,000.00)
106	Surface finish to insitu concrete slab on grade; Float finish		Bldg 4.4.1.1	21.50	47.00		1.00	1,010.50	m2	0.02	m2	CEpg 202	Unzoned	1.70	34.36	Concrete	62.13	$ 2,134.72		$ -		-	$ -
107	Weeping tiles below slab on grade; 225mm pipes unplasticized pvc pipes	1.4.1.8	Bldg 4.4.1.1	172.00			1.00	172.00	m	0.07	m	CEpg222	Unzoned	1.70	20.47	Groundworks	58.54	$ 1,198.24	0.74	$ 127.71	72.06	118.90	$ 20,450.63
	Pad foundations for tanks							-						-	-		-	$ -		$ -		-	$ -
108	Formwork for 19 - 100 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	3.50	2.00	19.00	835.66	m2	0.52	m2	CEpg192	Unzoned	1.70	738.73	Concrete	62.13	$ 45,899.67	9.97	$ 8,328.22	10.79	17.80	$ 14,877.74
109	Formwork for 2 - 50 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	2.75	1.75	2.00	60.48	m2	0.52	m2	CEpg192	Unzoned	1.70	53.46	Concrete	62.13	$ 3,321.69	9.97	$ 602.70	10.79	17.80	$ 1,076.68
110	Formwork for 4 - 25 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1	6.28	2.50	1.50	4.00	94.25	m2	0.52	m2	CEpg192	Unzoned	1.70	83.32	Concrete	62.13	$ 5,176.65	9.97	$ 939.27	10.79	17.80	$ 1,677.94
111	Reinforcement in Tank Foundations (150 Kgs/M3); deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.1.1.1	Bldg 4.4.1.2				249.38	249.38	MT	6.15	Tonne	CEpg196	Unzoned	1.70	2,607.22	Concrete	62.13	$ 161,995.43	149.94	$ 37,390.17	682.96	1,126.88	$ 281,015.05
112	Concrete for 19 - 100 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	12.25	2.00	19.00	1,462.41	m3	0.15	m3	CEpg190/187	Unzoned	1.70	372.91	Concrete	62.13	$ 23,170.51	15.97	$ 23,357.63		225.00	$ 329,042.56
113	Concrete for 2- 50 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	7.56	1.75	2.00	83.15	m3	0.15	m3	CEpg190/187	Unzoned	1.70	21.20	Concrete	62.13	$ 1,317.50	15.97	$ 1,328.14		225.00	$ 18,709.66
114	Concrete for 4 - 25 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1	3.14	6.25	1.50	4.00	117.81	m3	0.15	m3	CEpg190/187	Unzoned	1.70	30.04	Concrete	62.13	$ 1,866.58	15.97	$ 1,881.66		225.00	$ 26,507.19
115	Connection to main inspection pit (600 dia PVC)	1.4.1.8	Bldg 4.4.1.1	50.00				50.00	m				Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
	Inspection chamber							-						-	-		-	$ -		$ -		-	$ -
116	Formwork in Inspection Chamber -Base slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	10.50		0.30	1.00	3.15	m2	0.38	m2	CEpg193	Unzoned	1.70	2.03	Concrete	62.13	$ 126.44	7.28	$ 22.92	12.86	21.22	$ 66.84
117	Formwork in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	10.00		15.00	1.00	150.00	m2	0.48	m2	CEpg193	Unzoned	1.70	122.40	Concrete	62.13	$ 7,605.14	9.21	$ 1,381.05	21.08	34.78	$ 5,217.30
118	Formwork in Inspection Chamber -Walls	1.4.1.8	Bldg 4.4.1.1	11.60		15.00	1.00	174.00	m2	0.48	m2	CEpg193	Unzoned	1.70	141.98	Concrete	62.13	$ 8,821.96	9.21	$ 1,602.02	21.08	34.78	$ 6,052.07
119	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	2.50	2.50		1.00	6.25	m2	0.38	m2	CEpg193	Unzoned	1.70	4.04	Concrete	62.13	$ 250.86	7.28	$ 45.48	12.86	21.22	$ 132.62
120	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	11.60		0.30	1.00	3.48	m2	0.38	m2	CEpg193	Unzoned	1.70	2.25	Concrete	62.13	$ 139.68	7.28	$ 25.32	12.86	21.22	$ 73.84
121	Reinforcement in Inspection Chamber (150kgs/m3)	1.4.1.8	Bldg 4.4.1.2				1.00	1.00	MT	6.15	Tonne	CEpg196	Unzoned	1.70	10.46	Concrete	62.13	$ 649.61	149.94	$ 149.94	682.96	1,126.88	$ 1,126.88
122	Concrete in Inspection Chamber - Blinding; 150-300mm thick	1.4.1.8	Bldg 4.4.1.1	2.60	2.60	0.20	1.00	1.35	m3	0.16	m3	CEpg189/187	Unzoned	1.70	0.37	Concrete	62.13	$ 22.85	3.27	$ 4.42		225.00	$ 304.20
123	Concrete in Inspection Chamber - Base Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1	2.60	2.60	0.25	1.00	1.69	m3	0.18	m3	CEpg190/187	Unzoned	1.70	0.52	Concrete	62.13	$ 32.13	19.06	$ 32.21		225.00	$ 380.25
124	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	2.90	0.25	15.00	2.00	21.75	m3	0.22	m3	CEpg190/187	Unzoned	1.70	8.13	Concrete	62.13	$ 505.42	23.30	$ 506.73		225.00	$ 4,893.75
125	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1	2.50	0.25	15.00	2.00	18.75	m3	0.22	m3	CEpg190/187	Unzoned	1.70	7.01	Concrete	62.13	$ 435.71	23.30	$ 436.84		225.00	$ 4,218.75
126	Concrete in Inspection Chamber - Top Slab	1.4.1.8	Bldg 4.4.1.1	2.90	2.90	0.25	1.00	2.10	m3	0.18	m3	CEpg190/187	Unzoned	1.70	0.64	Concrete	62.13	$ 39.97	19.06	$ 40.07		225.00	$ 473.06

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
	Basement Walls							-						-	-		-	$ -		$ -		-	$ -
127	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1	21.50	1.50	2.00	1.00	64.50	m2	0.47	m2	CEpg192	Unzoned	1.70	51.54	Concrete	62.13	$ 3,202.08	9.14	$ 589.59	9.47	15.63	$ 1,007.84
128	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1	47.00	1.50	2.00	1.00	141.00	m2	0.47	m2	CEpg192	Unzoned	1.70	112.66	Concrete	62.13	$ 6,999.90	9.14	$ 1,288.88	9.47	15.63	$ 2,203.20
129	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1	24.50	2.00	1.50	2.00	147.00	m3	0.15	m3	CEpg190/187	Unzoned	1.70	37.49	Concrete	62.13	$ 2,329.07	15.97	$ 2,347.88		225.00	$ 33,075.00
130	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1	47.00	2.00	1.50	2.00	282.00	m3	0.15	m3	CEpg190/187	Unzoned	1.70	71.91	Concrete	62.13	$ 4,468.02	15.97	$ 4,504.10		225.00	$ 63,450.00
131	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1	21.50	2.00	13.00	1.00	559.00	m2	0.48	m2	CEpg193	Unzoned	1.70	456.14	Concrete	62.13	$ 28,341.82	9.21	$ 5,146.71	21.08	34.78	$ 19,443.14
132	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1	47.00	2.00	13.00	1.00	1,222.00	m2	0.48	m2	CEpg193	Unzoned	1.70	997.15	Concrete	62.13	$ 61,956.54	9.21	$ 11,250.95	21.08	34.78	$ 42,503.60
133	Reinforcement in Walls/Dikes (@120kgs/M3)	1.3.1.1	Bldg 4.4.1.2				1.00	420.00	MT	6.15	Tonne	CEpg196	Unzoned	1.70	4,391.10	Concrete	62.13	$ 272,834.41	149.94	$ 62,972.91	682.96	1,126.88	$ 473,288.51
134	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1	24.50	1.50	13.00	2.00	955.50	m3	0.22	m3	CEpg190/187	Unzoned	1.70	357.36	Concrete	62.13	$ 22,203.84	23.30	$ 22,261.24		225.00	$ 214,987.50
135	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1	47.00	1.50	13.00	2.00	1,833.00	m3	0.22	m3	CEpg190/187	Unzoned	1.70	685.54	Concrete	62.13	$ 42,595.12	23.30	$ 42,705.23		225.00	$ 412,425.00
	Concrete Ancillaries							-						-	-		-	$ -		$ -		-	$ -
136	Step ladders inside Inspection Chamber	1.4.1.8	Bldg 4.4.3.3				50.00	50.00	nr		nr	CEpg228	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
137	Manhole cover to inspection chamber; Complete with frame; Bed and set in concrete; access cover and frame	1.4.1.8	Bldg 4.4.3.3				1.00	1.00	nr		nr	CEpg228	Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
138	Rock anchors; 25mm diameter; 2m length; including drilling, steel and grout	1.4.1.9	Bldg 4.4.1.2				12.00	12.00	nr		nr	CEpg154/MEpg652	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
139	Rock Anchors 25mm - 2M Deep; including drilling, steel and grout	1.1.1.1	Bldg 4.4.1.2				421.00	421.00	nr		nr	CEpg154/MEpg652	Unzoned	1.70	-	Groundworks	58.54	$ -		$ -		-	$ -
140	Rock anchors 25mm 2M length for Dike wall		Bldg 4.4.1.2				145.00	145.00	nr					-	-	Groundworks	58.54	$ -		$ -		-	$ -
141	Insulation at Basement upto 1.5 M; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1	149.00		2.00	1.00	298.00	m2	0.08	m2	CEpg344	Unzoned	1.70	40.53	Groundworks	58.54	$ 2,372.59		$ -	5.68	9.37	$ 2,792.86
142	Insulation at Loading bay walls; boards; polystherene standard grade; fixing with adhesive; to floors; 40mm thick		Bldg 4.4.5.1	5.50	5.00		1.00	27.50	m2	0.08	m2	CEpg344	Unzoned	1.70	3.74	Groundworks	58.54	$ 218.95		$ -	5.68	9.37	$ 257.73
143	Insulation at Loading bay slab; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1	5.50	1.50		1.00	8.25	m2	0.06	m2	CEpg344	Unzoned	1.70	0.84	Groundworks	58.54	$ 49.26		$ -	7.13	11.76	$ 97.06
144	Trace heating to Loading bay Ramp & slab		Bldg 4.4.5.1	16.00	5.50		1.00	88.00	m2		m2	PP-Ext Str	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 2,206,514.66**		**$ 1,355,592.48**			**$ 2,114,399.86**
	SUPERSTRUCTURE																						
	Insitu concrete walls to first floor							-						-	-		-	$ -		$ -		-	$ -
145	Formwork - wall above Lvl 100.00 - 5 M high external; basic finish; height 3m above floor level	2.5.1.1	Bldg 4.4.1.1	137.00		5.00	2.00	1,370.00	m2	2.04	m2	ARp203	Unzoned	1.70	4,751.16	Concrete	62.13	$ 295,206.20		$ -	9.55	15.76	$ 21,587.78
146	Reinforcement in concrete walls; 120kgs/m3; 12 mm diameter; bent		Bldg 4.4.1.2				20.55	20.55	MT	24.00	tonne	ARp206	Unzoned	1.70	838.44	Concrete	62.13	$ 52,095.21		$ -	504.01	831.62	$ 17,089.72
147	Concrete wall above Lvl 100.00 - 5 M high external; grade C40	2.5.1.1	Bldg 4.4.1.1	137.00	0.25	5.00	1.00	171.25	m3	2.73	m3	ARp199	Unzoned	1.70	794.77	Concrete	62.13	$ 49,381.92		$ -		225.00	$ 38,531.25
148	Formwork Columns (400x400) - wall above Lvl 100.00 -7.8 M high	2.5.1.1	Bldg 4.4.1.1	4.00	0.40	7.80	12.00	149.76	m2	5.10	m2	ARp204	Unzoned	1.70	1,298.42	Concrete	62.13	$ 80,675.33		$ -	7.53	12.42	$ 1,860.69
149	Reinforcement for Columns (400x400) @ 150 kgs/m3; 12mm diameter; bent		Bldg 4.4.1.2				2.25	2.25	MT	24.00	tonne	ARp206	Unzoned	1.70	91.65	Concrete	62.13	$ 5,694.73		$ -	504.01	831.62	$ 1,868.14
150	Columns (400x400) - Concrete wall above Lvl 100.00 - 7.8 M high	2.5.1.1	Bldg 4.4.1.1	0.40	0.40	7.80	12.00	14.98	m3	4.44	m3	ARp199	Unzoned	1.70	113.04	Concrete	62.13	$ 7,023.50		$ -		225.00	$ 3,369.60
151	Concrete topping finishes - Hardeners; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.1.1	Bldg 4.4.1.1	48.50	21.50		1.00	1,042.75	m2	0.25	m2	ARp383	Unzoned	1.70	443.17	Concrete	62.13	$ 27,535.63		$ -	11.54	19.04	$ 19,855.00
	Insitu concrete upper floors - Beams							-						-	-		-	$ -		$ -		-	$ -
152	Formwork for Beams (300x750)	2.2.1.1	Bldg 4.4.1.1	75.00	1.80		1.00	135.00	m2	2.41	m2	ARp204	Unzoned	1.70	553.10	Concrete	62.13	$ 34,365.73		$ -	9.55	15.76	$ 2,127.26
153	Reinforcement in Beams (300x750) @ 200kg/m3	2.2.1.1	Bldg 4.4.1.2	1.00	17.00	0.20	1.00	3.40	MT	24.00	tonne	ARp206	Unzoned	1.70	138.72	Concrete	62.13	$ 8,619.16		$ -	504.01	831.62	$ 2,827.50
154	Concrete in Beams (300x750)	2.2.1.1	Bldg 4.4.1.1	75.00	0.30	0.75	1.00	16.88	m3	4.44	m3	ARp199	Unzoned	1.70	127.37	Concrete	62.13	$ 7,914.10		$ -		225.00	$ 3,796.88
155	35mpa Concrete in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	660.00	1.00	0.30	1.00	198.00	m3	2.59	m3	ARp199	Unzoned	1.70	871.79	Concrete	62.13	$ 54,167.61		$ -		225.00	$ 44,550.00
156	Formwork in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	660.00			1.00	660.00	m2	3.34	m2	ARpg202	Unzoned	1.70	3,747.48	Concrete	62.13	$ 232,844.05		$ -	9.34	15.41	$ 10,171.26
157	Formwork (sides) in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1	103.00		0.30	1.00	30.90	m2	3.34	m2	ARpg202	Unzoned	1.70	175.45	Concrete	62.13	$ 10,901.34		$ -	9.34	15.41	$ 476.20
158	Reinforcement in Suspended slab at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				29.70	29.70	MT	24.00	tonne	ARp206	Unzoned	1.70	1,211.76	Concrete	62.13	$ 75,290.89		$ -	504.01	831.62	$ 24,699.01
159	35 mpa Concrete in Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	103.00	0.35	0.40	1.00	14.42	m3	4.44	m3	ARp199	Unzoned	1.70	108.84	Concrete	62.13	$ 6,762.74		$ -		225.00	$ 3,244.50
160	35 mpa Concrete in Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	73.50	0.35	0.40	1.00	10.29	m3	4.44	m3	ARp199	Unzoned	1.70	77.67	Concrete	62.13	$ 4,825.84		$ -		225.00	$ 2,315.25
161	Formwork for Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	103.50		0.40	2.00	82.80	m2	2.41	m2	ARp204	Unzoned	1.70	339.23	Concrete	62.13	$ 21,077.65		$ -	9.55	15.76	$ 1,304.72
162	Formwork for Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1	73.50		0.40	2.00	58.80	m2	2.41	m2	ARp204	Unzoned	1.70	240.90	Concrete	62.13	$ 14,968.18		$ -	9.55	15.76	$ 926.54
163	Reinforcement in Beams at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				6.49	6.49	MT	24.00	tonne	ARp206	Unzoned	1.70	264.63	Concrete	62.13	$ 16,442.31		$ -	504.01	831.62	$ 5,393.86
164	35 mpa Concrete in Column footing (1.2x1.2x1.5) 6 ea	2.2.1.1	Bldg 4.4.1.1	1.20	1.20	1.50	6.00	12.96	m3	0.18	m3	CEpg190/187	Unzoned	1.70	3.97	Concrete	62.13	$ 246.41	19.06	$ 246.99		225.00	$ 2,916.00
165	Rock anchors 25mm 2M length for Col footing 9ea/6ftgs	2.2.1.1	Bldg 4.4.1.2				54.00	54.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
166	Reinforcement in Col footing at 120kgs/m3	2.2.1.1	Bldg 4.4.1.2				1.56	1.56	MT	24.00	tonne	ARp206	Unzoned	1.70	63.45	Concrete	62.13	$ 3,942.50		$ -	504.01	831.62	$ 1,293.33
167	35 mpa Concrete in Columns (600x600) lvl 87.00 to lvl100.00	2.2.1.1	Bldg 4.4.1.1	0.60	0.60	12.60	6.00	27.22	m3	4.44	m3	ARp199	Unzoned	1.70	205.43	Concrete	62.13	$ 12,763.86		$ -		225.00	$ 6,123.60
168	Formwork for Columns (600x600)	2.2.1.1	Bldg 4.4.1.1	4.00	0.60	12.60	6.00	181.44	m2	5.10	m2	ARp204	Unzoned	1.70	1,573.08	Concrete	62.13	$ 97,741.26		$ -	7.53	12.42	$ 2,254.30
169	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				4.08	4.08	MT	24.00	tonne	ARp206	Unzoned	1.70	166.56	Concrete	62.13	$ 10,349.08		$ -	504.01	831.62	$ 3,394.99
170	35 mpa Concrete in Columns (450x450) at Lvl 100.00 to Lvl 107.80	2.2.1.1	Bldg 4.4.1.1	0.45	0.45	7.30	6.00	8.87	m3	4.44	m3	ARp199	Unzoned	1.70	66.95	Concrete	62.13	$ 4,159.65		$ -		225.00	$ 1,995.64
171	Formwork for Columns (450x450)	2.2.1.1	Bldg 4.4.1.1	4.00	0.45	7.30	6.00	78.84	m2	5.10	m2	ARp204	Unzoned	1.70	683.54	Concrete	62.13	$ 42,470.91		$ -	7.53	12.42	$ 979.55
172	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2				1.33	1.33	MT	24.00	tonne	ARp206	Unzoned	1.70	54.28	Concrete	62.13	$ 3,372.69		$ -	504.01	831.62	$ 1,106.40
173	Reinforcement at Column locations in Dike walls (ext) @150kgs/m3	2.2.1.1	Bldg 4.4.1.2				4.80	4.80	MT	24.00	tonne	ARp206	Unzoned	1.70	195.84	Concrete	62.13	$ 12,168.22		$ -	504.01	831.62	$ 3,991.76
	Insitu concrete upper floor - Ground floor slab							-						-	-		-	$ -		$ -		-	$ -
174	Formwork for Suspended slab at 100.00	2.2.1.1	Bldg 4.4.1.1	48.50	21.50		1.00	1,042.75	m2	3.34	m2	ARpg202	Unzoned	1.70	5,920.73	Concrete	62.13	$ 367,875.96		$ -	9.34	15.41	$ 16,069.82
175	Reinforcement at Suspended slab at 100.00 (120Kg/m3)	2.2.1.1	Bldg 4.4.1.2	1.00	1.00		44.10	44.10	m2	24.00	tonne	ARp206	Unzoned	1.70	1,799.28	Concrete	62.13	$ 111,795.56		$ -	504.01	831.62	$ 36,674.29

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
176	Concrete in Suspended slab at LVL-100.00; thickness 150-450mm	2.2.1.1	Bldg 4.4.1.1	50.00	24.50	0.30	1.00	367.50	m3	2.59	m3	ARp199	Unzoned	1.70	1,618.10	Concrete	62.13	$ 100,538.37		$ -		225.00	$ 82,687.50
177	Less Concrete at Openings in slab - Elevators/Staircase	2.2.1.1	Bldg 4.4.1.1	1.00	1.00	1.00	1.00	1.00	m3	2.59	m3	ARp199	Unzoned	1.70	4.40	Concrete	62.13	$ 273.57		$ -		225.00	$ 225.00
	Insitu concrete loading bay							-						-	-		-	$ -		$ -		-	$ -
178	Formwork for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		13.00	13.00	m2	3.72	m2	ARpg202	Unzoned	1.70	82.21	Concrete	62.13	$ 5,108.12		$ -	9.55	15.76	$ 204.85
179	Formwork for Walls & Fdn to Loading Bay	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		34.00	34.00	m2	2.04	m2	ARp203	Unzoned	1.70	117.91	Concrete	62.13	$ 7,326.29		$ -	9.55	15.76	$ 535.76
180	Formwork for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1	1.00	1.00		120.00	120.00	m2	2.04	m2	ARp203	Unzoned	1.70	416.16	Concrete	62.13	$ 25,857.48		$ -	9.55	15.76	$ 1,890.90
181	Reinforcement for Loading Bay Walls/Pit/Ramp (120kgs/m3)	5.10.7.1	Bldg 4.4.1.2				120.00	120.00	MT	24.00	tonne	ARp206	Unzoned	1.70	4,896.00	Concrete	62.13	$ 304,205.62		$ -	504.01	831.62	$ 99,793.98
182	Concrete for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1				43.00	43.00	m3	2.82	m3	ARp199	Unzoned	1.70	206.14	Concrete	62.13	$ 12,808.32		$ -		225.00	$ 9,675.00
183	Concrete for Walls at Loading Bay	5.10.7.1	Bldg 4.4.1.1				8.00	8.00	m3	2.73	m3	ARp199	Unzoned	1.70	37.13	Concrete	62.13	$ 2,306.89		$ -		225.00	$ 1,800.00
184	Concrete for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1				31.00	31.00	m3	2.73	m3	ARp199	Unzoned	1.70	143.87	Concrete	62.13	$ 8,939.21		$ -		225.00	$ 6,975.00
	Miscellaneous concrete works							-						-	-		-	$ -		$ -		-	$ -
185	Formwork for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1	80.00		0.15	2.00	24.00	m2	2.04	m2	ARp203	Unzoned	1.70	83.23	Concrete	62.13	$ 5,171.50		$ -	9.55	15.76	$ 378.18
186	Rebar for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.2				0.29	0.29	MT	24.00	tonne	ARp206	Unzoned	1.70	11.75	Concrete	62.13	$ 730.09		$ -	504.01	831.62	$ 239.51
187	Concrete at Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1	80.00	0.30	0.15	1.00	3.60	m3	2.73	m3	ARp199	Unzoned	1.70	16.71	Concrete	62.13	$ 1,038.10		$ -		225.00	$ 810.00
188	Nosing angle SS at Kerb walls at Cleaning at Drum Cleaning areas; angle section bearers; 90 x 90 x 6mm		Bldg 4.4.3.1	80.00			2.00	160.00	m	0.31	m	ARp412	Unzoned	1.70	84.32	Concrete	62.13	$ 5,239.10		$ -	42.43	70.01	$ 11,201.52
189	Precast concrete at mid landing slab inside Inspection chamber		Bldg 4.4.1.1	3.00	0.75	0.20	8.00	3.60	m2		m2		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
190	Precast concrete cover slab to inspection chamber		Bldg 4.4.1.1				1.00	1.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
191	Precast concrete inspection pit; 15m x 2.5m x 2.5m		Bldg 4.4.1.1				15.00	15.00	nr		nr		Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
	Structural steel frame							-						-	-		-	$ -		$ -		-	$ -
192	Base plates for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.3.3				18.00	18.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
193	Foundation Bolts 20mm for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.1.2				72.00	72.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
194	Grouting of Base plates (300x300)	2.1.1.1	Bldg 4.4.1.3				18.00	18.00	nr		nr		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
195	Intumescent painting to Steel Columns; paint fire protection (60 minutes); spray applied	2.1.1.2	Bldg 4.4.5.3	11.00	1.10		12.00	145.20	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Structural Steel frame work Lvl 107.80 to roof (7.2M Height)							-						-	-		-	$ -		$ -			$ -
196	Steel members in frame work (15kgs/sqft)		Bldg 4.4.3.1				110.00	110.00	MT		tonne	ARp134	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
197	Roof trusses at 115.00m level; Steel roof trusses and beams; thermal and acoustic insulation;aluminum profiled composite cladding	2.3.1.1	Bldg 4.4.3.1				610.00	610.00	m2		m2	ARp135	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Fire protection to structural steelwork							-						-	-		-	$ -		$ -		-	$ -
198	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3				880.00	880.00	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
199	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3				660.00	660.00	m2		m2	ARp257	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Hoist gantries							-						-	-		-	$ -		$ -		-	$ -
200	Structural Steel Gantry for Hoists 1 T & 5 T	2.1.1.1	Bldg 4.4.3.2	44.00	220.00		1.00	9,680.00	kg		kg	ARp134	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Insitu concrete upper floors							-						-	-		-	$ -		$ -		-	$ -
201	Surface finish to insitu concrete; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.2.1	Bldg 4.4.1.1	880.00			1.00	880.00	m2	0.25	m2	ARp383	Unzoned	1.70	374.00	Concrete	62.13	$ 23,237.93		$ -	11.54	19.04	$ 16,756.08
	Tank inspection platforms							-						-	-		-	$ -		$ -		-	$ -
202	Open grid flooring for inspection around tanks on 94.00m level	2.1.1.1	Bldg 4.4.3.1				590.00	590.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
	Roof structure							-						-	-		-	$ -		$ -		-	$ -
203	Built up Roof at Lvl 115.00m; steel roof trusses and beams; thermal and acoustic insulation; aluminum profiled composite cladding	2.3.1.3	Bldg 4.4.5.1				600.00	600.00	m2		m2	ARp135	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
204	Waterproofing to Roof	2.3.2.1	Bldg 4.4.5.1				720.00	720.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
205	Waterproofing to openings	2.3.2.1	Bldg 4.4.5.1	16.00			1.00	16.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
206	Metal Flashings	2.3.2.1	Bldg 4.4.3.1	146.00	1.50		1.00	219.00	m2		m2	ARp310	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
207	Roof anchors SS on roof (6 nrs)		Bldg 4.4.3.1				6.00	6.00	nr		nr			-	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
208	600 x 600 x 2mm plain Cement tiles on roof at pathways c/w spacers & underpads		Bldg 4.4.6.6	0.60	0.60		380.00	136.80	m2		m2	CEpg81	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
	Rainwater goods							-						-	-		-	$ -		$ -		-	$ -
209	Rainwater down take pipes; fixed to backgrounds; including offsets and shoes; 110mm diameter uPVC	2.3.4.2	Bldg 4.4.5.1	15.00			6.00	90.00	m		m	ARp135	Unzoned	1.70	-	Roofers	58.38	$ -		$ -		-	$ -
	Cladding							-						-	-		-	$ -		$ -		-	$ -
210	Metal cladding External walls at Lvl 105.00 to 107.80; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	137.00		3.80	1.00	520.60	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
211	Metal cladding External walls at Lvl 107.80 to 115.00; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	146.00		7.70	1.00	1,124.20	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
212	Metal cladding external walls to staircase above 115.00m level; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.1.1	18.00		2.80	1.00	50.40	m2		m2	ARp140	Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 2,175,458.80**		**$ 246.99**			**$ 515,968.11**
	STAIRCASES																						
213	Light duty metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide	2.44.1	Bldg 4.4.3.3				8.00	8.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
214	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3				14.00	14.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
215	Light duty spiral metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide - Lvl 87.00 to Lvl 94.00 at Platform -Emergency	2.44.1	Bldg 4.4.3.3				2.00	2.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -

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Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
216	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3				3.00	3.00	nr		nr	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
217	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	2.00	2.00		8.00	32.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
218	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	2.00	4.00		4.00	32.00	m2		m2	ARp354	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	WINDOWS AND EXTERNAL DOORS																						
219	Aluminium Windows (Offices); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2-O	1.50		1.50	10.00	22.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
220	Aluminium Windows (Drum Handling); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	6.00	13.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
221	Aluminium Windows (HVAC Rm); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	6.00	13.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
222	Aluminium Windows (Roof); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	1.50		1.50	2.00	4.50	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
223	Exterior Doors c/w Frame door; single external steel door, including frame, ironmongery, powder coated finish	2.6.2.1	Bldg 4.4.6.1				6.00	6.00	nr		nr	ARp141	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
224	Rolling Shutters and collapsible gtes; galvanised steel; 1 hr fire resisting; self coiling; activated by fusible link; fixing with bolts; 2400 mm x 2750 mm	2.6.1.3	Bldg 4.4.6.1				2.00	2.00	nr		nr	ARp346	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	INTERNAL WALLS AND PARTITIONS																						
	Internal walls and partitions							-						-	-		-	$ -		$ -		-	$ -
225	Concrete filled Hollow Block Masonry 200mm(Offices)	2.7.1.1	Bldg 4.4.2.2-O	46.50		7.80	1.00	362.70	m2	0.56	m2	ARp230	Unzoned	1.70	345.29	Masonry	61.49	$ 21,231.91		$ -	20.56	33.92	$ 12,304.23
226	Concrete filled Hollow Block Masonry 200mm(Clean up Rm)	2.7.1.1	Bldg 4.4.2.2	23.00		7.80	1.00	179.40	m2	0.56	m2	ARp230	Unzoned	1.70	170.79	Masonry	61.49	$ 10,501.80		$ -	20.56	33.92	$ 6,085.97
227	Hollow Block Masonry 150 mm(HVAC/Elec))	2.7.1.1	Bldg 4.4.2.2	43.00		7.20	1.00	309.60	m2	0.20	m2	CEpg488	Unzoned	1.70	105.26	Masonry	61.49	$ 6,472.68	2.64	$ 817.34	14.96	24.68	$ 7,642.17
228	GWB on side of Block Masonry inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	52.50		3.30	1.00	173.25	m2		m2	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
229	GWB (Acoustic) wall inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	46.50		3.50	1.00	162.75	m2		m2	ARp143	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
230	Metal Stud Cement Board walls (Washroom)	2.7.1.1	Bldg 4.4.3.3-O	23.50		3.30	1.00	77.55	m2		m2	ARp143	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
231	Hollow Block Masonry 150mm in Battery room (UPS system)	2.7.1.1	Bldg 4.4.2.2	14.00		3.50	1.00	49.00	m2	0.20	m2	CEpg488	Unzoned	1.70	16.66	Masonry	61.49	$ 1,024.42	2.64	$ 129.36	14.96	24.68	$ 1,209.52
	Surface finishes to internal walls and partitions							-						-	-		-	$ -		$ -		-	$ -
232	Masonry wall Finishes; Two coats emulsion paint finish	3.1.1.1	Bldg 4.4.6.6				1,439.00	1,439.00	m2	0.21	m2	ARp380	Unzoned	1.70	513.72	Building works	60.43	$ 31,044.64		$ -	1.02	1.68	$ 2,421.84
233	GWB Wall Finishes	3.1.1.1	Bldg 4.4.6.15-O				654.00	654.00	m2	0.40	m2	ARp380	Unzoned	1.70	444.72	Building works	60.43	$ 26,874.74		$ -	3.19	5.26	$ 3,442.33
234	Finishes to Concrete walls	3.1.1.1	Bldg 4.4.6.6				3,286.00	3,286.00	m2	0.21	m2	ARp380	Unzoned	1.70	1,173.10	Building works	60.43	$ 70,891.38		$ -	1.02	1.68	$ 5,530.34
235	Epoxy painting to walls at Storage area		Bldg 4.4.6.6	137.00		13.00	1.00	1,781.00	m2	0.25	m2	ARp383	Unzoned	1.70	756.93	Concrete	62.13	$ 47,030.40		$ -	11.54	19.04	$ 33,912.02
236	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	18.00		2.20	1.00	39.60	m2	0.56	m2	ARp371	Unzoned	1.70	37.70	Building Works	60.43	$ 2,278.19		$ -	13.85	22.85	$ 904.96
237	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	5.00		2.20	1.00	11.00	m2	0.56	m2	ARp371	Unzoned	1.70	10.47	Building Works	60.43	$ 632.83		$ -	13.85	22.85	$ 251.38
238	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O	1.00		2.20	1.00	2.20	m2	0.56	m2	ARp371	Unzoned	1.70	2.09	Building Works	60.43	$ 126.57		$ -	13.85	22.85	$ 50.28
								-						-	-		-	$ -		$ -			$ -
	2.8 INTERNAL DOORS							-						-	-		-	$ -		$ -			$ -
239	Internal Doors c/w Frames (Offices); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; hardwood faced	2.8.1.2	Bldg 4.4.6.1-O				5.00	5.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
240	Internal Doors c/w Frames (Washroom); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; single leaf	2.8.1.1	Bldg 4.4.6.1-O				2.00	2.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
241	Internal Doors c/w Frames (HVAC); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1				4.00	4.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
242	Fire Resistant doors c/w Frames; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1				4.00	4.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
243	Internal Doors c/w Frames (Clean up room); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1				2.00	2.00	nr		nr	ARp142	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
244	New door for Access to new building from Exstg Bldg; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1				3.00	3.00	nr		nr	ARp142	Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
245	Automatic door; magnetic locks	2.8.1.2	Bldg 4.4.6.1				18.00	18.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Internal floor finishes							-						-	-		-	$ -		$ -		-	$ -
246	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				100.00	100.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
247	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				100.00	100.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
248	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				530.00	530.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
249	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				530.00	530.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
250	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O				200.00	200.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
251	Heavy duty carpet tiles; to cement and sand base - (Offices)		Bldg 4.4.6.3-O				200.00	200.00	m2	0.28	m2	ARp377	Unzoned	1.70	95.20	Flooring	63.61	$ 6,055.96		$ -	19.22	31.71	$ 6,342.60
252	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O				50.00	50.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
253	Glazed ceramic floor tile; anti-slip tiles		Bldg 4.4.6.3-O				50.00	50.00	m2		m2	ARp146	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
254	Line painting to Floors	3.2.1.6	Bldg 4.4.6.3	300.00			1.00	300.00	m	0.04	m2	ARp434	Unzoned	1.70	20.40	Building works	60.43	$ 1,232.79		$ -	0.19	0.31	$ 94.05
255	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				600.00	600.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
256	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				600.00	600.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
257	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3				1,010.00	1,010.00	m2		m2	ARp358	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
258	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3				1,010.00	1,010.00	m2		m2	ARp145	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Ceiling finishes							-						-	-		-	$ -		$ -		-	$ -
259	Paints to ceilings (Storage); two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4				1,010.00	1,010.00	m2		m2	ARp146	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
260	Paints to ceilings; two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4				600.00	600.00	m2		m2	ARp147	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
261	Acoustic ceilings to Offices on anti vibration mounting	3.3.3.1	Bldg 4.4.6.4-O				250.00	250.00	m2		m2	ARp147	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 225,398.30**		**$ 946.70**			**$ 80,191.67**
	ELEVATORS, LIFTS AND HOISTS																						
262	Dock Levellers (Elec Operated)	5.10.7.1	Bldg 4.4.6.7				2.00	2.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
263	Rubber Bumpers on Wall at Loading Bay	5.10.7.1	Bldg 4.4.6.7				8.00	8.00	nr				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
264	Temporary prefabricated Loading dock (use during construction)		Bldg 4.4.6.7				1.00	1.00	Item				Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	BUILDING SERVICES																						
	Sanitary appliances							-						-	-		-	$ -		$ -		-	$ -
265	Washroom Accessories (complete Male/Fe/HC)	5.1.1.1	Bldg 4.4.6.14-O				1.00	1.00	item				Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
	Disposal equipment							-						-	-		-	$ -		$ -		-	$ -
266	Garbage/Recycling Equipment	5.3.3.1	Bldg 4.4.6.14-O				1.00	1.00	nr		nr	ARp155	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Water installations							-						-	-		-	$ -		$ -		-	$ -
267	Hot and cold water installations; complete installation		Bldg 4.2.1.4				250.00	250.00	m2		m2	ARp149	Unzoned	1.70	-	Plumbers	66.47	$ -		$ -		-	$ -
268	Stand alone Demineralized water tank on Metal stand (1000 gallons Cap)		Bldg 4.2.6.2				1.00	1.00	item				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
	Water installations							-						-	-		-	$ -		$ -			$ -
269	Water Heater 100 litres		Bldg 4.2.6.2	1.00			2.00	2.00	nr	2.00	nr	MEpg238	Unzoned	1.70	6.80	Plumbers	66.47	$ 452.00		$ -	957.44	1,579.78	$ 3,159.55
	Uninterruptible Power Supply							-						-	-		-	$ -		$ -			$ -
270	Static UPS including Control panel & Batteries for 500 KVA @ $495/KVA		Bldg 4.1.1.5				500.00	500.00	kVA		KVA		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
271	Inverter Panels		Bldg 4.1.1.5				2.00	2.00	nr		nr		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
272	Battery Racks		Bldg 4.1.1.5				2.00	2.00	nr		nr		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	ELECTRICAL							-						-	-		-	$ -		$ -			$ -
273	Sub Station (prefabricated) @ $45,000		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
274	Transformer - 1000 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
275	Transformer - 1500 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
276	Transformer - 2000 KVA		Bldg 4.1.1.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
277	Standby Generator (Diesel powered) 1000 KVA @ $350,000		Bldg 4.1.2.1				1.00	1.00	item				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
278	Ring Main Unit 11 kv including Electrical terminations @ $29,700		Bldg 4.1.1.1				3.00	3.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
279	Lighting and power installation - Offices 250m2 -		Bldg 4.1.5.3-O				250.00	250.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
280	Electrical Installation - Storage Area - 1010 m2 - Lighting Installation		Bldg 4.1.5.2				1,010.00	1,010.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
281	Electrical Installation - Facility/Clean up/Drum Handling-630 m2		Bldg 4.1.5.2				630.00	630.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
282	Electrical Installation -HVAC /Electrical Rm - 600 m2 - Lighting Installation		Bldg 4.1.5.2				600.00	600.00	m2		m2	ARpg150	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
283	Lightening Arrestor (c/w earthing wire, copper rods)		Bldg 4.1.5.2				1.00	1.00	item		item		Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Space Heating & Air Treatment							-						-	-		-	$ -		$ -			$ -
284	Heating - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
285	Cooling - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
286	Ductwork - Offices - 250 m2		Bldg 4.2.1.10-O				250.00	250.00	m2				Unzoned	1.70	-	Cladding	67.62	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
287	Heating - Storage Area - 1010 m2		PROC 4.2.1.7				1,010.00	1,010.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
288	BMS System Installation		PROC 4.2.1.7				1,010.00	1,010.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
289	Heating - Facility/Clean up/Drum Handling - 630 m2		PROC 4.2.1.7				630.00	630.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
290	BMS System Installation		PROC 4.2.1.7				630.00	630.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-					Unzoned	1.70	-		-	$ -		$ -			$ -
291	Heating - HVAC/Elec Rm - 600 m2		PROC 4.2.1.7				600.00	600.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
292	BMS System Installation		PROC 4.2.1.7				600.00	600.00	m2				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	SPRINKLER INSTALLATION							-						-	-		-	$ -		$ -			$ -
293	Offices - 250 m2		Bldg 4.2.10.3-O				250.00	250.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
294	Storage Area - 1010 m2		Bldg 4.2.10.1				1,010.00	1,010.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
295	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.2.10.1				630.00	630.00	m2		m2	MEpg106	Unzoned	-	-	Pipefitters	69.11	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
296	HVAC/Elec Rm - 600 m2		Bldg 4.2.10.1				600.00	600.00	m2		m2	MEpg106	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	COMMUNICATION INSTALLATION - Fire/Voice Alarm							-						-	-		-	$ -		$ -			$ -
297	Offices - 250 m2		Bldg 4.1.3.8-O				250.00	250.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
298	Storage Area - 1010 m2		Bldg 4.1.3.4				1,010.00	1,010.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
299	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.1.3.4				630.00	630.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
300	HVAC/Elec Rm - 600 m2		Bldg 4.1.3.4				600.00	600.00	m2		m2	MEpg106	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Natural Gas Installation							-						-	-		-	$ -		$ -			$ -
	Not Required							-						-	-		-	$ -		$ -		-	$ -
	Heating, Ventilation and Air Conditioning							-						-	-		-	$ -		$ -		-	$ -
301	Building Management system tie ins for Office building Heating & Cooling system	5.6.1.1	Bldg 4.2.2.7-O				250.00	250.00	m2		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
302	Main Steam line tie ins from Main Source	5.6.1.1	Bldg 4.2.2.7-O				1.00	1.00	item		item	ARp150	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
303	Local ventilation to WC	5.6.1.1	Bldg 4.2.2.7-O				4.00	4.00	nr		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
304	Ventilation system to toilet areas	5.6.1.1	Bldg 4.2.2.7-O				50.00	50.00	m2		m2	ARp149	Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
305	Electrical Space Heaters at Storage Area - 1010 M2	5.6.2.1	Bldg 4.2.6.2				4.00	4.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
306	Clean Breathing Air System Plant	5.7.1.1	PROC 4.2.1.7				2.00	2.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
307	Service Air System Plant	5.7.1.1	PROC 4.2.1.7				1.00	1.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
308	Instrument System Plant (with dessicant air dryer)	5.7.1.1	PROC 4.2.1.7				1.00	1.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
307	Exhaust Fan with Mech operated Louvers c/w control system	5.7.3.1	Bldg 4.4.6.5				6.00	6.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
309	Pre fab Mech Operated Metal Louvres (prefinished)2x3M	5.7.3.1	Bldg 4.4.6.5				6.00	6.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Electrical installations							-						-	-		-	$ -		$ -		-	$ -
310	Electrical Main Junction & Distribution Box	5.8.1.1	Bldg 4.1.1.2				1.00	1.00	item	3.50			Unzoned	1.70	5.95	Electrical Workers	68.23	$ 405.99		$ -	10,234.18	16,886.40	$ 16,886.40
311	Internal LV wiring	5.8.1.1	Bldg 4.1.1.2				490.00	490.00	m	0.20			Unzoned	1.70	166.60	Electrical Workers	68.23	$ 11,367.62		$ -	9.27	15.30	$ 7,494.80
312	Lighting & Fixtures (Office)	5.8.3.1	Bldg 4.1.5.2-O				12.00	12.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
313	Lighting & Fixtures (Storage)	5.8.3.1	Bldg 4.1.5.2				20.00	20.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
314	Lighting & Fixtures (HVAC room)	5.8.3.1	Bldg 4.1.5.2				8.00	8.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
315	Lighting & Fixtures (External)	5.8.3.1	Bldg 4.1.5.2				18.00	18.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
316	Special Lighting systems	5.8.4.1	Bldg 4.1.5.2				4.00	4.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
317	Way finding Signs (Illuminated)	5.8.4.1	Bldg 4.1.5.2				16.00	16.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Fire and lightening protection							-						-	-		-	$ -		$ -		-	$ -
318	Fire alarms/appliances		Bldg 4.1.6.1	1.00	1.00	1.00	2,500.00	2,500.00	m2				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
319	Lightening protection system	5.11.2.1	Bldg 4.1.6.1	1.00	1.00	1.00	2,500.00	2,500.00	m2				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
320	Fire and Smoke Detectors		Bldg 4.1.6.1				16.00	16.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
	Communication, security and control systems							-						-	-		-	$ -		$ -		-	$ -
321	LAN	5.12.1.2	Bldg 4.1.3.5-O				12.00	12.00	nr		nr	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
322	Internal Communication system; Telecommunication System	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
323	Public address system	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
324	Central security control devices; Security Systems; Security Lights and lighting system,	5.12.1.1	Bldg 4.1.3.1				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
325	TV monitors	5.12.1.14	Bldg 4.1.3.6-O				8.00	8.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
326	Surveillance equipment; detectors and alarms	5.12.1.1	Bldg 4.1.3.2				1.00	2,490.00	m2		m2	PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
	Builders work in connection with building services							-						-	-		-	$ -		$ -		-	$ -
327	Cutting and Patching	5.14.1.1	STIE 4.2.11.1				100.00	100.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
328	Fire & smoke stopping	5.14.1.1	Bldg 4.1.6.1				2,490.00	2,490.00	m2				Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
329	Ducts/Pipe sleeves/Openings	5.14.1.1	STIE 4.2.11.1				150.00	150.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
330	Housekeeping pads; 150mm thick	5.14.1.1	Bldg 4.4.1.1	3.00	6.00		15.00	270.00	m2				Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
331	Housekeeping pads; 100mm thick	5.14.1.1	Bldg 4.4.1.1	1.50	2.50		10.00	37.50	m2				Unzoned	1.70	-	Concrete	62.13	$ -		$ -		-	$ -
	Ducts for incoming services							-						-	-		-	$ -		$ -		-	$ -
332	Excavation for Duct bank for services (incoming)		SPRP 4.4.7.1	30.00	1.50	1.50	1.00	67.50	m3	0.29	m3	CEpg169	Unzoned	1.70	33.28	Groundworks	58.54	$ 1,948.13	17.79	$ 1,200.62		-	$ -
333	Concrete in blinding for Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	1.00	0.10	1.00	3.00	m3	0.16	m3	CEpg189/187	Unzoned	1.70	0.82	Concrete	62.13	$ 50.70	3.27	$ 9.80	92.91	153.30	$ 459.90
334	Concrete in base slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.90	0.15	1.00	4.05	m3	0.18	m3	CEpg190/187	Unzoned	1.70	1.24	Concrete	62.13	$ 77.00	19.06	$ 77.18	92.91	153.30	$ 620.87
335	Concrete in walls Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.15	1.05	2.00	9.45	m3	0.22	m3	CEpg190/187	Unzoned	1.70	3.53	Concrete	62.13	$ 219.60	23.30	$ 220.17	92.91	153.30	$ 1,448.70
336	Concrete in roof slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00	0.90	0.15	1.00	4.05	m3	0.18	m3	CEpg190/187	Unzoned	1.70	1.24	Concrete	62.13	$ 77.00	19.06	$ 77.18	92.91	153.30	$ 620.87
337	Formwork in walls Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		1.05	2.00	63.00	m2	2.04	m2	ARp203	Unzoned	1.70	218.48	Concrete	62.13	$ 13,575.18		$ -	9.55	15.76	$ 992.72
338	Formwork for Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		0.75	2.00	45.00	m2	3.34	m2	ARpg202	Unzoned	1.70	255.51	Concrete	62.13	$ 15,875.73		$ -	9.34	15.41	$ 693.50
339	Formwork for roof slab Duct bank for services (incoming)		Bldg 4.4.1.1	30.00		0.75	1.00	22.50	m2	3.34	m2	ARpg202	Unzoned	1.70	127.76	Concrete	62.13	$ 7,937.87		$ -	9.34	15.41	$ 346.75
340	Reinforcement for Duct bank for services (incoming)		Bldg 4.4.1.2				1.00	1.00	MT	24.00	tonne	ARp206	Unzoned	1.70	40.80	Concrete	62.13	$ 2,535.05		$ -	504.01	831.62	$ 831.62
	Tie-ins to existing services							-						-	-		-	$ -		$ -		-	$ -
	Testing and commissioning building services							-						-	-		-	$ -		$ -		-	$ -
341	Testing Telecommunication System;		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
342	Testing Public Address System;		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
343	Testing Fire Detection and Alarm Systems		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
344	Testing Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
345	Testing Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
346	Testing Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4				16.00	16.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
347	Commissioning Telecommunication System;		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
348	Commissioning Public Address System;		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
349	Commissioning Fire Detection and Alarm Systems		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
350	Commissioning Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
351	Commissioning Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
352	Commissioning Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4				32.00	32.00	hrs		hrs	PP-WESB	Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
353	Specialist Training and Information sharing	5.15.1.1	Bldg 4.4.8.1.3				60.00	60.00	hours	1.00	hrs		Zone 3	2.33	139.80	Electrical Workers	68.23	$ 9,538.97		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 64,060.83**		**$ 1,584.96**			**$ 33,555.67**
	MISCELLANEOUS METALWORK																						
354	Railings at Roof top; mild steel balustrade and steel handrail; 1100mm high		Bldg 4.4.3.3	146.00			1.00	146.00	m		m	ARp138	Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
355	Miscellaneous metals (Offices)		Bldg 4.4.3.5-O				1.00	1.00	LS		LS		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
356	Miscellaneous Mmetals (Building)		Bldg 4.4.3.1				1.00	1.00	LS		LS		Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT																						
	General fixtures and fittings							-						-	-		-	$ -		$ -		-	$ -
357	Furniture to Offices (18 personnel)		Bldg 4.4.6.13-O				18.00	18.00	people		nr	PP	Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
358	Furniture to Conference room and Admin area		Bldg 4.4.6.13-O				1.00	1.00	item				Unzoned	1.70	-	Building Works	60.43	$ -		$ -		-	$ -
359	Window Blinds; 2.0m wide		Bldg 4.4.6.13-O				10.00	10.00	nr	1.45	nr	ARp395	Unzoned	1.70	24.65	Building works	60.43	$ 14,896.17		$ -	109.78	181.14	$ 1,811.37
360	Eye wash Station		Bldg 4.4.6.14-O				2.00	2.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
361	Emergency Shower		Bldg 4.4.6.14-O				2.00	2.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
362	Laboratory Shelving		Bldg 4.4.6.14-O				1.00	1.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
363	Change room station		Bldg 4.4.6.14-O				1.00	1.00	item			PP	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
364	Fume hoods - cover at all tanks		Bldg 4.2.2.5				25.00	25.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
365	Fume hoods @ Drum Cleaning Area		Bldg 4.2.2.5				2.00	2.00	nr		nr	PP-DMCDF	Unzoned	1.70	-	Building works	60.43	$ -		$ -		-	$ -
365	Radiation monitors (Storage area)		Bldg 4.1.9.1				1.00	1.00	nr				Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
366	SAM - Small Article Monitor		Bldg 4.1.9.1				1.00	1.00	nr			PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
367	Motion detector		Bldg 4.1.9.1				8.00	8.00	nr			PP-WESB	Unzoned	1.70	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ 14,896.17**		**$ -**			**$ 1,811.37**
	PROCESS EQUIPMENT																						
	PHT D2O Supply Tanks (8 ea)							-						-	-		-	$ -		$ -		-	$ -
368	Tanks 100 Mg 38110 - SS 304 Class 6		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
369	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
370	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
371	Pressure sensors		PROC 4.2.1.3				8.00	8.00	nr	6.00			Unzoned	1.70	81.60	Pipefitters	69.11	$ 5,639.62		$ -		517.00	$ 4,136.00
372	Level sensors		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Pipefitters	69.11	$ 7,519.49		$ -		2,269.00	$ 36,304.00
373	Pressure Gauges		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Pipefitters	69.11	$ 7,519.49		$ -		1,493.00	$ 23,888.00
374	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			8.00	600.00	m	0.58			Unzoned	1.70	586.50	Pipefitters	69.11	$ 40,534.77		$ -		52.15	$ 31,290.00
375	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			8.00	600.00	m	0.58			Unzoned	1.70	586.50	Pipefitters	69.11	$ 40,534.77		$ -		52.15	$ 31,290.00
376	Switches - 2 level		PROC 4.2.1.3				16.00	16.00	nr	3.50			Unzoned	1.70	95.20	Electrical Workers	68.23	$ 6,495.78		$ -		1,011.00	$ 16,176.00
377	Transmitters - 2 ea		PROC 4.2.1.3				16.00	16.00	nr	4.00			Unzoned	1.70	108.80	Electrical Workers	68.23	$ 7,423.75		$ -		554.00	$ 8,864.00
378	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				8.00	8.00	nr	4.00			Unzoned	1.70	54.40	Electrical Workers	68.23	$ 3,711.88		$ -		758.00	$ 6,064.00
379	Isolation Valve		PROC 4.2.1.2				8.00	8.00	nr	0.39			Unzoned	1.70	5.30	Pipefitters	69.11	$ 366.58		$ -		2,577.00	$ 20,616.00
380	Data Cables to Control room		Bldg 4.1.3.1	90.00			8.00	720.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
381	Item-6- Cover gas Vent Control Valve pnuematic control Valve and Accessories		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
382	Item - 8 - Cover Gas Relief Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
383	Item - 9 - Main Outlet Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
384	Item - 11 & 12 - Outlet Isolation Valves		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
385	Item - 15 - Main Inlet Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
386	Item 24 & 25 - Inlet Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
387	Item - 26 - Cover Gas Supply Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
388	Item - 28 - Supply Header Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
389	Item - 29 - Vacuum Relief Valve		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
390	Item - 32 - Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -		517.00	$ 517.00
391	Item 33 & 34 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	3.50			Unzoned	1.70	11.90	Electrical Workers	68.23	$ 811.97		$ -		2,269.00	$ 4,538.00
392	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.5.4				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		-	$ -
393	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Moderator D2O Supply Tanks(7 ea)							-						-	-		-	$ -		$ -			$ -
394	Tanks 100 Mg 38110; SS 304 Class 3		PROC 4.2.5.4				7.00	7.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
395	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				7.00	7.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
396	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
397	Valves		PROC 4.2.1.2				14.00	14.00	nr	0.39			Unzoned	1.70	9.28	Pipefitters	69.11	$ 641.51		$ -		-	$ -
398	Pressure sensors		PROC 4.2.1.3				7.00	7.00	nr	6.00			Unzoned	1.70	71.40	Pipefitters	69.11	$ 4,934.67		$ -		517.00	$ 3,619.00
399	Level sensors		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Pipefitters	69.11	$ 6,579.56		$ -		2,269.00	$ 31,766.00
400	Pressure Gauges		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Pipefitters	69.11	$ 6,579.56		$ -		1,493.00	$ 20,902.00
401	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			7.00	525.00	m	8.00			Unzoned	1.70	7,140.00	Pipefitters	69.11	$ 493,466.82		$ -		52.15	$ 27,378.75
402	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			7.00	525.00	m	6.00			Unzoned	1.70	5,355.00	Pipefitters	69.11	$ 370,100.12		$ -		52.15	$ 27,378.75
403	Switches - 2 level		PROC 4.2.1.3				14.00	14.00	nr	3.50			Unzoned	1.70	83.30	Electrical Workers	68.23	$ 5,683.81		$ -		1,011.00	$ 14,154.00
404	Transmitters - 2 ea		PROC 4.2.1.3				14.00	14.00	nr	4.00			Unzoned	1.70	95.20	Electrical Workers	68.23	$ 6,495.78		$ -		554.00	$ 7,756.00
405	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				7.00	7.00	nr	4.00			Unzoned	1.70	47.60	Electrical Workers	68.23	$ 3,247.89		$ -		758.00	$ 5,306.00
406	Isolation Valve		PROC 4.2.1.2				7.00	7.00	nr	0.39			Unzoned	1.70	4.64	Pipefitters	69.11	$ 320.75		$ -		2,577.00	$ 18,039.00
407	Data Cables to Control room		Bldg 4.1.3.1	90.00			7.00	630.00	m	0.39			Zone 3	2.33	572.48	Electrical Workers	68.23	$ 39,062.10		$ -		12.10	$ 7,623.00

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
408	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.1.3				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		-	$ -
409	Item-5-Cover Gas Vent Control Pnuematic Valve & Accessories- 2 "		PROC 4.2.1.2				2.00	1.00	nr	6.00			Unzoned	1.70	10.20	Pipefitters	69.11	$ 704.95		$ -		790.00	$ 790.00
410	Item-7-Cover Gas Relief Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
411	item-10-Main Outlet Header Isolation Valve 3 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
412	Item-13&14- Outlet Isolation Valve - 3 "		PROC 4.2.1.2				2.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
413	Item - 18 & 19- Inlet Isolation Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		460.00	$ 920.00
414	Item - 27 - Cover Gas Supply Isolation Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
415	Item - 30 - Vacuum Relief Valve - 2"		PROC 4.2.1.2				2.00	2.00	nr	4.50			Unzoned	1.70	15.30	Pipefitters	69.11	$ 1,057.43		$ -		1,170.00	$ 2,340.00
416	Item - 31- Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	6.00			Unzoned	1.70	10.20	Electrical Workers	68.23	$ 695.98		$ -		517.00	$ 517.00
417	Item- 35 & 36 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		2,269.00	$ 4,538.00
418	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TRF/SUP Feed Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
419	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
420	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
421	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
422	Valves		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		-	$ -
423	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
424	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
425	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
426	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
427	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
428	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
429	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
430	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
431	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
432	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
433	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TRF/SUP Product Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
434	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
435	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
436	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
437	Valves		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		-	$ -
438	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
439	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
440	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
441	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
442	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
443	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
444	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
445	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
446	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
447	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
448	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Downgraded D2O Tank (2 ea)							-						-	-		-	$ -		$ -			$ -
449	Tanks 50 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
450	Tanks 50 Mg 38500 - Installation		PROC 4.2.5.4				2.00	2.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
451	Tanks 50 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
452	Valves; 3"		PROC 4.2.1.2				4.00	4.00	nr	0.39	nr		Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		790.00	$ 3,160.00
453	Pressure sensors		PROC 4.2.1.3				2.00	2.00	nr	6.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,034.00
454	Level sensors		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		2,269.00	$ 9,076.00
455	Pressure Gauges		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Pipefitters	69.11	$ 1,879.87		$ -		1,493.00	$ 5,972.00
456	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	8.00			Unzoned	1.70	2,040.00	Pipefitters	69.11	$ 140,990.52		$ -		52.15	$ 7,822.50
457	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			2.00	150.00	m	6.00			Unzoned	1.70	1,530.00	Pipefitters	69.11	$ 105,742.89		$ -		52.15	$ 7,822.50
458	Switches - 2 level		PROC 4.2.1.3				4.00	4.00	nr	3.50			Unzoned	1.70	23.80	Electrical Workers	68.23	$ 1,623.95		$ -		1,011.00	$ 4,044.00
459	Transmitters - 2 ea		PROC 4.2.1.3				4.00	4.00	nr	4.00			Unzoned	1.70	27.20	Electrical Workers	68.23	$ 1,855.94		$ -		554.00	$ 2,216.00
460	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		758.00	$ 1,516.00
461	Isolation Valve		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		2,577.00	$ 5,154.00
462	Data Cables to Control room		Bldg 4.1.3.1	90.00			2.00	180.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
463	Item - 38 & 39 - Transfer Pump; including Item 40 & 41 24 HP motor		PROC 4.2.2.4				2.00	2.00	nr	4.00	nr		Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		13,955.00	$ 27,910.00
464	Item - 42 & 43 - Check Valve 1 1/2 "		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		1,039.00	$ 2,078.00
465	Item - 44 - Main Inlet Header Check valve 1 1/2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
466	Item - 45 - Cover Gas Vent Control Valve pnuematic Control Valve and Accessories 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
467	Item - 46 & 47 - Outlet Control Valve and Accessories 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
468	Item 48 & 49 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
469	Item - 50 - Cover Gas Relief Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
470	Item 51 & 52 - Relief Valve - 1 1/2 "		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		620.00	$ 1,240.00
471	Item 53 & 54 - Inlet Isolation Valve 2 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		770.00	$ 1,540.00
472	Item 55 - Cover Gas Supply Isolation Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
473	Item 56 - Cover Gas Drain Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00

DNGS Heavy Water Management Building - Construction Cost Estimate

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Ref	Item	NRM Ref	PBS	Quantity						Labour									Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
474	Item 57 - Vent Isolation Valve 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
475	Item - 58 - Recirculation Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
476	Item - 59 - Clean up system Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
477	Item - 60 & 61 - Outlet Isolation Valve 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
478	Item - 62 - Transfer System Supply Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
479	Item - 63 - Main Discharge Header Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
480	Item - 64 & 65 - Main Inlet Header Spare Connection Isolation Valve 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
481	Item - 66 - Main Inlet Header Isolation Valve 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		460.00	$ 460.00
482	Item - 67 - Vacuum Relief Valve - 2"		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
483	Item - 68 - Recirculation Flow Orifice 1 1/2"		PROC 4.2.1.3				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
484	Item 69 & 70 - Commissioning Strainer 2 1/2"		PROC 4.2.1.3				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		300.00	$ 600.00
485	Item 71 & 72 - Level Transmitter		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		2,269.00	$ 4,538.00
486	Item 73 - Cover Gas Pressure Transmitter		PROC 4.2.1.3				1.00	1.00	nr	6.00			Unzoned	1.70	10.20	Electrical Workers	68.23	$ 695.98		$ -		517.00	$ 517.00
487	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	Downgraded D2O Tank (1 ea)							-						-	-		-	$ -		$ -			$ -
488	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
489	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
490	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
491	Valves; 2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		620.00	$ 1,240.00
492	Pressure sensors		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Pipefitters	69.11	$ 469.97		$ -		517.00	$ 517.00
493	Level sensors		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		2,269.00	$ 4,538.00
494	Pressure Gauges		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		1,493.00	$ 2,986.00
495	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			1.00	75.00	m	0.58			Unzoned	1.70	73.31	Pipefitters	69.11	$ 5,066.85		$ -		52.15	$ 3,911.25
496	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			1.00	75.00	m	0.58			Unzoned	1.70	73.31	Pipefitters	69.11	$ 5,066.85		$ -		52.15	$ 3,911.25
497	Switches - 2 level		PROC 4.2.1.3				2.00	2.00	nr	3.50			Unzoned	1.70	11.90	Electrical Workers	68.23	$ 811.97		$ -		1,011.00	$ 2,022.00
498	Transmitters - 2 ea		PROC 4.2.1.3				2.00	2.00	nr	4.00			Unzoned	1.70	13.60	Electrical Workers	68.23	$ 927.97		$ -		554.00	$ 1,108.00
499	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3				1.00	1.00	nr	4.00			Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -		758.00	$ 758.00
500	Isolation Valve		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
501	Data Cables to Control room		Bldg 4.1.3.1	90.00			1.00	90.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -			$ -
502	Item - 100 - Transfer System Feed Isolation Valve - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
503	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	CLEAN Up D2O Tank (3 ea)							-						-	-		-	$ -		$ -			$ -
504	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4				3.00	3.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
505	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4				3.00	3.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
506	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4				8.00	8.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
507	Valves; 2"		PROC 4.2.1.2				6.00	6.00	nr	0.39			Unzoned	1.70	3.98	Pipefitters	69.11	$ 274.93		$ -		620.00	$ 3,720.00
508	Pressure sensors		PROC 4.2.1.3				3.00	3.00	nr	4.00			Unzoned	1.70	20.40	Pipefitters	69.11	$ 1,409.91		$ -		517.00	$ 1,551.00
509	Level sensors		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Pipefitters	69.11	$ 2,819.81		$ -		2,269.00	$ 13,614.00
510	Pressure Gauges		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Pipefitters	69.11	$ 2,819.81		$ -		1,493.00	$ 8,958.00
511	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1	75.00			3.00	225.00	m	0.58			Unzoned	1.70	221.85	Pipefitters	69.11	$ 15,332.72		$ -		52.15	$ 11,733.75
512	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1	75.00			3.00	225.00	m	0.58			Unzoned	1.70	221.85	Pipefitters	69.11	$ 15,332.72		$ -		52.15	$ 11,733.75
513	Switches - 2 level		PROC 4.2.1.3				6.00	6.00	nr	3.50			Unzoned	1.70	35.70	Electrical Workers	68.23	$ 2,435.92		$ -		1,011.00	$ 6,066.00
514	Transmitters - 2 ea		PROC 4.2.1.3				6.00	6.00	nr	4.00			Unzoned	1.70	40.80	Electrical Workers	68.23	$ 2,783.91		$ -		554.00	$ 3,324.00
515	Beetle - Leak Detection - 1 ea		PROC 4.2.1.2				3.00	3.00	nr	4.00			Unzoned	1.70	20.40	Electrical Workers	68.23	$ 1,391.95		$ -		758.00	$ 2,274.00
516	Isolation Valve		PROC 4.2.1.2				3.00	3.00	nr	0.39			Unzoned	1.70	1.99	Pipefitters	69.11	$ 137.47		$ -		2,577.00	$ 7,731.00
517	Data Cables to Control room		Bldg 4.1.3.1	90.00			3.00	270.00	m				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
518	Item - 75 & 76 - Clean up Product Transfer Pump Suction 1 1/2" Discharge 1 1/2" including Item 78 & 79 Pump motor 4 HP		PROC 4.2.2.4				2.00	2.00	nr	4.00	nr		Unzoned	1.70	13.60	Pipefitters	69.11	$ 939.94		$ -		13,955.00	$ 27,910.00
519	Item - 77 - Oxidation unit Feed Pump Suction 1" Discharge 1/2" including Item 80 Oxidation Pump Motor 1 HP		PROC 4.2.2.4				1.00	1.00	nr	4.00	nr		Unzoned	1.70	6.80	Pipefitters	69.11	$ 469.97		$ -		13,955.00	$ 13,955.00
520	Item - 81 - Cover Gas Vent Control Valve Pnuematic Valve & Accessories 2 "		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		790.00	$ 790.00
521	Item - 82 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
522	Item - 83 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
523	Item - 84 & 85- Outlet Control Valve Pnuematic Control Valve & Accessories 1"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		790.00	$ 1,580.00
524	Item - 86 - Cover Gas Relief Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		620.00	$ 620.00
525	Item - 87, 88,& 89 - Relief Valve 3/4"		PROC 4.2.1.2				3.00	3.00	nr	0.39			Unzoned	1.70	1.99	Pipefitters	69.11	$ 137.47		$ -		1,271.00	$ 3,813.00
526	Item - 90 - Station Upgrader Feed Isolation Valve 2 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
527	Item - 91 - Vent Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
528	Item - 92 - Cover Gas Supply Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -			$ -
529	Item - 93 - Isolation Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
530	Item - 94 - Cover Gas Drain Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
531	Item - 95 - Feed Isolation Valve 2 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
532	Item - 96, 97, 98 & 99 - Isolation Valve 1 1/2"		PROC 4.2.1.2				4.00	4.00	nr	0.39			Unzoned	1.70	2.65	Pipefitters	69.11	$ 183.29		$ -		2,577.00	$ 10,308.00
533	Item - 101 & 102 - Discharge Isolation Valve - 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -		580.00	$ 1,160.00
534	Item - 103 - Isolation Valve - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		2,577.00	$ 2,577.00
535	Item - 104 - Clean Up Feed Isolation Valves - 1 1/2"		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Pipefitters	69.11	$ 45.82		$ -		580.00	$ 580.00
536	Item - 105 - Vacuum Relief Valve 2"		PROC 4.2.1.2				1.00	1.00	nr	4.50			Unzoned	1.70	7.65	Pipefitters	69.11	$ 528.71		$ -		1,271.00	$ 1,271.00
537	Item - 106 Recirculation Flow Orifice 1"		PROC 4.2.1.2				1.00	1.00	nr	0.33			Unzoned	1.70	0.56	Pipefitters	69.11	$ 38.77		$ -			$ -
538	Item - 107 & 108 - Commissioning Strainer 1 1/2"		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Pipefitters	69.11	$ 91.64		$ -			$ -
539	Item - 109 - Cover Gas Pressure Transmitter		PROC 4.2.1.2				1.00	1.00	nr	0.39			Unzoned	1.70	0.66	Electrical Workers	68.23	$ 45.24		$ -		517.00	$ 517.00

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Ref	Item	NRM Ref	PBS	Quantity L [m]	W [m]	H [m]	Nr [each]	Qty	Unit	Labour Norm Hrs/unit	Norm Unit	Norm Ref	Zone	Productivity [multiplier]	DFL Hours [Hrs]	Crew	Crew Rate [$/hr]	Labour Total [$]	Construction Equipment Rate [$/unit]	Equipment Total [$]	Materials Rate [GBP/unit]	Rate [CAD$/unit]	Material Total [$]
540	Item - 110 & 111 - Level Transmitter		PROC 4.2.1.2				2.00	2.00	nr	0.39			Unzoned	1.70	1.33	Electrical Workers	68.23	$ 90.48		$ -		2,269.00	$ 4,538.00
541	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4				1.00	1.00	item				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -		-	$ -
	TIE-ins for new tanks with Exstg tanks (at Exstg bldg)							-						-	-		-	$ -		$ -		-	$ -
	PHT D20 Supply 38110 - 100 Mg (8 Tanks)							-						-	-		-	$ -		$ -		-	$ -
542	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				8.00	8.00	item	30.00			Zone 3	2.33	559.20	Pipefitters	69.11	$ 38,647.99		$ -	6,500.00	10,725.00	$ 85,800.00
	Moderator D20 Supply 38110 - 100 Mg (7 Tanks)							-						-	-		-	$ -		$ -			$ -
543	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				7.00	7.00	item	30.00			Zone 3	2.33	489.30	Pipefitters	69.11	$ 33,816.99		$ -	6,500.00	10,725.00	$ 75,075.00
	TRF/SUP Feed 38110 - 100 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
544	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	6,500.00	10,725.00	$ 21,450.00
	TRF/SUP Product 38110 - 100 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
545	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	6,500.00	10,725.00	$ 21,450.00
	Downgraded D20 38500 - 50 Mg (2 Tanks)							-						-	-		-	$ -		$ -			$ -
546	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				2.00	2.00	item	30.00			Zone 3	2.33	139.80	Pipefitters	69.11	$ 9,662.00		$ -	5,500.00	9,075.00	$ 18,150.00
	Downgraded D20 38500 - 25 Mg (1 Tank)							-						-	-		-	$ -		$ -			$ -
547	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				1.00	1.00	item	30.00			Zone 3	2.33	69.90	Pipefitters	69.11	$ 4,831.00		$ -	5,000.00	8,250.00	$ 8,250.00
	D20 Clean up - 38410 - 25 Mg (3 Tanks)							-						-	-		-	$ -		$ -			$ -
548	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1				3.00	3.00	item	30.00			Zone 3	2.33	209.70	Pipefitters	69.11	$ 14,493.00		$ -	5,000.00	8,250.00	$ 24,750.00
								-						-	-		-	$ -		$ -			$ -
549	Rubber mats at all likely spill locations (25 ea) (6X4ft)		STIE 4.2.11.1				25.00	25.00	EA				Zone 3	2.33	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
550	Cathodic protection including all accessories (25 ea)		Bldg 4.1.5.1				25.00	25.00	EA	3.00			Zone 3	2.33	174.75	Electrical Workers	68.23	$ 11,923.72		$ -	1,500.00	2,475.00	$ 61,875.00
								-						-	-		-	$ -		$ -			$ -
551	Crane Heavy duty Rental (for 3 months @ $40,000/month)		Bldg 4.2.4.1				3.00	3.00	mnths				Zone 3	2.33	-	Building Works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
552	Stack Monitor (installation, electrical connections, switches)		PROC 4.2.2.6				2.00	2.00	nr				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
553	Stainless Steel Ducts in Effluent Stack (14" dia) - ALL		PROC 4.2.2.6				140.00	140.00	m				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
554	Stainless Steel hoods and cover		PROC 4.2.2.6				3.00	3.00	nr				Zone 3	2.33	-	Cladding	67.62	$ -		$ -		-	$ -
	COMMON GENERAL ITEMS							-						-	-		-	$ -		$ -		-	$ -
555	Cable Trays c/w hanging supports and metal brackets		Bldg 4.1.3.1	200.00			1.00	200.00	m	0.60			Unzoned	1.70	204.00	Electrical Workers	68.23	$ 13,919.53		$ -	12.71	20.97	$ 4,194.30
556	Pipe supports c/w supports and rawl plugs		STIE 4.2.1.1				46.00	46.00	nr	1.20	nr		Unzoned	1.70	93.84	Pipefitters	69.11	$ 6,485.56	10.00	$ 460.00		54.00	$ 2,484.00
557	Instrumentation - SCADA (tanks to Control Room)		PROC 4.3.5.1				25.00	25.00	nr				Unzoned	1.70	-	Pipefitters	69.11	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
	Tie-ins to existing services							-						-	-		-	$ -		$ -		-	$ -
558	X-ray scanning of tie-in locations		STIE 4.2.11.1				4.00	4.00	nr				Zone 3	2.33	-	Building works	60.43	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
	Sub-Total																	**$ 2,054,344.04**		**$ 460.00**			**$ 1,052,371.80**
	ELECTRICAL CONTROL SYSTEMS																						
559	Main Control Panel (600 wide x 800deep); 2000A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
560	Main Control Panel (600 wide x 800deep); 2500A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
561	Main Control Panel (600 wide x 800deep); 3000A		Bldg 4.1.1.6				1.00	1.00	nr					-	-	Electrical Workers	68.23	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -			$ -
562	Panel Boards; 2000A		Bldg 4.1.1.6				1.00	1.00	nr	4.00	nr	MEpg558	Unzoned	1.70	6.80	Electrical Workers	68.23	$ 463.98		$ -	11,140.05	18,381.08	$ 18,381.08
														-	-		-	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
								-						-	-		-	$ -		$ -			$ -
	Sub-Total																	**$ 463.98**		**$ -**			**$ 18,381.08**
	SPECIALIST EQUIPMENT																						
563	Mono rail system; 1T		Bldg 4.2.4.3				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
564	Mono rail system; 5T		Bldg 4.2.4.3				1.00	1.00	nr				Unzoned	1.70	-	Structural Steelwork	67.24	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**
	TOTAL																	**$ 6,765,676.84**		**$ 1,374,557.91**			**$ 3,837,858.83**

	LIFE CYCLE COSTINGS																						
	Replacement roof materials							-						-	-		-	$ -		$ -		-	$ -
565	Built up Roof at Lvl 115.00 - Re-roof at 25 years	2.3.1.3	Bldg 4.4.5.1				600.00	600.00	m2				Zone 3	2.33	-	Roofers	58.38	$ -		$ -		-	$ -
566	Epoxy floor coatings (1 re-coat)		Bldg 4.4.6.3				1,042.75	1,042.75	m2				Zone 3	2.33	-	Flooring	63.61	$ -		$ -		-	$ -
567	Duct controllers (15 years)		PROC 4.2.1.3				1.00	1.00	item				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
568	Control valves (15 years)		PROC 4.2.1.2				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
569	Valves (20 years)		PROC 4.2.1.2				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
570	SCADA (25 years)		PROC 4.3.5.1				1.00	1.00	item				Zone 3	2.33	-	Electrical Workers	68.23	$ -		$ -		-	$ -
571	Office furniture		Bldg 4.4.6.14-O				1.00	1.00	item				Zone 3	2.33	-		-	$ -		$ -		-	$ -
572	Office flooring		Bldg 4.4.6.3-O				250.00	250.00	m2				Zone 3	2.33	-	Flooring	63.61	$ -		$ -		-	$ -

DNGS Heavy Water Management Building - Construction Cost Estimate

1.65

Ref	Item	NRM Ref	PBS	Quantity						Labour								Construction Equipment		Materials		
				L	W	H	Nr	Qty	Unit	Norm		Norm Ref	Zone	Productivity	DFL Hours	Crew	Crew Rate	Labour Total	Rate	Equipment Total	Rate		Material Total
				[m]	[m]	[m]	[each]			Hrs/unit	Unit			[multiplier]	[Hrs]		[$/hr]	[$]	[$/unit]	[$]	[GBP/unit]	[CAD$/unit]	[$]
573	Washroom appliances		Bldg 4.4.6.14-O				1.00	1.00	item				Zone 3	2.33	-	Plumbers	66.47	$ -		$ -		-	$ -
574	Pumps (20 years) - overhaul and new impellers		PROC 4.2.2.4				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
575	Replacement of valves and controls to HVAC systems		PROC 4.2.1.7				1.00	1.00	item				Zone 3	2.33	-	Pipefitters	69.11	$ -		$ -		-	$ -
								-						-	-		-	$ -		$ -		-	$ -
	Sub-Total																	**$ -**		**$ -**			**$ -**

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
	[formulas >>>]				$ -		$ -	$ -				$ -	$ -	$ -	-		
	EXTERNAL WORKS																
	Remove existing surfaces				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
1	Clearing of Site / Site strip; 250mm deep	8.1.1.1	SPRP 4.4.7.1	5.60	$ 9,564.80	45%	$ 2,582.50	$ 12,147.30	60%	0%	40%	$ 7,288.38	$ -	$ 4,858.92	124.5 hrs		
2	Remove existing Conc Curbs & Dispose	8.1.2.3	SPRP 4.4.7.1		$ -	45%	$ 134.35	$ 957.62				$ 432.92	$ 524.70	$ -	12.5 hrs		
3	Remove existing Asphalt pavement and dispose	8.1.2.3	SPRP 4.4.7.1		$ -	45%	$ 752.38	$ 8,264.02				$ 2,424.34	$ 5,839.68	$ -	70.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Ground investigation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
4	Trial trenches, 3m deep; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ 854.49	$ 3,007.00				$ 2,753.36	$ 253.64	$ -	79.5 hrs		
5	Trial trenches, 3m deep, commencing from 3m depth; 5.0m x 0.50m	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ 854.49	$ 3,007.00				$ 2,753.36	$ 253.64	$ -	79.5 hrs		
	Temporary services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
6	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminaries		Bldg 4.7.2.5	2,279.39	$ 9,117.56	45%	$ 820.58	$ 9,938.14	20%	70%	10%	$ 1,987.63	$ 6,956.70	$ 993.81	30.9 hrs		
7	Lunchroom Trailers and Washroom Trailers 22ft * 7ft 6" c.w Drying Racks, Lockers, Tables, Seating, heaters, Microwave, etc. Including transportation @$1200/mnth		Bldg 4.7.2.4	1,200.00	$ 33,600.00	45%	$ -	$ 33,600.00	0%	100%	0%	$ -	$ 33,600.00	$ -	-		One Office trailer c/w Furniture and one Portable toilet for 24 months rental
8	Temporary Offices - 3 - 20' office trailers for 28 months rental @ $750 ea per month including furniture, mobilisation and demobilisation		Bldg 4.7.2.4	2,250.00	$ 63,000.00	45%	$ -	$ 63,000.00	0%	100%	0%	$ -	$ 63,000.00	$ -	-		One Office trailer c/w Furniture and one Portable toilet for 24 months rental
	Site access road				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
9	Temporary road to new site	8.2.1.1	Bldg 4.7.2.1	65.21	$ 54,774.72	45%	$ 7,394.59	$ 62,169.31	30%	50%	20%	$ 18,650.79	$ 31,084.65	$ 12,433.86	318.6 hrs		
	Temporary car parking				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
10	Car parking alternatives	8.2.1.3	Bldg 4.7.2.1	94.38	$ 33,976.80	45%	$ 4,586.87	$ 38,563.67	30%	50%	20%	$ 11,569.10	$ 19,281.83	$ 7,712.73	197.6 hrs		
	Temporary Fencing, Railing and Walls				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
11	Fencing, OPG Standard Security height, 2.4m; Corner posts braced, intermediate posts at 3m centres, 1.2m set in ground, concrete surround.	8.4.1.1	Bldg 4.7.2.3	164.00	$ 36,080.00	45%	$ 4,870.80	$ 40,950.80	30%	60%	10%	$ 12,285.24	$ 24,570.48	$ 4,095.08	182.7 hrs		
12	Pedestrian access around new site		Bldg 4.7.2.1		$ -	45%	$ 537.42	$ 8,123.17				$ 1,731.67	$ 402.00	$ 5,989.50	50.0 hrs		
13	Gates (3.6 Mx1.175 H)	8.4.1.3	Bldg 4.7.2.1	1,833.96	$ 7,335.84	45%	$ 990.34	$ 8,326.18	30%	60%	10%	$ 2,497.85	$ 4,995.71	$ 832.62	37.1 hrs		
	Street Furniture				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
14	External Lighting; Lighting Columns, OPG Security Standard c/w with lamp 8m high 2 luminnaire	8.7.9.2	SPRP 4.4.7.2	3,798.98	$ 18,994.91	45%	$ 2,564.31	$ 21,559.23	30%	60%	10%	$ 6,467.77	$ 12,935.54	$ 2,155.92	100.5 hrs		
15	Bollards; permanent bollard; non illuminated; galvanised steel removable and lockable pattern	8.4.4.3	SPRP 4.4.7.2		$ -	45%	$ 1,521.03	$ 14,325.23				$ 4,901.09	$ 760.98	$ 8,663.16	133.3 hrs		
16	Turnstiles		SPRP 4.4.7.2	5,060.84	$ 20,243.36	45%	$ 2,732.85	$ 22,976.21	30%	60%	10%	$ 6,892.86	$ 13,785.73	$ 2,297.62	114.1 hrs		
17	Directional signage		SPRP 4.4.7.2		$ -	45%	$ 42.78	$ 4,262.84				$ 137.84	$ -	$ 4,125.00	3.7 hrs		
18	Removal of one Light post incld UG cable		SPRP 4.4.7.2		$ -	45%	$ 30.04	$ 165.05				$ 96.81	$ 68.24	$ -	2.5 hrs		
	External drainage				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
19	Sewer line connections to main line		STIE 4.2.11.2	55.00	$ 2,200.00	45%	$ 396.00	$ 2,596.00	40%	40%	20%	$ 1,038.40	$ 1,038.40	$ 519.20	17.7 hrs		as per previous project
20	Storm water connections to main line		STIE 4.2.11.2	55.00	$ 2,750.00	45%	$ 495.00	$ 3,245.00	40%	40%	20%	$ 1,298.00	$ 1,298.00	$ 649.00	22.2 hrs		
21	Manholes/Access chambers; 750 x 700 chamber 1500 depth to invert; includes excavation, support, backfilling and disposal, concrete base, brickwork chamber, concrete cover slab, concrete benching and channels, step irons, access cover and frames	8.6.1.5	SPRP 4.4.7.2	2,786.44	$ 16,718.63	45%	$ 3,009.35	$ 19,727.98	40%	40%	20%	$ 7,891.19	$ 7,891.19	$ 3,945.60	134.8 hrs		
22	Valve Chambers; 1.2m diameter x 2.5m depth	8.6.1.5	SPRP 4.4.7.2	2,844.37	$ 11,377.48	45%	$ 2,047.95	$ 13,425.42	40%	40%	20%	$ 5,370.17	$ 5,370.17	$ 2,685.08	91.7 hrs		
23	Weeper tiles (perforated pipe in drainage under slab on grade c/w Geotextile membrane and stone surround (600mm Dia)		SPRP 4.4.7.1	200.00	$ 31,000.00	45%	$ 5,580.00	$ 36,580.00	40%	40%	20%	$ 14,632.00	$ 14,632.00	$ 7,316.00	249.9 hrs		
24	Excavation in rock for weeper tile (1mx1mx1m)		SPRP 4.4.7.1		$ -	45%	$ 5,553.29	$ 25,517.86				$ 17,893.95	$ 7,623.91	$ -	516.5 hrs		
	Connection to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
25	Main water line connections	8.7.1.1	Bldg 4.2.1.4	120.45	$ 2,409.00	45%	$ 433.62	$ 2,842.62	40%	40%	20%	$ 1,137.05	$ 1,137.05	$ 568.52	17.1 hrs		
26	Fire Hydrants		Bldg 4.2.10.2		$ -	45%	$ 762.75	$ 4,859.35				$ 2,457.74	$ -	$ 2,401.61	62.5 hrs		
27	CCTV cameras		Bldg 4.1.3.6-O	2,899.99	$ 46,399.84	45%	$ 6,263.98	$ 52,663.82	30%	50%	20%	$ 15,799.15	$ 26,331.91	$ 10,532.76	231.5 hrs		
28	Buried Services - Appendix - F - Standby Generator Cable Duct		SPRP 4.1.8.1	6,000.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	50%	20%	$ 2,043.00	$ 3,405.00	$ 1,362.00	29.9 hrs		
29	Buried Services - Appendix - F - Service water - Low pressure		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	15.4 hrs		
30	Buried Services - Appendix - F - Cables 500 below Ground		SPRP 4.1.8.1		$ -	45%	$ -	Excluded									
31	Buried Services - Appendix - F- 12" Steam & 3" Condensate return		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
32	Buried Services - Appendix - F- 6" Air		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
33	Buried Services - Appendix - F- 8" Water		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
34	Buried Services - Appendix - F- Inactive Drainage		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
35	Buried Services - Appendix - F- Misc Fire Line		SPRP 4.3.8.1		$ -	45%	$ -	Excluded									
36	Buried Services - Appendix - F-Fire Protection		SPRP 4.3.8.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
37	Buried Services - Appendix - F-Helium		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
38	Buried Services - Appendix - F- Oxygen		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
39	Buried Services - Appendix - F-Argon		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	14.8 hrs		
40	Buried Services - Appendix - F-Nitrogen		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
41	Buried Services - Appendix - F-Box Drain Sump		SPRP 4.2.12.1		$ -	45%	$ -	Excluded									
42	Buried Services - Appendix - F-600 mm Dia Corrugated Steel Pipe CSP Yard Drainage		SPRP 4.2.12.1	1,500.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	50%	20%	$ 510.75	$ 851.25	$ 340.50	8.7 hrs		
43	Relocate Existing Cable Duct from Standby Generators OIL Tanks # 1 & 2		SPRP 4.2.12.1	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	50%	20%	$ 1,021.50	$ 1,702.50	$ 681.00	15.0 hrs		
44	Relocate existing Low Pressure Service Water open system piping.		SPRP 4.2.12.1	1,500.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	50%	20%	$ 510.75	$ 851.25	$ 340.50	7.7 hrs		
	Demolition/removal of existing structures				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
45	Demolition of existing building (Offices)	9.2.1.1	SPRP 4.4.8.1	43.84	$ 6,904.88	45%	$ 1,864.32	$ 8,769.20	60%	10%	30%	$ 5,261.52	$ 876.92	$ 2,630.76	89.9 hrs		
46	Demolition of existing underground services (Offices)	9.2.1.2	SPRP 4.4.8.1	43.84	$ 1,380.98	45%	$ 372.86	$ 1,753.84	60%	10%	30%	$ 1,052.30	$ 175.38	$ 526.15	18.0 hrs		
47	Temporary Terminating of services	9.4.1.2	Bldg 4.7.2.5	178.56	$ 714.25	45%	$ 192.85	$ 907.10	60%	30%	10%	$ 544.26	$ 272.13	$ 90.71	9.3 hrs		
	Asphalt road				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
48	Reinstatement of Asphalt road (incld roadbase)		SPRP 4.4.7.2	65.21	$ 10,433.28	45%	$ 1,408.49	$ 11,841.77	30%	50%	20%	$ 3,552.53	$ 5,920.89	$ 2,368.35	60.7 hrs		
49	New Kerbs at roads (reinstated road portions)		SPRP 4.4.7.2	41.68	$ 2,667.46	45%	$ 360.11	$ 3,027.56	30%	50%	20%	$ 908.27	$ 1,513.78	$ 605.51	15.5 hrs		
50	Line painting;Continuous line in reflectorised white 200mm wide		SPRP 4.4.7.2	2.15	$ 343.20	45%	$ 46.33	$ 389.53	30%	50%	20%	$ 116.86	$ 194.77	$ 77.91	2.0 hrs		
51	Road signs		SPRP 4.4.7.2	172.43	$ 689.70	45%	$ 93.11	$ 782.81	30%	50%	20%	$ 234.84	$ 391.40	$ 156.56	4.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 449,676.67**		**$ 63,794.83**	**$ 574,917.61**				**$ 171,252.73**	**$ 308,303.91**	**$ 95,360.96**	**3,216.0 hrs**		
	SITE INVESTIGATION																
52	CAT scan of existing buried services and other obstacles	9.5.3.1	SPRP 4.4.7.1		$ -	45%	$ -	Excluded									BY OWNER
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ -**		**$ -**	**$ -**				**$ -**	**$ -**	**$ -**	**-**		
	WORKS TO EXISTING STRUCTURES																
53	Remove existing Loading bay and Dock	7.1.1.1	SPRP 4.4.8.1	43.84	$ 3,616.84	45%	$ 976.55	$ 4,593.39	60%	10%	30%	$ 2,756.03	$ 459.34	$ 1,378.02	47.1 hrs		
54	Cut and patch at new openings for pipes	7.1.1.2	SPRP 4.4.7.2	300.00	$ 15,000.00	45%	$ 4,050.00	$ 19,050.00	60%	10%	30%	$ 11,430.00	$ 1,905.00	$ 5,715.00	189.1 hrs		
55	New door for Access to new building	7.1.1.2	Bldg 4.4.6.1	1,334.03	$ 1,334.03	45%	$ 180.09	$ 1,514.12	30%	60%	10%	$ 454.24	$ 908.47	$ 151.41	7.5 hrs		
	Minor building works				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
56	Repairs to existing building after Ramp removal	8.8.1.1	SPRP 4.4.7.2	50.04	$ 6,255.56	45%	$ 844.50	$ 7,100.06	30%	60%	10%	$ 2,130.02	$ 4,260.04	$ 710.01	35.2 hrs		
57	Repairs to existing building after Loading dock removal	8.8.1.3	SPRP 4.4.7.2	40.64	$ 1,015.99	45%	$ 137.16	$ 1,153.15	30%	60%	10%	$ 345.94	$ 691.89	$ 115.31	5.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 27,222.42**		**$ 6,188.30**	**$ 33,410.72**				**$ 17,116.23**	**$ 8,224.74**	**$ 8,069.75**	**284.7 hrs**		
	SUBSTRUCTURE																
	EXCAVATION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Bulk excavation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
58	Vacuum Excavation (uptp 2.5 M) at buried services (4 weeks@$40,000/week		SPRP 4.7.1.2	40,000.00	$ 160,000.00	45%	$ 14,400.00	$ 174,400.00	20%	20%	60%	$ 34,880.00	$ 34,880.00	$ 104,640.00	595.8 hrs		4 weeks rental of Vaccuum truck & pumps
59	Hand Excavation around buried services		SPRP 4.4.7.1		$ -	45%	$ 1,269.64	$ 4,091.08				$ 4,091.08	$ -	$ -	118.1 hrs		hand excavation around cables
60	Bulk excavation for tank farm; 10-15m max depth		SPRP 4.4.7.1		$ -	45%	$ 198,871.75	$ 913,172.40				$ 640,808.96	$ 272,363.44	$ -	18,495.2 hrs		
61	Extra over for excavation in rock; 1.0-2.0m maximum depth		SPRP 4.4.7.1		$ -	45%	$ 43,888.94	$ 201,673.37				$ 141,419.91	$ 60,253.46	$ -	4,081.7 hrs		
62	Disposal of excavated material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4		$ -	45%	$ 34,288.23	$ 175,164.30				$ 110,484.30	$ 64,680.00	$ -	3,188.8 hrs		
63	Disposal of excavated rock material to temporary spoil heap; 100m from excavations		SPRP 4.4.7.4		$ -	45%	$ 3,291.67	$ 16,831.94				$ 10,606.49	$ 6,225.45	$ -	306.1 hrs		
64	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 12,618.07	$ 67,884.46				$ 40,658.22	$ 27,226.24	$ -	1,173.5 hrs		
65	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 75,434.11	$ 405,776.09				$ 243,065.47	$ 162,710.63	$ -	7,015.4 hrs		
66	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper; ADDITIONAL for contaminated sludge		SPRP 4.4.7.4	217.80	$ 1,667,531.25	45%	$ 375,194.53	$ 2,042,725.78	50%	0%	50%	$ 1,021,362.89	$ -	$ 1,021,362.89	17,446.7 hrs		
67	Disposal of excavated material from temporary spoil heap to licensed tip; Un-contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 75,434.11	$ 405,776.09				$ 243,065.47	$ 162,710.63	$ -	7,015.4 hrs		
68	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 82,291.76	$ 400,080.77				$ 265,162.33	$ 134,918.44	$ -	7,653.2 hrs		
69	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 10,972.23	$ 53,364.31				$ 35,354.98	$ 18,009.34	$ -	1,020.4 hrs		
70	Contaminated waste disposal fees (766 loads x 10 = 7660 M3)		SPRP 4.4.7.4		$ -	45%	$ -	Excluded									By Owner - cost not carried
	Detailed excavation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
71	Detailed excavation for 100Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 28,870.63	$ 132,662.97				$ 93,027.58	$ 39,635.39	$ -	2,685.0 hrs		
72	Detailed excavation for 50Mg tanks; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 2,110.43	$ 9,697.59				$ 6,800.26	$ 2,897.32	$ -	196.3 hrs		
73	Detailed excavation for 25Mg tanks; in rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 3,418.89	$ 15,710.09				$ 11,016.42	$ 4,693.66	$ -	318.0 hrs		
74	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 2,984.45	$ 13,713.79				$ 9,616.55	$ 4,097.24	$ -	277.6 hrs		
75	Detail Excavation for dike foundations; in rock; 1.0-2.0m maximum depth	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 6,090.71	$ 27,987.33				$ 19,625.62	$ 8,361.71	$ -	566.4 hrs		
76	Excavation for Inspection pit	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 5,107.35	$ 23,451.76				$ 16,457.02	$ 6,994.74	$ -	475.0 hrs		
77	Excavation for Inspection pit ; in rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 3,251.36	$ 14,940.29				$ 10,476.62	$ 4,463.67	$ -	302.4 hrs		
78	Detail Excavation for Weeper Tiles in Rock	1.1.1.1	SPRP 4.4.7.1		$ -	45%	$ 862.73	$ 3,964.32				$ 2,779.91	$ 1,184.41	$ -	80.2 hrs		
79	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4		$ -	45%	$ 3,014.90	$ 16,217.79				$ 9,714.68	$ 6,503.11	$ -	280.4 hrs		
80	Disposal of caisson spoils; removal 15 km distance; using 20 t tipper	8.8.3.1	SPRP 4.4.7.4		$ -	45%	$ 6,029.80	$ 32,435.59				$ 19,429.36	$ 13,006.22	$ -	560.8 hrs		
81	Disposal of excavated rock material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4		$ -	45%	$ 3,569.19	$ 18,251.04				$ 11,500.72	$ 6,750.32	$ -	331.9 hrs		
82	Disposal of excavated material to temporary spoil heap; 100m from excavations	1.2.1.5	SPRP 4.4.7.4		$ -	45%	$ 880.58	$ 4,498.51				$ 2,837.42	$ 1,661.09	$ -	81.9 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
83	Disposal of excavated rock material to temporary spoil heap; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 13,681.89	$ 73,607.77				$ 44,086.10	$ 29,521.67	$ -	1,272.4 hrs		
84	Disposal of excavated material from temporary spoil heap to licensed tip; Contaminated waste; removal 15 km distance; using 20 t tipper		SPRP 4.4.7.4		$ -	45%	$ 3,874.54	$ 20,841.99				$ 12,484.64	$ 8,357.35	$ -	360.3 hrs		
85	Double handling of excavated earth material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 2,113.39	$ 10,274.73				$ 6,809.80	$ 3,464.93	$ -	196.5 hrs		
86	Double handling of excavated rock material; using 1.5 m3 tractor loader and 22.5 t ADT; 1000m average distance moved		SPRP 4.4.7.4		$ -	45%	$ 11,897.30	$ 57,863.44				$ 38,335.74	$ 19,527.70	$ -	1,106.5 hrs		
87	Contaminated waste disposal fees	1.2.1.2	SPRP 4.4.7.4		$ -	45%	$ 387.45	$ 1,248.46				$ 1,248.46	$ -	$ -	36.0 hrs		By Owner - cost not carried
	Earthwork support				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
88	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter cast-in-place piles; 20N/mm2 concrete; nominal reinforcement	8.8.3.1	SPRP 4.4.7.1	188.27	$ 1,328,397.84	45%	$ 119,555.81	$ 1,447,953.65	20%	40%	40%	$ 289,590.73	$ 579,181.46	$ 579,181.46	4,660.8 hrs		
89	Caissons; bored in situ reinforced concrete piling; vertical 450mm diameter empty bores	8.8.3.1	SPRP 4.4.7.1	86.30	$ 608,897.52	45%	$ 54,800.78	$ 663,698.30	20%	40%	40%	$ 132,739.66	$ 265,479.32	$ 265,479.32	2,267.4 hrs		
90	Trimming material other than topsoil, rock or artificial hard material; using D4H dozer, tractor loader or motor grader average rate to sides of caisson walls; 45-90˚ to horizontal	8.8.3.1	SPRP 4.4.7.1		$ -	45%	$ 5,004.68	$ 19,967.61				$ 16,126.20	$ 3,841.41	$ -	465.4 hrs		
91	Trimming rock; using D6E dozer; vertical to sides of caisson walls	8.8.3.1	SPRP 4.4.7.1		$ -	45%	$ 7,073.28	$ 28,684.72				$ 22,791.69	$ 5,893.02	$ -	657.8 hrs		
92	Steel in Caissons (Soldier Piles) IPN 280 @ 54Kgs/LM; 203 x 203 mm; length 15m		SPRP 4.4.7.1	10,534.74	$ 316,042.16	45%	$ 14,221.90	$ 330,264.05	10%	60%	30%	$ 33,026.41	$ 198,158.43	$ 99,079.22	531.5 hrs		
93	Waterproofing to sides of wall (inside face); Bituthene 4000; lapped joints; at any inclination	1.3.1.1	SPRP 4.4.7.1		$ -	45%	$ 8,007.49	$ 77,983.58				$ 25,801.92	$ 4,830.95	$ 47,350.71	744.7 hrs		
94	Shoring for inspection pit	8.8.3.1	SPRP 4.4.7.1	120.00	$ 53,760.00	45%	$ 7,257.60	$ 61,017.60	30%	60%	10%	$ 18,305.28	$ 36,610.56	$ 6,101.76	312.7 hrs		
	Dewatering				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
95	Dewatering equipment (rental 3months)	9.3.1.1	SPRP 4.7.1.3	60,000.00	$ 60,000.00	45%	$ -	$ 60,000.00	0%	0%	100%	$ -	$ -	$ 60,000.00	-		
96	Holding tanks and filter bags(rental 3months)	9.3.1.1	SPRP 4.7.1.3	75,000.00	$ 75,000.00	45%	$ -	$ 75,000.00	0%	0%	100%	$ -	$ -	$ 75,000.00	-		
97	75mm pipes for temp dewatering - 2 lines for 300m length discharge to Intake		SPRP 4.7.1.3	20.00	$ 12,000.00	45%	$ 1,620.00	$ 13,620.00	30%	60%	10%	$ 4,086.00	$ 8,172.00	$ 1,362.00	69.8 hrs		
98	Pumps rental (3 months) 600 V - 2 ea		SPRP 4.7.1.3	3,000.00	$ 18,000.00	45%	$ -	$ 18,000.00	0%	0%	100%	$ -	$ -	$ 18,000.00	-		
99	Diesel Genset for Pumps rental (3 months)		SPRP 4.7.1.3	3,000.00	$ 18,000.00	45%	$ -	$ 18,000.00	0%	0%	100%	$ -	$ -	$ 18,000.00	-		
100	Diesel fuel (50 liters daily for 60 daysx2 ea)		SPRP 4.7.1.3	1.50	$ 9,000.00	45%	$ -	$ 9,000.00	0%	0%	100%	$ -	$ -	$ 9,000.00	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	BELOW GROUND CONSTRUCTION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Slab on grade				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
101	Level and compact bottoms of excavations	1.4.1.1	Bldg 4.4.7.1		$ -	45%	$ 3,620.39	$ 41,827.61				$ 11,665.70	$ 30,161.91	$ -	336.7 hrs		
102	Formwork to sides of slab on grade; plane vertical; width 0.3m	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,367.50	$ 5,599.93				$ 4,406.39	$ 551.34	$ 642.21	119.8 hrs		
103	Reinforcement to insitu concrete slab; 100kg/m3; deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.4.1.1	Bldg 4.4.1.2		$ -	45%	$ 8,915.84	$ 67,671.61				$ 28,728.81	$ 4,573.03	$ 34,369.76	781.2 hrs		
104	Insitu concrete slab on grade; Grade C40 cement; 300mm thick	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,593.69	$ 82,343.46				$ 8,357.43	$ 5,777.28	$ 68,208.75	227.3 hrs		
105	Less: Pad foundations for tanks	1.4.1.1	Bldg 4.4.1.1		$ -	45%	$ (684.46)	$ (21,730.09)				$ (2,205.49)	$ (1,524.60)	$ (18,000.00)	(60.0 hrs)		
106	Surface finish to insitu concrete slab on grade; Float finish		Bldg 4.4.1.1		$ -	45%	$ 960.62	$ 3,095.34				$ 3,095.34	$ -	$ -	84.2 hrs		
107	Weeping tiles below slab on grade; 225mm pipes unplasticized pvc pipes	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 539.21	$ 22,315.78				$ 1,737.44	$ 127.71	$ 20,450.63	50.1 hrs		
	Pad foundations for tanks				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
108	Formwork for 19 - 100 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 20,654.85	$ 89,760.49				$ 66,554.53	$ 8,328.22	$ 14,877.74	1,809.9 hrs		
109	Formwork for 2 - 50 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,494.76	$ 6,495.82				$ 4,816.45	$ 602.70	$ 1,076.68	131.0 hrs		
110	Formwork for 4 - 25 Mg Tank Foundations; curved; width exceeding 1.22m	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,329.49	$ 10,123.36				$ 7,506.15	$ 939.27	$ 1,677.94	204.1 hrs		
111	Reinforcement in Tank Foundations (150 Kgs/M3); deformed high yield steel bars in bent and cut lengths; using 16mm nominal size	1.1.1.1	Bldg 4.4.1.2		$ -	45%	$ 72,897.94	$ 553,298.59				$ 234,893.38	$ 37,390.17	$ 281,015.05	6,387.7 hrs		
112	Concrete for 19 - 100 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 10,426.73	$ 385,997.43				$ 33,597.24	$ 23,357.63	$ 329,042.56	913.6 hrs		
113	Concrete for 2- 50 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 592.87	$ 21,948.16				$ 1,910.37	$ 1,328.14	$ 18,709.66	52.0 hrs		
114	Concrete for 4 - 25 Mg Tank Foundations; thickness exceeding 500mm	1.1.1.1	Bldg 4.4.1.1		$ -	45%	$ 839.96	$ 31,095.39				$ 2,706.54	$ 1,881.66	$ 26,507.19	73.6 hrs		
115	Connection to main inspection pit (600 dia PVC)	1.4.1.8	Bldg 4.4.1.1	750.00	$ 37,500.00	45%	$ 5,062.50	$ 42,562.50	30%	60%	10%	$ 12,768.75	$ 25,537.50	$ 4,256.25	218.1 hrs		
	Inspection chamber				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
116	Formwork in Inspection Chamber -Base slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 56.90	$ 273.09				$ 183.33	$ 22.92	$ 66.84	5.0 hrs		
117	Formwork in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 3,422.31	$ 17,625.80				$ 11,027.45	$ 1,381.05	$ 5,217.30	299.9 hrs		
118	Formwork in Inspection Chamber -Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 3,969.88	$ 20,445.93				$ 12,791.85	$ 1,602.02	$ 6,052.07	347.9 hrs		
119	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 112.89	$ 541.85				$ 363.75	$ 45.48	$ 132.62	9.9 hrs		
120	Formwork in Inspection Chamber - Top Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 62.86	$ 301.70				$ 202.54	$ 25.32	$ 73.84	5.5 hrs		
121	Reinforcement in Inspection Chamber (150kgs/m3)	1.4.1.8	Bldg 4.4.1.2		$ -	45%	$ 292.32	$ 2,218.74				$ 941.93	$ 149.94	$ 1,126.88	25.6 hrs		
122	Concrete in Inspection Chamber - Blinding; 150-300mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 10.28	$ 341.75				$ 33.13	$ 4.42	$ 304.20	0.9 hrs		
123	Concrete in Inspection Chamber - Base Slab; 250mm thick	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 14.46	$ 459.05				$ 46.59	$ 32.21	$ 380.25	1.3 hrs		
124	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 227.44	$ 6,133.35				$ 732.87	$ 506.73	$ 4,893.75	19.9 hrs		
125	Concrete in Inspection Chamber - Walls	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 196.07	$ 5,287.37				$ 631.78	$ 436.84	$ 4,218.75	17.2 hrs		
126	Concrete in Inspection Chamber - Top Slab	1.4.1.8	Bldg 4.4.1.1		$ -	45%	$ 17.99	$ 571.09				$ 57.96	$ 40.07	$ 473.06	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
	Basement Walls				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
127	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,440.94	$ 6,240.46				$ 4,643.02	$ 589.59	$ 1,007.84	126.3 hrs		
128	Formwork in Dike wall Foundations; rough finish; plane vertical; width exceeding 1.22m	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,149.95	$ 13,641.93				$ 10,149.85	$ 1,288.88	$ 2,203.20	276.0 hrs		
129	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,048.08	$ 38,800.04				$ 3,377.16	$ 2,347.88	$ 33,075.00	91.8 hrs		
130	Concrete in Dike wall Foundations; thickness exceeding 500mm	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,010.61	$ 74,432.73				$ 6,478.63	$ 4,504.10	$ 63,450.00	176.2 hrs		
131	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 12,753.82	$ 65,685.49				$ 41,095.64	$ 5,146.71	$ 19,443.14	1,117.6 hrs		
132	Formwork in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 27,880.44	$ 143,591.55				$ 89,836.99	$ 11,250.95	$ 42,503.60	2,443.0 hrs		
133	Reinforcement in Walls/Dikes (@120kgs/M3)	1.3.1.1	Bldg 4.4.1.2		$ -	45%	$ 122,775.49	$ 931,871.32				$ 395,609.90	$ 62,972.91	$ 473,288.51	10,758.2 hrs		
134	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 9,991.73	$ 269,444.31				$ 32,195.57	$ 22,261.24	$ 214,987.50	875.5 hrs		
135	Concrete in Dike wall	1.3.1.1	Bldg 4.4.1.1		$ -	45%	$ 19,167.81	$ 516,893.16				$ 61,762.93	$ 42,705.23	$ 412,425.00	1,679.6 hrs		
	Concrete Ancillaries				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
136	Step ladders inside Inspection Chamber	1.4.1.8	Bldg 4.4.3.3	53.74	$ 2,687.03	45%	$ 362.75	$ 3,049.77	30%	60%	10%	$ 914.93	$ 1,829.86	$ 304.98	14.7 hrs		
137	Manhole cover to inspection chamber; Complete with frame; Bed and set in concrete; access cover and frame	1.4.1.8	Bldg 4.4.3.3	544.50	$ 544.50	45%	$ 73.51	$ 618.01	30%	60%	10%	$ 185.40	$ 370.80	$ 61.80	3.0 hrs		
138	Rock anchors; 25mm diameter; 2m length; including drilling, steel and grout	1.4.1.9	Bldg 4.4.1.2	50.00	$ 600.00	45%	$ 162.00	$ 762.00	60%	30%	10%	$ 457.20	$ 228.60	$ 76.20	7.8 hrs		
139	Rock Anchors 25mm - 2M Deep; including drilling, steel and grout	1.1.1.1	Bldg 4.4.1.2	50.00	$ 21,050.00	45%	$ 5,683.50	$ 26,733.50	60%	30%	10%	$ 16,040.10	$ 8,020.05	$ 2,673.35	274.0 hrs		
140	Rock anchors 25mm 2M length for Dike wall		Bldg 4.4.1.2	50.00	$ 7,250.00	45%	$ 978.75	$ 8,228.75	30%	60%	10%	$ 2,468.63	$ 4,937.25	$ 822.88	42.2 hrs		
141	Insulation at Basement upto 1.5 M; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 1,067.67	$ 6,233.11				$ 3,440.26	$ -	$ 2,792.86	99.3 hrs		
142	Insulation at Loading bay walls; boards; polystherene standard grade; fixing with adhesive; to floors; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 98.53	$ 575.20				$ 317.47	$ -	$ 257.73	9.2 hrs		
143	Insulation at Loading bay slab; boards; polystherene standard grade; fixing with adhesive; to walls; 40mm thick		Bldg 4.4.5.1		$ -	45%	$ 22.17	$ 168.49				$ 71.43	$ -	$ 97.06	2.1 hrs		
144	Trace heating to Loading bay Ramp & slab		Bldg 4.4.5.1	261.83	$ 23,041.04	45%	$ 3,110.54	$ 26,151.58	30%	60%	10%	$ 7,845.47	$ 15,690.95	$ 2,615.16	115.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 4,419,301.33**		**$ 1,595,415.75**	**$ 11,691,224.08**				**$ 4,774,117.70**	**$ 2,534,689.27**	**$ 4,382,417.12**	**117,123.5 hrs**		
	SUPERSTRUCTURE																
	Insitu concrete walls to first floor				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
145	Formwork - wall above Lvl 100.00 - 5 M high external; basic finish; height 3m above floor level	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 132,842.79	$ 449,636.76				$ 428,048.99	$ -	$ 21,587.78	11,640.3 hrs		
146	Reinforcement in concrete walls; 120kgs/m3; 12 mm diameter; bent		Bldg 4.4.1.2		$ -	45%	$ 23,442.85	$ 92,627.78				$ 75,538.06	$ -	$ 17,089.72	2,054.2 hrs		
147	Concrete wall above Lvl 100.00 - 5 M high external; grade C40	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 22,221.86	$ 110,135.03				$ 71,603.78	$ -	$ 38,531.25	1,947.2 hrs		
148	Formwork Columns (400x400) - wall above Lvl 100.00 -7.8 M high	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 36,303.90	$ 118,839.92				$ 116,979.23	$ -	$ 1,860.69	3,181.1 hrs		
149	Reinforcement for Columns (400x400) @ 150 kgs/m3; 12mm diameter; bent		Bldg 4.4.1.2		$ -	45%	$ 2,562.63	$ 10,125.50				$ 8,257.36	$ -	$ 1,868.14	224.6 hrs		
150	Columns (400x400) - Concrete wall above Lvl 100.00 - 7.8 M high	2.5.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,160.57	$ 13,553.67				$ 10,184.07	$ -	$ 3,369.60	276.9 hrs		
151	Concrete topping finishes - Hardeners; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 12,391.03	$ 59,781.66				$ 39,926.66	$ -	$ 19,855.00	1,085.8 hrs		
	Insitu concrete upper floors - Beams				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
152	Formwork for Beams (300x750)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 15,464.58	$ 51,957.57				$ 49,830.31	$ -	$ 2,127.26	1,355.1 hrs		
153	Reinforcement in Beams (300x750) @ 200kg/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 3,878.62	$ 15,325.28				$ 12,497.78	$ -	$ 2,827.50	339.9 hrs		
154	Concrete in Beams (300x750)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,561.34	$ 15,272.32				$ 11,475.44	$ -	$ 3,796.88	312.1 hrs		
155	35mpa Concrete in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 24,375.43	$ 123,093.04				$ 78,543.04	$ -	$ 44,550.00	2,135.9 hrs		
156	Formwork in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 104,779.82	$ 347,795.13				$ 337,623.87	$ -	$ 10,171.26	9,181.3 hrs		
157	Formwork (sides) in Suspended slab at Lvl 107.8 - 300mm thk	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 4,905.60	$ 16,283.14				$ 15,806.94	$ -	$ 476.20	429.9 hrs		
158	Reinforcement in Suspended slab at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 33,880.90	$ 133,870.80				$ 109,171.79	$ -	$ 24,699.01	2,968.8 hrs		
159	35 mpa Concrete in Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 3,043.23	$ 13,050.48				$ 9,805.98	$ -	$ 3,244.50	266.7 hrs		
160	35 mpa Concrete in Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 2,171.63	$ 9,312.72				$ 6,997.47	$ -	$ 2,315.25	190.3 hrs		
161	Formwork for Beams External at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 9,484.94	$ 31,867.31				$ 30,562.59	$ -	$ 1,304.72	831.1 hrs		
162	Formwork for Beams Internal at Lvl 107.80 (350x700)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 6,735.68	$ 22,630.41				$ 21,703.87	$ -	$ 926.54	590.2 hrs		
163	Reinforcement in Beams at Lvl 107.8 @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 7,399.04	$ 29,235.22				$ 23,841.35	$ -	$ 5,393.86	648.3 hrs		
164	35 mpa Concrete in Column footing (1.2x1.2x1.5) 6 ea	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 110.88	$ 3,520.27				$ 357.29	$ 246.99	$ 2,916.00	9.7 hrs		
165	Rock anchors 25mm 2M length for Col footing 9ea/6ftgs	2.2.1.1	Bldg 4.4.1.2	50.00	$ 2,700.00	45%	$ 364.50	$ 3,064.50	30%	60%	10%	$ 919.35	$ 1,838.70	$ 306.45	14.8 hrs		
166	Reinforcement in Col footing at 120kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 1,774.13	$ 7,009.96				$ 5,716.63	$ -	$ 1,293.33	155.5 hrs		
167	35 mpa Concrete in Columns (600x600) lvl 87.00 to lvl100.00	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 5,743.74	$ 24,631.20				$ 18,507.60	$ -	$ 6,123.60	503.3 hrs		
168	Formwork for Columns (600x600)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 43,983.57	$ 143,979.13				$ 141,724.83	$ -	$ 2,254.30	3,854.1 hrs		
169	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 4,657.08	$ 18,401.15				$ 15,006.16	$ -	$ 3,394.99	408.1 hrs		
170	35 mpa Concrete in Columns (450x450) at Lvl 100.00 to Lvl 107.80	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 1,871.84	$ 8,027.13				$ 6,031.49	$ -	$ 1,995.64	164.0 hrs		
171	Formwork for Columns (450x450)	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 19,111.91	$ 62,562.36				$ 61,582.81	$ -	$ 979.55	1,674.7 hrs		
172	Reinforcement in Columns @ 150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 1,517.71	$ 5,996.80				$ 4,890.40	$ -	$ 1,106.40	133.0 hrs		
173	Reinforcement at Column locations in Dike walls (ext) @150kgs/m3	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 5,475.70	$ 21,635.68				$ 17,643.93	$ -	$ 3,991.76	479.8 hrs		
	Insitu concrete upper floor - Ground floor slab				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
174	Formwork for Suspended slab at 100.00	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 165,544.18	$ 549,489.96				$ 533,420.14	$ -	$ 16,069.82	14,505.8 hrs		
175	Reinforcement at Suspended slab at 100.00 (120Kg/m3)	2.2.1.1	Bldg 4.4.1.2		$ -	45%	$ 50,308.00	$ 198,777.86				$ 162,103.57	$ -	$ 36,674.29	4,408.2 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
176	Concrete in Suspended slab at LVL-100.00; thickness 150-450mm	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 45,242.27	$ 228,468.14				$ 145,780.64	$ -	$ 82,687.50	3,964.4 hrs		
177	Less Concrete at Openings in slab - Elevators/Staircase	2.2.1.1	Bldg 4.4.1.1		$ -	45%	$ 123.11	$ 621.68				$ 396.68	$ -	$ 225.00	10.8 hrs		
	Insitu concrete loading bay				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
178	Formwork for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 2,298.65	$ 7,611.62				$ 7,406.77	$ -	$ 204.85	201.4 hrs		
179	Formwork for Walls & Fdn to Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 3,296.83	$ 11,158.87				$ 10,623.11	$ -	$ 535.76	288.9 hrs		
180	Formwork for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 11,635.86	$ 39,384.24				$ 37,493.34	$ -	$ 1,890.90	1,019.6 hrs		
181	Reinforcement for Loading Bay Walls/Pit/Ramp (120kgs/m3)	5.10.7.1	Bldg 4.4.1.2		$ -	45%	$ 136,892.53	$ 540,892.12				$ 441,098.14	$ -	$ 99,793.98	11,995.2 hrs		
182	Concrete for Ramps to Loading Bay; sloping	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 5,763.75	$ 28,247.07				$ 18,572.07	$ -	$ 9,675.00	505.0 hrs		
183	Concrete for Walls at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 1,038.10	$ 5,144.99				$ 3,344.99	$ -	$ 1,800.00	91.0 hrs		
184	Concrete for Pits at Loading Bay	5.10.7.1	Bldg 4.4.1.1		$ -	45%	$ 4,022.64	$ 19,936.85				$ 12,961.85	$ -	$ 6,975.00	352.5 hrs		
	Miscellaneous concrete works				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
185	Formwork for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1		$ -	45%	$ 2,327.17	$ 7,876.85				$ 7,498.67	$ -	$ 378.18	203.9 hrs		
186	Rebar for Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.2		$ -	45%	$ 328.54	$ 1,298.14				$ 1,058.64	$ -	$ 239.51	28.8 hrs		
187	Concrete at Kerb walls at Cleaning at Drum Cleaning areas		Bldg 4.4.1.1		$ -	45%	$ 467.15	$ 2,315.25				$ 1,505.25	$ -	$ 810.00	40.9 hrs		
188	Nosing angle SS at Kerb walls at Cleaning at Drum Cleaning areas; angle section bearers; 90 x 90 x 6mm		Bldg 4.4.3.1		$ -	45%	$ 2,357.59	$ 18,798.21				$ 7,596.69	$ -	$ 11,201.52	206.6 hrs		
189	Precast concrete at mid landing slab inside Inspection chamber		Bldg 4.4.1.1	350.00	$ 1,260.00	45%	$ 170.10	$ 1,430.10	30%	60%	10%	$ 429.03	$ 858.06	$ 143.01	6.9 hrs		
190	Precast concrete cover slab to inspection chamber		Bldg 4.4.1.1	4,500.00	$ 4,500.00	45%	$ 607.50	$ 5,107.50	30%	60%	10%	$ 1,532.25	$ 3,064.50	$ 510.75	24.7 hrs		
191	Precast concrete inspection pit; 15m x 2.5m x 2.5m		Bldg 4.4.1.1	3,500.00	$ 52,500.00	45%	$ 7,087.50	$ 59,587.50	30%	60%	10%	$ 17,876.25	$ 35,752.50	$ 5,958.75	287.7 hrs		
	Structural steel frame				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
192	Base plates for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.3.3	120.00	$ 2,160.00	45%	$ 291.60	$ 2,451.60	30%	60%	10%	$ 735.48	$ 1,470.96	$ 245.16	10.9 hrs		
193	Foundation Bolts 20mm for Steel frames at Lvl 107.8 (300x300)	2.1.1.1	Bldg 4.4.1.2	45.00	$ 3,240.00	45%	$ 437.40	$ 3,677.40	30%	60%	10%	$ 1,103.22	$ 2,206.44	$ 367.74	16.4 hrs		
194	Grouting of Base plates (300x300)	2.1.1.1	Bldg 4.4.1.3	120.00	$ 2,160.00	45%	$ 291.60	$ 2,451.60	30%	60%	10%	$ 735.48	$ 1,470.96	$ 245.16	10.9 hrs		
195	Intumescent painting to Steel Columns; paint fire protection (60 minutes); spray applied	2.1.1.2	Bldg 4.4.5.3	22.72	$ 3,299.02	45%	$ 445.37	$ 3,744.38	30%	60%	10%	$ 1,123.32	$ 2,246.63	$ 374.44	18.6 hrs		
	Structural Steel frame work Lvl 107.80 to roof (7.2M Height)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
196	Steel members in frame work (15kgs/sqft)		Bldg 4.4.3.1	3,130.88	$ 344,396.25	45%	$ 46,493.49	$ 390,889.74	30%	60%	10%	$ 117,266.92	$ 234,533.85	$ 39,088.97	1,743.9 hrs		
197	Roof trusses at 115.00m level; Steel roof trusses and beams; thermal and acoustic insulation;aluminum profiled composite cladding	2.3.1.1	Bldg 4.4.3.1	399.30	$ 243,573.00	45%	$ 32,882.36	$ 276,455.36	30%	60%	10%	$ 82,936.61	$ 165,873.21	$ 27,645.54	1,233.4 hrs		
	Fire protection to structural steelwork				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
198	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3	22.72	$ 19,994.04	45%	$ 2,699.20	$ 22,693.24	30%	60%	10%	$ 6,807.97	$ 13,615.94	$ 2,269.32	112.7 hrs		
199	Fire protection to Steel frame	2.1.1.1	Bldg 4.4.5.3	22.72	$ 14,995.53	45%	$ 2,024.40	$ 17,019.93	30%	60%	10%	$ 5,105.98	$ 10,211.96	$ 1,701.99	84.5 hrs		
	Hoist gantries				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
200	Structural Steel Gantry for Hoists 1 T & 5 T	2.1.1.1	Bldg 4.4.3.2	3.13	$ 30,306.87	45%	$ 4,091.43	$ 34,398.30	30%	60%	10%	$ 10,319.49	$ 20,638.98	$ 3,439.83	153.5 hrs		
	Insitu concrete upper floors				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
201	Surface finish to insitu concrete; Two coats epoxy anti slip floor paint on screeded surfaces	2.2.2.1	Bldg 4.4.1.1		$ -	45%	$ 10,457.07	$ 50,451.08				$ 33,695.00	$ -	$ 16,756.08	916.3 hrs		
	Tank inspection platforms				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
202	Open grid flooring for inspection around tanks on 94.00m level	2.1.1.1	Bldg 4.4.3.1	502.30	$ 296,357.74	45%	$ 40,008.29	$ 336,366.03	30%	60%	10%	$ 100,909.81	$ 201,819.62	$ 33,636.60	1,500.7 hrs		
	Roof structure				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
203	Built up Roof at Lvl 115.00m; steel roof trusses and beams; thermal and acoustic insulation; aluminum profiled composite cladding	2.3.1.3	Bldg 4.4.5.1	399.30	$ 239,580.00	45%	$ 32,343.30	$ 271,923.30	30%	60%	10%	$ 81,576.99	$ 163,153.98	$ 27,192.33	1,397.4 hrs		
204	Waterproofing to Roof	2.3.2.1	Bldg 4.4.5.1	121.95	$ 87,805.08	45%	$ 11,853.69	$ 99,658.77	30%	60%	10%	$ 29,897.63	$ 59,795.26	$ 9,965.88	512.1 hrs		
205	Waterproofing to openings	2.3.2.1	Bldg 4.4.5.1	134.15	$ 2,146.35	45%	$ 289.76	$ 2,436.10	30%	60%	10%	$ 730.83	$ 1,461.66	$ 243.61	12.5 hrs		
206	Metal Flashings	2.3.2.1	Bldg 4.4.3.1	147.56	$ 32,315.93	45%	$ 4,362.65	$ 36,678.58	30%	60%	10%	$ 11,003.57	$ 22,007.15	$ 3,667.86	188.5 hrs		
207	Roof anchors SS on roof (6 nrs)		Bldg 4.4.3.1	4,500.00	$ 27,000.00	45%	$ 3,645.00	$ 30,645.00	30%	60%	10%	$ 9,193.50	$ 18,387.00	$ 3,064.50	136.7 hrs		
208	600 x 600 x 2mm plain Cement tiles on roof at pathways c/w spacers & underpads		Bldg 4.4.6.6	42.19	$ 5,771.66	45%	$ 779.17	$ 6,550.83	30%	60%	10%	$ 1,965.25	$ 3,930.50	$ 655.08	33.7 hrs		
	Rainwater goods				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
209	Rainwater down take pipes; fixed to backgrounds; including offsets and shoes; 110mm diameter uPVC	2.3.4.2	Bldg 4.4.5.1	22.87	$ 2,058.21	45%	$ 277.86	$ 2,336.07	30%	60%	10%	$ 700.82	$ 1,401.64	$ 233.61	12.0 hrs		
	Cladding				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
210	Metal cladding External walls at Lvl 105.00 to 107.80; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	82.58	$ 42,992.45	45%	$ 5,803.98	$ 48,796.43	30%	60%	10%	$ 14,638.93	$ 29,277.86	$ 4,879.64	216.5 hrs		
211	Metal cladding External walls at Lvl 107.80 to 115.00; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.3.4	82.58	$ 92,839.25	45%	$ 12,533.30	$ 105,372.54	30%	60%	10%	$ 31,611.76	$ 63,223.53	$ 10,537.25	467.5 hrs		
212	Metal cladding external walls to staircase above 115.00m level; Metal profiled cladding; coated steel profiled cladding on steel rails; insulated and built up system	2.5.1.1	Bldg 4.4.1.1	82.58	$ 4,162.16	45%	$ 561.89	$ 4,724.05	30%	60%	10%	$ 1,417.21	$ 2,834.43	$ 472.40	21.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 1,558,113.52**		**$ 1,189,301.79**	**$ 5,439,089.21**				**$ 3,684,952.92**	**$ 1,061,322.29**	**$ 692,813.99**	**93,998.5 hrs**		
	STAIRCASES																
213	Light duty metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide	2.44.1	Bldg 4.4.3.3	6,715.50	$ 53,724.00	45%	$ 7,252.74	$ 60,976.74	30%	60%	10%	$ 18,293.02	$ 36,586.04	$ 6,097.67	272.0 hrs		
214	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3	480.98	$ 6,733.65	45%	$ 909.04	$ 7,642.69	30%	60%	10%	$ 2,292.81	$ 4,585.62	$ 764.27	34.1 hrs		
215	Light duty spiral metal staircase; galvanised finish; perforated treads; no risers; balustrades and handrails; 3m rise; straight; 900mm wide - Lvl 87.00 to Lvl 94.00 at Platform -Emergency	2.44.1	Bldg 4.4.3.3	7,623.00	$ 15,246.00	45%	$ 2,058.21	$ 17,304.21	30%	60%	10%	$ 5,191.26	$ 10,382.53	$ 1,730.42	77.2 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
216	plus for each 300mm variation in storey height	2.44.1	Bldg 4.4.3.3	598.95	$ 1,796.85	45%	$ 242.57	$ 2,039.42	30%	60%	10%	$ 611.83	$ 1,223.65	$ 203.94	9.1 hrs		
217	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	502.30	$ 16,073.64	45%	$ 2,169.94	$ 18,243.58	30%	60%	10%	$ 5,473.07	$ 10,946.15	$ 1,824.36	81.4 hrs		
218	Landing; chequer plate; galvanised; over 300mm wide; 6mm thick	2.44.1	Bldg 4.4.3.3	502.30	$ 16,073.64	45%	$ 2,169.94	$ 18,243.58	30%	60%	10%	$ 5,473.07	$ 10,946.15	$ 1,824.36	81.4 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 109,647.78**		**$ 14,802.45**	**$ 124,450.23**				**$ 37,335.07**	**$ 74,670.14**	**$ 12,445.02**	**555.2 hrs**		
	WINDOWS AND EXTERNAL DOORS																
219	Aluminium Windows (Offices); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2-O	807.68	$ 18,172.69	45%	$ 2,453.31	$ 20,626.00	30%	60%	10%	$ 6,187.80	$ 12,375.60	$ 2,062.60	102.4 hrs		
220	Aluminium Windows (Drum Handling); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 10,903.61	45%	$ 1,471.99	$ 12,375.60	30%	60%	10%	$ 3,712.68	$ 7,425.36	$ 1,237.56	61.4 hrs		
221	Aluminium Windows (HVAC Rm); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 10,903.61	45%	$ 1,471.99	$ 12,375.60	30%	60%	10%	$ 3,712.68	$ 7,425.36	$ 1,237.56	61.4 hrs		
222	Aluminium Windows (Roof); standard windows; anodised finish; double glazed	2.6.1.1	Bldg 4.4.6.2	807.68	$ 3,634.54	45%	$ 490.66	$ 4,125.20	30%	60%	10%	$ 1,237.56	$ 2,475.12	$ 412.52	20.5 hrs		
223	Exterior Doors c/w Frame door; single external steel door, including frame, ironmongery, powder coated finish	2.6.2.1	Bldg 4.4.6.1	1,334.03	$ 8,004.15	45%	$ 1,080.56	$ 9,084.71	30%	60%	10%	$ 2,725.41	$ 5,450.83	$ 908.47	45.1 hrs		
224	Rolling Shutters and collapsible gtes; galvanised steel; 1 hr fire resisting; self coiling; activated by fusible link; fixing with bolts; 2400 mm x 2750 mm	2.6.1.3	Bldg 4.4.6.1	3,244.46	$ 6,488.92	45%	$ 876.00	$ 7,364.92	30%	60%	10%	$ 2,209.48	$ 4,418.95	$ 736.49	36.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 58,107.52**		**$ 7,844.51**	**$ 65,952.03**				**$ 19,785.61**	**$ 39,571.22**	**$ 6,595.20**	**327.4 hrs**		
	INTERNAL WALLS AND PARTITIONS																
	Internal walls and partitions				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
225	Concrete filled Hollow Block Masonry 200mm(Offices)	2.7.1.1	Bldg 4.4.2.2-O		$ -	45%	$ 9,554.36	$ 43,090.50				$ 30,786.26	$ -	$ 12,304.23	846.0 hrs		
226	Concrete filled Hollow Block Masonry 200mm(Clean up Rm)	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 4,725.81	$ 21,313.58				$ 15,227.61	$ -	$ 6,085.97	418.4 hrs		
227	Hollow Block Masonry 150 mm(HVAC/Elec))	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 2,912.71	$ 17,844.90				$ 9,385.39	$ 817.34	$ 7,642.17	257.9 hrs		
228	GWB on side of Block Masonry inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	98.01	$ 16,980.23	45%	$ 2,292.33	$ 19,272.56	30%	60%	10%	$ 5,781.77	$ 11,563.54	$ 1,927.26	95.7 hrs		
229	GWB (Acoustic) wall inside office; Metal stud and plasterboard partitions; 90mm thick; 1 layer 13mm board each side; tape and fill joints; emulsion finish	2.7.1.1	Bldg 4.4.3.5-O	117.98	$ 19,200.43	45%	$ 2,592.06	$ 21,792.49	30%	60%	10%	$ 6,537.75	$ 13,075.49	$ 2,179.25	108.2 hrs		
230	Metal Stud Cement Board walls (Washroom)	2.7.1.1	Bldg 4.4.3.3-O	141.57	$ 10,978.75	45%	$ 1,482.13	$ 12,460.89	30%	60%	10%	$ 3,738.27	$ 7,476.53	$ 1,246.09	61.9 hrs		
231	Hollow Block Masonry 150mm in Battery room (UPS system)	2.7.1.1	Bldg 4.4.2.2		$ -	45%	$ 460.99	$ 2,824.29				$ 1,485.41	$ 129.36	$ 1,209.52	40.8 hrs		
	Surface finishes to internal walls and partitions				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
232	Masonry wall Finishes; Two coats emulsion paint finish	3.1.1.1	Bldg 4.4.6.6		$ -	45%	$ 13,970.09	$ 47,436.57				$ 45,014.73	$ -	$ 2,421.84	1,258.6 hrs		
233	GWB Wall Finishes	3.1.1.1	Bldg 4.4.6.15-O		$ -	45%	$ 12,093.63	$ 42,410.70				$ 38,968.37	$ -	$ 3,442.33	1,089.6 hrs		
234	Finishes to Concrete walls	3.1.1.1	Bldg 4.4.6.6		$ -	45%	$ 31,901.12	$ 108,322.83				$ 102,792.49	$ -	$ 5,530.34	2,874.1 hrs		
235	Epoxy painting to walls at Storage area		Bldg 4.4.6.6		$ -	45%	$ 21,163.68	$ 102,106.10				$ 68,194.08	$ -	$ 33,912.02	1,854.5 hrs		
236	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 1,025.19	$ 4,208.33				$ 3,303.37	$ -	$ 904.96	92.4 hrs		
237	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 284.77	$ 1,168.98				$ 917.60	$ -	$ 251.38	25.7 hrs		
238	Ceramic to walls at Washrooms (male & female)		Bldg 4.4.6.15-O		$ -	45%	$ 56.95	$ 233.80				$ 183.52	$ -	$ 50.28	5.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	2.8 INTERNAL DOORS				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
239	Internal Doors c/w Frames (Offices); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; hardwood faced	2.8.1.2	Bldg 4.4.6.1-O	843.98	$ 4,219.88	45%	$ 569.68	$ 4,789.56	30%	60%	10%	$ 1,436.87	$ 2,873.73	$ 478.96	23.8 hrs		
240	Internal Doors c/w Frames (Washroom); Standard softwood doors and hardwood frames; including lintel; ironmongery and painting; flush; solid core; single leaf	2.8.1.1	Bldg 4.4.6.1-O	816.75	$ 1,633.50	45%	$ 220.52	$ 1,854.02	30%	60%	10%	$ 556.21	$ 1,112.41	$ 185.40	9.2 hrs		
241	Internal Doors c/w Frames (HVAC); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1	1,361.25	$ 5,445.00	45%	$ 735.08	$ 6,180.08	30%	60%	10%	$ 1,854.02	$ 3,708.05	$ 618.01	30.7 hrs		
242	Fire Resistant doors c/w Frames; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1	2,132.63	$ 8,530.50	45%	$ 1,151.62	$ 9,682.12	30%	60%	10%	$ 2,904.64	$ 5,809.27	$ 968.21	48.1 hrs		
243	Internal Doors c/w Frames (Clean up room); Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing solid core; heavy duty; single leaf	2.8.1.2	Bldg 4.4.6.1	1,361.25	$ 2,722.50	45%	$ 367.54	$ 3,090.04	30%	60%	10%	$ 927.01	$ 1,854.02	$ 309.00	15.3 hrs		
244	New door for Access to new building from Exstg Bldg; Softwood doors and hardwood frames; including lintel; ironmongery, painting and polishing flush; 1 hr fire resisting; single leaf	2.8.1.2	Bldg 4.4.6.1	2,132.63	$ 6,397.88	45%	$ 863.71	$ 7,261.59	30%	60%	10%	$ 2,178.48	$ 4,356.95	$ 726.16	36.0 hrs		
245	Automatic door; magnetic locks	2.8.1.2	Bldg 4.4.6.1	600.00	$ 10,800.00	45%	$ 1,458.00	$ 12,258.00	30%	60%	10%	$ 3,677.40	$ 7,354.80	$ 1,225.80	60.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Internal floor finishes				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
246	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 2,268.75	45%	$ 306.28	$ 2,575.03	30%	60%	10%	$ 772.51	$ 1,545.02	$ 257.50	12.8 hrs		
247	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 4,719.00	45%	$ 637.07	$ 5,356.07	30%	60%	10%	$ 1,606.82	$ 3,213.64	$ 535.61	26.6 hrs		
248	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 12,024.38	45%	$ 1,623.29	$ 13,647.67	30%	60%	10%	$ 4,094.30	$ 8,188.60	$ 1,364.77	67.8 hrs		
249	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 25,010.70	45%	$ 3,376.44	$ 28,387.14	30%	60%	10%	$ 8,516.14	$ 17,032.29	$ 2,838.71	140.9 hrs		
250	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O	22.69	$ 4,537.50	45%	$ 612.56	$ 5,150.06	30%	60%	10%	$ 1,545.02	$ 3,090.04	$ 515.01	25.6 hrs		
251	Heavy duty carpet tiles; to cement and sand base - (Offices)		Bldg 4.4.6.3-O		$ -	45%	$ 2,725.18	$ 15,123.74				$ 8,781.14	$ -	$ 6,342.60	233.2 hrs		
252	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3-O	22.69	$ 1,134.38	45%	$ 153.14	$ 1,287.52	30%	60%	10%	$ 386.25	$ 772.51	$ 128.75	6.4 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
253	Glazed ceramic floor tile; anti-slip tiles		Bldg 4.4.6.3-O	76.23	$ 3,811.50	45%	$ 514.55	$ 4,326.05	30%	60%	10%	$ 1,297.82	$ 2,595.63	$ 432.61	21.5 hrs		
254	Line painting to Floors	3.2.1.6	Bldg 4.4.6.3		$ -	45%	$ 554.75	$ 1,881.59	30%	60%	10%	$ 1,787.54	$ -	$ 94.05	50.0 hrs		
255	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 13,612.50	45%	$ 1,837.69	$ 15,450.19	30%	60%	10%	$ 4,635.06	$ 9,270.11	$ 1,545.02	76.7 hrs		
256	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 28,314.00	45%	$ 3,822.39	$ 32,136.39	30%	60%	10%	$ 9,640.92	$ 19,281.83	$ 3,213.64	159.5 hrs		
257	Cement and sand (1:3) screeds; 50mm thick		Bldg 4.4.6.3	22.69	$ 22,914.38	45%	$ 3,093.44	$ 26,007.82	30%	60%	10%	$ 7,802.34	$ 15,604.69	$ 2,600.78	129.1 hrs		
258	Two coats of epoxy anti-slip floor paint on screed		Bldg 4.4.6.3	47.19	$ 47,661.90	45%	$ 6,434.36	$ 54,096.26	30%	60%	10%	$ 16,228.88	$ 32,457.75	$ 5,409.63	268.6 hrs		
	Ceiling finishes				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
259	Paints to ceilings (Storage); two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4	5.45	$ 5,499.45	45%	$ 742.43	$ 6,241.88	30%	60%	10%	$ 1,872.56	$ 3,745.13	$ 624.19	31.0 hrs		
260	Paints to ceilings; two coats emulsion paint	3.3.1.1	Bldg 4.4.6.4	9.08	$ 5,445.00	45%	$ 735.08	$ 6,180.08	30%	60%	10%	$ 1,854.02	$ 3,708.05	$ 618.01	30.7 hrs		
261	Acoustic ceilings to Offices on anti vibration mounting	3.3.3.1	Bldg 4.4.6.4-O	98.01	$ 24,502.50	45%	$ 3,307.84	$ 27,810.34	30%	60%	10%	$ 8,343.10	$ 16,686.20	$ 2,781.03	138.1 hrs		
					$ -	45%	$ -	$ -	30%	60%	10%	$ -	$ -	$ -	-		
	Sub-Total				**$ 288,364.59**		**$ 140,358.46**	**$ 735,259.72**				**$ 425,015.68**	**$ 197,322.99**	**$ 112,921.05**	**10,671.0 hrs**		
	ELEVATORS, LIFTS AND HOISTS																
262	Dock Levellers (Elec Operated)	5.10.7.1	Bldg 4.4.6.7	8,000.00	$ 16,000.00	45%	$ 2,160.00	$ 18,160.00	30%	60%	10%	$ 5,448.00	$ 10,896.00	$ 1,816.00	90.2 hrs		
263	Rubber Bumpers on Wall at Loading Bay	5.10.7.1	Bldg 4.4.6.7	400.00	$ 3,200.00	45%	$ 432.00	$ 3,632.00	30%	60%	10%	$ 1,089.60	$ 2,179.20	$ 363.20	18.0 hrs		
264	Temporary prefabricated Loading dock (use during construction)		Bldg 4.4.6.7	6,000.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	33.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 25,200.00**		**$ 3,402.00**	**$ 28,602.00**				**$ 8,580.60**	**$ 17,161.20**	**$ 2,860.20**	**142.0 hrs**		
	BUILDING SERVICES																
	Sanitary appliances				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
265	Washroom Accessories (complete Male/Fe/HC)	5.1.1.1	Bldg 4.4.6.14-O	52,000.00	$ 52,000.00	45%	$ 7,020.00	$ 59,020.00	30%	60%	10%	$ 17,706.00	$ 35,412.00	$ 5,902.00	266.4 hrs		
	Disposal equipment				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
266	Garbage/Recycling Equipment	5.3.3.1	Bldg 4.4.6.14-O	562.65	$ 562.65	45%	$ 75.96	$ 638.61	30%	60%	10%	$ 191.58	$ 383.16	$ 63.86	3.2 hrs		
	Water installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
267	Hot and cold water installations; complete installation		Bldg 4.2.1.4	44.47	$ 11,116.88	45%	$ 1,500.78	$ 12,617.65	30%	60%	10%	$ 3,785.30	$ 7,570.59	$ 1,261.77	56.9 hrs		
268	Stand alone Demineralized water tank on Metal stand (1000 gallons Cap)		Bldg 4.2.6.2	12,000.00	$ 12,000.00	45%	$ 1,620.00	$ 13,620.00	30%	60%	10%	$ 4,086.00	$ 8,172.00	$ 1,362.00	67.6 hrs		
	Water installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
269	Water Heater 100 litres		Bldg 4.2.6.2		$ -	45%	$ 203.40	$ 3,814.95	30%	60%	10%	$ 655.40	$ -	$ 3,159.55	16.7 hrs		
	Uninterruptible Power Supply				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
270	Static UPS including Control panel & Batteries for 500 KVA @ $495/KVA		Bldg 4.1.1.5	820.00	$ 410,000.00	45%	$ 55,350.00	$ 465,350.00	30%	60%	10%	$ 139,605.00	$ 279,210.00	$ 46,535.00	2,046.0 hrs		
271	Inverter Panels		Bldg 4.1.1.5	750.00	$ 1,500.00	45%	$ 202.50	$ 1,702.50	30%	60%	10%	$ 510.75	$ 1,021.50	$ 170.25	7.5 hrs		
272	Battery Racks		Bldg 4.1.1.5	2,400.00	$ 4,800.00	45%	$ 648.00	$ 5,448.00	30%	60%	10%	$ 1,634.40	$ 3,268.80	$ 544.80	24.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	ELECTRICAL				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
273	Sub Station (prefabricated) @ $45,000		Bldg 4.1.1.1	45,000.00	$ 45,000.00	45%	$ 6,075.00	$ 51,075.00	30%	60%	10%	$ 15,322.50	$ 30,645.00	$ 5,107.50	253.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
274	Transformer - 1000 KVA		Bldg 4.1.1.1	29,700.00	$ 29,700.00	45%	$ 4,009.50	$ 33,709.50	30%	60%	10%	$ 10,112.85	$ 20,225.70	$ 3,370.95	148.2 hrs		
275	Transformer - 1500 KVA		Bldg 4.1.1.1	61,000.00	$ 61,000.00	45%	$ 8,235.00	$ 69,235.00	30%	60%	10%	$ 20,770.50	$ 41,541.00	$ 6,923.50	304.4 hrs		
276	Transformer - 2000 KVA		Bldg 4.1.1.1	73,000.00	$ 73,000.00	45%	$ 9,855.00	$ 82,855.00	30%	60%	10%	$ 24,856.50	$ 49,713.00	$ 8,285.50	364.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
277	Standby Generator (Diesel powered) 1000 KVA @ $350,000		Bldg 4.1.2.1	350,000.00	$ 350,000.00	45%	$ 47,250.00	$ 397,250.00	30%	60%	10%	$ 119,175.00	$ 238,350.00	$ 39,725.00	1,746.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
278	Ring Main Unit 11 kv including Electrical terminations @ $29,700		Bldg 4.1.1.1	29,700.00	$ 89,100.00	45%	$ 12,028.50	$ 101,128.50	30%	60%	10%	$ 30,338.55	$ 60,677.10	$ 10,112.85	444.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
279	Lighting and power installation - Offices 250m2 -		Bldg 4.1.5.3-O	190.58	$ 47,643.75	45%	$ 6,431.91	$ 54,075.66	30%	60%	10%	$ 16,222.70	$ 32,445.39	$ 5,407.57	237.8 hrs		
280	Electrical Installation - Storage Area - 1010 m2 - Lighting Installation		Bldg 4.1.5.2	79.86	$ 80,658.60	45%	$ 10,888.91	$ 91,547.51	30%	60%	10%	$ 27,464.25	$ 54,928.51	$ 9,154.75	402.5 hrs		
281	Electrical Installation - Facility/Clean up/Drum Handling-630 m2		Bldg 4.1.5.2	79.86	$ 50,311.80	45%	$ 6,792.09	$ 57,103.89	30%	60%	10%	$ 17,131.17	$ 34,262.34	$ 5,710.39	251.1 hrs		
282	Electrical Installation -HVAC /Electrical Rm - 600 m2 - Lighting Installation		Bldg 4.1.5.2	79.86	$ 47,916.00	45%	$ 6,468.66	$ 54,384.66	30%	60%	10%	$ 16,315.40	$ 32,630.80	$ 5,438.47	239.1 hrs		
283	Lightening Arrestor (c/w earthing wire, copper rods)		Bldg 4.1.5.2	20,000.00	$ 20,000.00	45%	$ 2,700.00	$ 22,700.00	30%	60%	10%	$ 6,810.00	$ 13,620.00	$ 2,270.00	99.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Space Heating & Air Treatment				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
284	Heating - Offices - 250 m2		Bldg 4.2.1.10-O	47.45	$ 11,863.50	45%	$ 1,601.57	$ 13,465.07	30%	60%	10%	$ 4,039.52	$ 8,079.04	$ 1,346.51	58.4 hrs		
285	Cooling - Offices - 250 m2		Bldg 4.2.1.10-O	56.22	$ 14,053.88	45%	$ 1,897.27	$ 15,951.15	30%	60%	10%	$ 4,785.34	$ 9,570.69	$ 1,595.11	69.2 hrs		
286	Ductwork - Offices - 250 m2		Bldg 4.2.1.10-O	140.42	$ 35,103.75	45%	$ 4,739.01	$ 39,842.76	30%	60%	10%	$ 11,952.83	$ 23,905.65	$ 3,984.28	176.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
287	Heating - Storage Area - 1010 m2		PROC 4.2.1.7	39.01	$ 39,396.06	45%	$ 5,318.47	$ 44,714.53	30%	60%	10%	$ 13,414.36	$ 26,828.72	$ 4,471.45	194.1 hrs		
288	BMS System Installation		PROC 4.2.1.7	9.83	$ 9,932.34	45%	$ 1,340.87	$ 11,273.21	30%	60%	10%	$ 3,381.96	$ 6,763.92	$ 1,127.32	48.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
289	Heating - Facility/Clean up/Drum Handling - 630 m2		PROC 4.2.1.7	39.01	$ 24,573.78	45%	$ 3,317.46	$ 27,891.24	30%	60%	10%	$ 8,367.37	$ 16,734.74	$ 2,789.12	121.1 hrs		
290	BMS System Installation		PROC 4.2.1.7	9.83	$ 6,195.42	45%	$ 836.38	$ 7,031.80	30%	60%	10%	$ 2,109.54	$ 4,219.08	$ 703.18	30.5 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
291	Heating - HVAC/Elec Rm - 600 m2		PROC 4.2.1.7	39.01	$ 23,403.60	45%	$ 3,159.49	$ 26,563.09	30%	60%	10%	$ 7,968.93	$ 15,937.85	$ 2,656.31	115.3 hrs		
292	BMS System Installation		PROC 4.2.1.7	9.83	$ 5,900.40	45%	$ 796.55	$ 6,696.95	30%	60%	10%	$ 2,009.09	$ 4,018.17	$ 669.70	29.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	SPRINKLER INSTALLATION				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
293	Offices - 250 m2		Bldg 4.2.10.3-O	36.96	$ 9,240.00	45%	$ 1,247.40	$ 10,487.40	30%	60%	10%	$ 3,146.22	$ 6,292.44	$ 1,048.74	45.5 hrs		
294	Storage Area - 1010 m2		Bldg 4.2.10.1	36.96	$ 37,329.60	45%	$ 5,039.50	$ 42,369.10	30%	60%	10%	$ 12,710.73	$ 25,421.46	$ 4,236.91	183.9 hrs		
295	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.2.10.1	36.96	$ 23,284.80	45%	$ 3,143.45	$ 26,428.25	30%	60%	10%	$ 7,928.47	$ 15,856.95	$ 2,642.82	114.7 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
296	HVAC/Elec Rm - 600 m2		Bldg 4.2.10.1	36.96	$ 22,176.00	45%	$ 2,993.76	$ 25,169.76	30%	60%	10%	$ 7,550.93	$ 15,101.86	$ 2,516.98	109.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	COMMUNICATION INSTALLATION - Fire/Voice Alarm				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
297	Offices - 250 m2		Bldg 4.1.3.8-O	21.38	$ 5,346.00	45%	$ 721.71	$ 6,067.71	30%	60%	10%	$ 1,820.31	$ 3,640.63	$ 606.77	26.7 hrs		
298	Storage Area - 1010 m2		Bldg 4.1.3.4	21.38	$ 21,597.84	45%	$ 2,915.71	$ 24,513.55	30%	60%	10%	$ 7,354.06	$ 14,708.13	$ 2,451.35	107.8 hrs		
299	Facility/Clean up/Drum Handling - 630 m2		Bldg 4.1.3.4	21.38	$ 13,471.92	45%	$ 1,818.71	$ 15,290.63	30%	60%	10%	$ 4,587.19	$ 9,174.38	$ 1,529.06	67.2 hrs		
300	HVAC/Elec Rm - 600 m2		Bldg 4.1.3.4	21.38	$ 12,830.40	45%	$ 1,732.10	$ 14,562.50	30%	60%	10%	$ 4,368.75	$ 8,737.50	$ 1,456.25	64.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Natural Gas Installation				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Not Required				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Heating, Ventilation and Air Conditioning				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
301	Building Management system tie ins for Office building Heating & Cooling system	5.6.1.1	Bldg 4.2.2.7-O	32.88	$ 8,221.13	45%	$ 1,109.85	$ 9,330.98	30%	60%	10%	$ 2,799.29	$ 5,598.59	$ 933.10	40.5 hrs		
302	Main Steam line tie ins from Main Source	5.6.1.1	Bldg 4.2.2.7-O	25,000.00	$ 25,000.00	45%	$ 3,375.00	$ 28,375.00	30%	60%	10%	$ 8,512.50	$ 17,025.00	$ 2,837.50	123.2 hrs		
303	Local ventilation to WC	5.6.1.1	Bldg 4.2.2.7-O	435.60	$ 1,742.40	45%	$ 235.22	$ 1,977.62	30%	60%	10%	$ 593.29	$ 1,186.57	$ 197.76	8.6 hrs		
304	Ventilation system to toilet areas	5.6.1.1	Bldg 4.2.2.7-O	36.30	$ 1,815.00	45%	$ 245.03	$ 2,060.03	30%	60%	10%	$ 618.01	$ 1,236.02	$ 206.00	8.9 hrs		
305	Electrical Space Heaters at Storage Area - 1010 M2	5.6.2.1	Bldg 4.2.6.2	1,500.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	29.9 hrs		
306	Clean Breathing Air System Plant	5.7.1.1	PROC 4.2.1.7	45,900.00	$ 91,800.00	45%	$ 12,393.00	$ 104,193.00	30%	60%	10%	$ 31,257.90	$ 62,515.80	$ 10,419.30	452.3 hrs		
307	Service Air System Plant	5.7.1.1	PROC 4.2.1.7	23,000.00	$ 23,000.00	45%	$ 3,105.00	$ 26,105.00	30%	60%	10%	$ 7,831.50	$ 15,663.00	$ 2,610.50	113.3 hrs		
308	Instrument System Plant (with dessicant air dryer)	5.7.1.1	PROC 4.2.1.7	23,000.00	$ 23,000.00	45%	$ 3,105.00	$ 26,105.00	30%	60%	10%	$ 7,831.50	$ 15,663.00	$ 2,610.50	113.3 hrs		
307	Exhaust Fan with Mech operated Louvers c/w control system	5.7.3.1	Bldg 4.4.6.5	28,000.00	$ 168,000.00	45%	$ 22,680.00	$ 190,680.00	30%	60%	10%	$ 57,204.00	$ 114,408.00	$ 19,068.00	838.4 hrs		
309	Pre fab Mech Operated Metal Louvres (prefinished)2x3M	5.7.3.1	Bldg 4.4.6.5	1,200.00	$ 7,200.00	45%	$ 972.00	$ 8,172.00	30%	60%	10%	$ 2,451.60	$ 4,903.20	$ 817.20	35.5 hrs		
	Electrical installations				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
310	Electrical Main Junction & Distribution Box	5.8.1.1	Bldg 4.1.1.2		$ -	45%	$ 182.69	$ 17,475.08	30%	60%	10%	$ 588.68	$ -	$ 16,886.40	14.6 hrs		
311	Internal LV wiring	5.8.1.1	Bldg 4.1.1.2		$ -	45%	$ 5,115.43	$ 23,977.84	30%	60%	10%	$ 16,483.05	$ -	$ 7,494.80	408.2 hrs		
312	Lighting & Fixtures (Office)	5.8.3.1	Bldg 4.1.5.2-O	300.00	$ 3,600.00	45%	$ 486.00	$ 4,086.00	30%	60%	10%	$ 1,225.80	$ 2,451.60	$ 408.60	18.0 hrs		
313	Lighting & Fixtures (Storage)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 6,000.00	45%	$ 810.00	$ 6,810.00	30%	60%	10%	$ 2,043.00	$ 4,086.00	$ 681.00	29.9 hrs		
314	Lighting & Fixtures (HVAC room)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 2,400.00	45%	$ 324.00	$ 2,724.00	30%	60%	10%	$ 817.20	$ 1,634.40	$ 272.40	12.0 hrs		
315	Lighting & Fixtures (External)	5.8.3.1	Bldg 4.1.5.2	300.00	$ 5,400.00	45%	$ 729.00	$ 6,129.00	30%	60%	10%	$ 1,838.70	$ 3,677.40	$ 612.90	26.9 hrs		
316	Special Lighting systems	5.8.4.1	Bldg 4.1.5.2	500.00	$ 2,000.00	45%	$ 270.00	$ 2,270.00	30%	60%	10%	$ 681.00	$ 1,362.00	$ 227.00	10.0 hrs		
317	Way finding Signs (Illuminated)	5.8.4.1	Bldg 4.1.5.2	350.00	$ 5,600.00	45%	$ 756.00	$ 6,356.00	30%	60%	10%	$ 1,906.80	$ 3,813.60	$ 635.60	27.9 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Fire and lightening protection				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
318	Fire alarms/appliances		Bldg 4.1.6.1	14.00	$ 35,000.00	45%	$ 4,725.00	$ 39,725.00	30%	60%	10%	$ 11,917.50	$ 23,835.00	$ 3,972.50	174.7 hrs		
319	Lightening protection system	5.11.2.1	Bldg 4.1.6.1	2.00	$ 5,000.00	45%	$ 675.00	$ 5,675.00	30%	60%	10%	$ 1,702.50	$ 3,405.00	$ 567.50	25.0 hrs		
320	Fire and Smoke Detectors		Bldg 4.1.6.1	250.00	$ 4,000.00	45%	$ 540.00	$ 4,540.00	30%	60%	10%	$ 1,362.00	$ 2,724.00	$ 454.00	20.0 hrs		
	Communication, security and control systems				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
321	LAN	5.12.1.2	Bldg 4.1.3.5-O	1,200.00	$ 14,400.00	45%	$ 1,944.00	$ 16,344.00	30%	60%	10%	$ 4,903.20	$ 9,806.40	$ 1,634.40	71.9 hrs		
322	Internal Communication system; Telecommunication System	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
323	Public address system	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
324	Central security control devices; Security Systems; Security Lights and lighting system,	5.12.1.1	Bldg 4.1.3.1	3.85	$ 9,586.50	45%	$ 1,294.18	$ 10,880.68	30%	60%	10%	$ 3,264.20	$ 6,528.41	$ 1,088.07	47.8 hrs		
325	TV monitors	5.12.1.14	Bldg 4.1.3.6-O	1,200.00	$ 9,600.00	45%	$ 1,296.00	$ 10,896.00	30%	60%	10%	$ 3,268.80	$ 6,537.60	$ 1,089.60	47.9 hrs		
326	Surveillance equipment; detectors and alarms	5.12.1.1	Bldg 4.1.3.2	7.70	$ 19,173.00	45%	$ 2,588.36	$ 21,761.36	30%	60%	10%	$ 6,528.41	$ 13,056.81	$ 2,176.14	95.7 hrs		
	Builders work in connection with building services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
327	Cutting and Patching	5.14.1.1	STIE 4.2.11.1	300.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	169.0 hrs		
328	Fire & smoke stopping	5.14.1.1	Bldg 4.1.6.1	10.00	$ 24,900.00	45%	$ 3,361.50	$ 28,261.50	30%	60%	10%	$ 8,478.45	$ 16,956.90	$ 2,826.15	140.3 hrs		
329	Ducts/Pipe sleeves/Openings	5.14.1.1	STIE 4.2.11.1	300.00	$ 45,000.00	45%	$ 6,075.00	$ 51,075.00	30%	60%	10%	$ 15,322.50	$ 30,645.00	$ 5,107.50	253.6 hrs		
330	Housekeeping pads; 150mm thick	5.14.1.1	Bldg 4.4.1.1	400.00	$ 108,000.00	45%	$ 14,580.00	$ 122,580.00	30%	60%	10%	$ 36,774.00	$ 73,548.00	$ 12,258.00	591.9 hrs		
331	Housekeeping pads; 100mm thick	5.14.1.1	Bldg 4.4.1.1	300.00	$ 11,250.00	45%	$ 1,518.75	$ 12,768.75	30%	60%	10%	$ 3,830.63	$ 7,661.25	$ 1,276.88	61.7 hrs		
	Ducts for incoming services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
332	Excavation for Duct bank for services (incoming)		SPRP 4.4.7.1		$ -	45%	$ 876.66	$ 4,025.41	60%	30%	10%	$ 2,824.79	$ 1,200.62	$ -	81.5 hrs		
333	Concrete in blinding for Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 22.82	$ 543.22	60%	30%	10%	$ 73.52	$ 9.80	$ 459.90	2.0 hrs		
334	Concrete in base slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 34.65	$ 809.71	60%	30%	10%	$ 111.65	$ 77.18	$ 620.87	3.0 hrs		
335	Concrete in walls Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 98.82	$ 1,987.28	60%	30%	10%	$ 318.42	$ 220.17	$ 1,448.70	8.7 hrs		
336	Concrete in roof slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 34.65	$ 809.71	60%	30%	10%	$ 111.65	$ 77.18	$ 620.87	3.0 hrs		
337	Formwork in walls Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 6,108.83	$ 20,676.73	60%	30%	10%	$ 19,684.00	$ -	$ 992.72	535.3 hrs		
338	Formwork for Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 7,144.08	$ 23,713.30	60%	30%	10%	$ 23,019.81	$ -	$ 693.50	626.0 hrs		
339	Formwork for roof slab Duct bank for services (incoming)		Bldg 4.4.1.1		$ -	45%	$ 3,572.04	$ 11,856.65	60%	30%	10%	$ 11,509.90	$ -	$ 346.75	313.0 hrs		
340	Reinforcement for Duct bank for services (incoming)		Bldg 4.4.1.2		$ -	45%	$ 1,140.77	$ 4,507.43	60%	30%	10%	$ 3,675.82	$ -	$ 831.62	100.0 hrs		
	Tie-ins to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Testing and commissioning building services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
341	Testing Telecommunication System;		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
342	Testing Public Address System;		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
343	Testing Fire Detection and Alarm Systems		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
344	Testing Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
345	Testing Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
346	Testing Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4	70.50	$ 1,128.00	45%	$ 355.32	$ 1,483.32	70%	15%	15%	$ 1,038.32	$ 222.50	$ 222.50	15.2 hrs		
347	Commissioning Telecommunication System;		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
348	Commissioning Public Address System;		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
349	Commissioning Fire Detection and Alarm Systems		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
350	Commissioning Security Systems; Surveillance equipment; detectors		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
351	Commissioning Security Systems; Surveillance equipment; alarms		STIE 4.3.7.2	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
352	Commissioning Security Systems; Security Lights and lighting system, in y Nr		STIE 4.1.7.4	70.50	$ 2,256.00	45%	$ 710.64	$ 2,966.64	70%	15%	15%	$ 2,076.65	$ 445.00	$ 445.00	30.4 hrs		
353	Specialist Training and Information sharing	5.15.1.1	Bldg 4.4.8.1.3		$ -	45%	$ 4,292.54	$ 13,831.51	70%	15%	15%	$ 13,831.51	$ -	$ -	342.5 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 2,438,173.99**		**$ 361,635.58**	**$ 2,899,011.02**				**$ 934,862.76**	**$ 1,652,159.38**	**$ 311,988.88**	**14,937.9 hrs**		
	MISCELLANEOUS METALWORK																
354	Railings at Roof top; mild steel balustrade and steel handrail; 1100mm high		Bldg 4.4.3.3	490.05	$ 71,547.30	45%	$ 9,658.89	$ 81,206.19	30%	60%	10%	$ 24,361.86	$ 48,723.71	$ 8,120.62	362.3 hrs		
355	Miscellaneous metals (Offices)		Bldg 4.4.3.5-O	50,000.00	$ 50,000.00	45%	$ 6,750.00	$ 56,750.00	30%	60%	10%	$ 17,025.00	$ 34,050.00	$ 5,675.00	253.2 hrs		
356	Miscellaneous Mmetals (Building)		Bldg 4.4.3.1	200,000.00	$ 200,000.00	45%	$ 27,000.00	$ 227,000.00	30%	60%	10%	$ 68,100.00	$ 136,200.00	$ 22,700.00	1,012.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 321,547.30**		**$ 43,408.89**	**$ 364,956.19**				**$ 109,486.86**	**$ 218,973.71**	**$ 36,495.62**	**1,628.2 hrs**		
	INTERNAL FITTINGS, FURNISHINGS AND EQUIPMENT																
	General fixtures and fittings				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
357	Furniture to Offices (18 personnel)		Bldg 4.4.6.13-O	3,500.00	$ 63,000.00	45%	$ 8,505.00	$ 71,505.00	30%	60%	10%	$ 21,451.50	$ 42,903.00	$ 7,150.50	355.0 hrs		
358	Furniture to Conference room and Admin area		Bldg 4.4.6.13-O	75,000.00	$ 75,000.00	45%	$ 10,125.00	$ 85,125.00	30%	60%	10%	$ 25,537.50	$ 51,075.00	$ 8,512.50	422.6 hrs		
359	Window Blinds; 2.0m wide		Bldg 4.4.6.13-O		$ -	45%	$ 6,703.28	$ 23,410.81	30%	60%	10%	$ 21,599.44	$ -	$ 1,811.37	382.1 hrs		
360	Eye wash Station		Bldg 4.4.6.14-O	3,500.00	$ 7,000.00	45%	$ 945.00	$ 7,945.00	30%	60%	10%	$ 2,383.50	$ 4,767.00	$ 794.50	39.4 hrs		
361	Emergency Shower		Bldg 4.4.6.14-O	7,500.00	$ 15,000.00	45%	$ 2,025.00	$ 17,025.00	30%	60%	10%	$ 5,107.50	$ 10,215.00	$ 1,702.50	84.5 hrs		
362	Laboratory Shelving		Bldg 4.4.6.14-O	3,000.00	$ 3,000.00	45%	$ 405.00	$ 3,405.00	30%	60%	10%	$ 1,021.50	$ 2,043.00	$ 340.50	16.9 hrs		
363	Change room station		Bldg 4.4.6.14-O	3,500.00	$ 3,500.00	45%	$ 472.50	$ 3,972.50	30%	60%	10%	$ 1,191.75	$ 2,383.50	$ 397.25	19.7 hrs		
364	Fume hoods - cover at all tanks		Bldg 4.2.2.5	12,000.00	$ 300,000.00	45%	$ 40,500.00	$ 340,500.00	30%	60%	10%	$ 102,150.00	$ 204,300.00	$ 34,050.00	1,690.4 hrs		
365	Fume hoods @ Drum Cleaning Area		Bldg 4.2.2.5	15,000.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	169.0 hrs		
365	Radiation monitors (Storage area)		Bldg 4.1.9.1		$ -	45%	$ -	Excluded	30%	60%	10%						
366	SAM - Small Article Monitor		Bldg 4.1.9.1	81,000.00	$ 81,000.00	45%	$ 10,935.00	$ 91,935.00	30%	60%	10%	$ 27,580.50	$ 55,161.00	$ 9,193.50	404.2 hrs		
367	Motion detector		Bldg 4.1.9.1	988.00	$ 7,904.00	45%	$ 1,067.04	$ 8,971.04	30%	60%	10%	$ 2,691.31	$ 5,382.62	$ 897.10	39.4 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 585,404.00**		**$ 85,732.82**	**$ 687,844.35**				**$ 220,929.50**	**$ 398,660.12**	**$ 68,254.72**	**3,623.3 hrs**		
	PROCESS EQUIPMENT																
	PHT D2O Supply Tanks (8 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
368	Tanks 100 Mg 38110 - SS 304 Class 6		PROC 4.2.5.4	572,000.00	$ 4,576,000.00	45%	$ -	$ 4,576,000.00	0%	100%	0%	$ -	$ 4,576,000.00	$ -	-		From previous estimate
369	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 108,000.00	45%	$ -	$ 108,000.00	0%	85%	15%	$ -	$ 91,800.00	$ 16,200.00	-		From previous estimate
370	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
371	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 2,537.83	$ 12,313.45				$ 8,177.45	$ -	$ 4,136.00	199.9 hrs		
372	Level sensors		PROC 4.2.1.3		$ -	45%	$ 3,383.77	$ 47,207.27				$ 10,903.27	$ -	$ 36,304.00	266.6 hrs		
373	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 3,383.77	$ 34,791.27				$ 10,903.27	$ -	$ 23,888.00	266.6 hrs		
374	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 18,240.65	$ 90,065.42				$ 58,775.42	$ -	$ 31,290.00	1,436.9 hrs		
375	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 18,240.65	$ 90,065.42				$ 58,775.42	$ -	$ 31,290.00	1,436.9 hrs		
376	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 2,923.10	$ 25,594.88				$ 9,418.88	$ -	$ 16,176.00	233.2 hrs		
377	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 3,340.69	$ 19,628.44				$ 10,764.44	$ -	$ 8,864.00	266.6 hrs		
378	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 1,670.34	$ 11,446.22				$ 5,382.22	$ -	$ 6,064.00	133.3 hrs		
379	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 164.96	$ 21,147.53				$ 531.53	$ -	$ 20,616.00	13.0 hrs		
380	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 8,712.00	45%	$ 784.08	$ 9,496.08	20%	60%	20%	$ 1,899.22	$ 5,697.65	$ 1,899.22	27.8 hrs		
381	Item-6- Cover gas Vent Control Valve pnuematic control Valve and Accessories		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
382	Item - 8 - Cover Gas Relief Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
383	Item - 9 - Main Outlet Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
384	Item - 11 & 12 - Outlet Isolation Valves		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
385	Item - 15 - Main Inlet Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
386	Item 24 & 25 - Inlet Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
387	Item - 26 - Cover Gas Supply Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
388	Item - 28 - Supply Header Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
389	Item - 29 - Vacuum Relief Valve		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
390	Item - 32 - Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 208.79	$ 1,189.78				$ 672.78	$ -	$ 517.00	16.7 hrs		
391	Item 33 & 34 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 365.39	$ 5,715.36				$ 1,177.36	$ -	$ 4,538.00	29.2 hrs		
392	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.5.4		$ -	45%	$ 317.23	$ 1,022.18				$ 1,022.18	$ -	$ -	25.0 hrs		
393	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	655,184.40	$ 655,184.40	45%	$ 117,933.19	$ 773,117.59	40%	0%	60%	$ 309,247.04	$ -	$ 463,870.55	4,474.5 hrs		
	Moderator D2O Supply Tanks(7 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
394	Tanks 100 Mg 38110; SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 4,887,120.00	45%	$ -	$ 4,887,120.00	0%	100%	0%	$ -	$ 4,887,120.00	$ -	-		From previous estimate
395	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 94,500.00	45%	$ -	$ 94,500.00	0%	85%	15%	$ -	$ 80,325.00	$ 14,175.00	-		From previous estimate
396	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
397	Valves		PROC 4.2.1.2		$ -	45%	$ 288.68	$ 930.18				$ 930.18	$ -	$ -	22.7 hrs		
398	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 2,220.60	$ 10,774.27				$ 7,155.27	$ -	$ 3,619.00	174.9 hrs		
399	Level sensors		PROC 4.2.1.3		$ -	45%	$ 2,960.80	$ 41,306.36				$ 9,540.36	$ -	$ 31,766.00	233.2 hrs		
400	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 2,960.80	$ 30,442.36				$ 9,540.36	$ -	$ 20,902.00	233.2 hrs		
401	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 222,060.07	$ 742,905.64				$ 715,526.89	$ -	$ 27,378.75	17,493.0 hrs		
402	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 166,545.05	$ 564,023.92				$ 536,645.17	$ -	$ 27,378.75	13,119.8 hrs		
403	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 2,557.71	$ 22,395.52				$ 8,241.52	$ -	$ 14,154.00	204.1 hrs		
404	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 2,923.10	$ 17,174.88				$ 9,418.88	$ -	$ 7,756.00	233.2 hrs		
405	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 1,461.55	$ 10,015.44				$ 4,709.44	$ -	$ 5,306.00	116.6 hrs		
406	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 144.34	$ 18,504.09				$ 465.09	$ -	$ 18,039.00	11.4 hrs		
407	Data Cables to Control room		Bldg 4.1.3.1		$ -	45%	$ 17,577.94	$ 64,263.04				$ 56,640.04	$ -	$ 7,623.00	1,402.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate	All-in Total	Indirect Costs % of Labour Total	Indirect Total	Total Cost	All-in Rate Split Lab	Mat	Equip	Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	[$]	[%]	[$]	[$]	[%]	[%]	[%]	[$]	[$]	[$]	[hours]		
408	Item-4-Storage Tank Cover Gas Chilled Condenser - Inlet 2", Outlet 2"		PROC 4.2.1.3		$ -	45%	$ 317.23	$ 1,022.18				$ 1,022.18	$ -	$ -	25.0 hrs		
409	Item-5-Cover Gas Vent Control Pnuematic Valve & Accessories- 2 "		PROC 4.2.1.2		$ -	45%	$ 317.23	$ 1,812.18				$ 1,022.18	$ -	$ 790.00	25.0 hrs		
410	Item-7-Cover Gas Relief Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
411	item-10-Main Outlet Header Isolation Valve 3 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
412	Item-13&14- Outlet Isolation Valve - 3 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
413	Item - 18 & 19- Inlet Isolation Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,052.88				$ 132.88	$ -	$ 920.00	3.2 hrs		
414	Item - 27 - Cover Gas Supply Isolation Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
415	Item - 30 - Vacuum Relief Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 475.84	$ 3,873.27				$ 1,533.27	$ -	$ 2,340.00	37.5 hrs		
416	Item - 31- Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 313.19	$ 1,526.17				$ 1,009.17	$ -	$ 517.00	25.0 hrs		
417	Item- 35 & 36 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 5,883.55				$ 1,345.55	$ -	$ 4,538.00	33.3 hrs		
418	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	696,337.03	$ 696,337.03	45%	$ 125,340.66	$ 821,677.69	40%	0%	60%	$ 328,671.08	$ -	$ 493,006.61	4,755.6 hrs		
	TRF/SUP Feed Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
419	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 1,396,320.00	45%	$ -	$ 1,396,320.00	0%	100%	0%	$ -	$ 1,396,320.00	$ -	-		From previous estimate
420	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		From previous estimate
421	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
422	Valves		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 265.77				$ 265.77	$ -	$ -	6.5 hrs		
423	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
424	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
425	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
426	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
427	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
428	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
429	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
430	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
431	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
432	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
433	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	199,791.94	$ 199,791.94	45%	$ 35,962.55	$ 235,754.49	40%	0%	60%	$ 94,301.80	$ -	$ 141,452.70	1,364.5 hrs		
	TRF/SUP Product Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
434	Tanks 100 Mg 38110 SS 304 Class 3		PROC 4.2.5.4	698,160.00	$ 1,396,320.00	45%	$ -	$ 1,396,320.00	0%	100%	0%	$ -	$ 1,396,320.00	$ -	-		From previous estimate
435	Tanks 100 Mg 38110 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		From previous estimate
436	Tanks 100 Mg 38110 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
437	Valves		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 265.77				$ 265.77	$ -	$ -	6.5 hrs		
438	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
439	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
440	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
441	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
442	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
443	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
444	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
445	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
446	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
447	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
448	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	199,791.94	$ 199,791.94	45%	$ 35,962.55	$ 235,754.49	40%	0%	60%	$ 94,301.80	$ -	$ 141,452.70	1,364.5 hrs		
	Downgraded D2O Tank (2 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
449	Tanks 50 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	428,000.00	$ 856,000.00	45%	$ -	$ 856,000.00	0%	100%	0%	$ -	$ 856,000.00	$ -	-		Prorated
450	Tanks 50 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 27,000.00	45%	$ -	$ 27,000.00	0%	85%	15%	$ -	$ 22,950.00	$ 4,050.00	-		Prorated
451	Tanks 50 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
452	Valves; 3"		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 3,425.77				$ 265.77	$ -	$ 3,160.00	6.5 hrs		
453	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,078.36				$ 2,044.36	$ -	$ 1,034.00	50.0 hrs		
454	Level sensors		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 11,801.82				$ 2,725.82	$ -	$ 9,076.00	66.6 hrs		
455	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 845.94	$ 8,697.82				$ 2,725.82	$ -	$ 5,972.00	66.6 hrs		
456	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 63,445.73	$ 212,258.75				$ 204,436.25	$ -	$ 7,822.50	4,998.0 hrs		
457	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 47,584.30	$ 161,149.69				$ 153,327.19	$ -	$ 7,822.50	3,748.5 hrs		
458	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 730.78	$ 6,398.72				$ 2,354.72	$ -	$ 4,044.00	58.3 hrs		
459	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 835.17	$ 4,907.11				$ 2,691.11	$ -	$ 2,216.00	66.6 hrs		
460	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,861.55				$ 1,345.55	$ -	$ 1,516.00	33.3 hrs		
461	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 5,286.88				$ 132.88	$ -	$ 5,154.00	3.2 hrs		
462	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 2,178.00	45%	$ 196.02	$ 2,374.02	20%	60%	20%	$ 474.80	$ 1,424.41	$ 474.80	7.0 hrs		
463	Item - 38 & 39 - Transfer Pump; including Item 40 & 41 24 HP motor		PROC 4.2.2.4		$ -	45%	$ 422.97	$ 29,272.91				$ 1,362.91	$ -	$ 27,910.00	33.3 hrs		
464	Item - 42 & 43 - Check Valve 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 2,210.88				$ 132.88	$ -	$ 2,078.00	3.2 hrs		
465	Item - 44 - Main Inlet Header Check valve 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
466	Item - 45 - Cover Gas Vent Control Valve pnuematic Control Valve and Accessories 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
467	Item - 46 & 47 - Outlet Control Valve and Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
468	Item 48 & 49 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
469	Item - 50 - Cover Gas Relief Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
470	Item 51 & 52 - Relief Valve - 1 1/2 "		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,372.88				$ 132.88	$ -	$ 1,240.00	3.2 hrs		
471	Item 53 & 54 - Inlet Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,672.88				$ 132.88	$ -	$ 1,540.00	3.2 hrs		
472	Item 55 - Cover Gas Supply Isolation Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
473	Item 56 - Cover Gas Drain Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
474	Item 57 - Vent Isolation Valve 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
475	Item - 58 - Recirculation Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
476	Item - 59 - Clean up system Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
477	Item - 60 & 61 - Outlet Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
478	Item - 62 - Transfer System Supply Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
479	Item - 63 - Main Discharge Header Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
480	Item - 64 & 65 - Main Inlet Header Spare Connection Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
481	Item - 66 - Main Inlet Header Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 526.44				$ 66.44	$ -	$ 460.00	1.6 hrs		
482	Item - 67 - Vacuum Relief Valve - 2"		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
483	Item - 68 - Recirculation Flow Orifice 1 1/2"		PROC 4.2.1.3		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
484	Item 69 & 70 - Commissioning Strainer 2 1/2"		PROC 4.2.1.3		$ -	45%	$ 41.24	$ 732.88				$ 132.88	$ -	$ 600.00	3.2 hrs		
485	Item 71 & 72 - Level Transmitter		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 5,883.55				$ 1,345.55	$ -	$ 4,538.00	33.3 hrs		
486	Item 73 - Cover Gas Pressure Transmitter		PROC 4.2.1.3		$ -	45%	$ 313.19	$ 1,526.17				$ 1,009.17	$ -	$ 517.00	25.0 hrs		
487	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	124,147.14	$ 124,147.14	45%	$ 22,346.49	$ 146,493.63	40%	0%	60%	$ 58,597.45	$ -	$ 87,896.18	847.8 hrs		
	Downgraded D2O Tank (1 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
488	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	264,000.00	$ 264,000.00	45%	$ -	$ 264,000.00	0%	100%	0%	$ -	$ 264,000.00	$ -	-		Prorated
489	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 13,500.00	45%	$ -	$ 13,500.00	0%	85%	15%	$ -	$ 11,475.00	$ 2,025.00	-		Prorated
490	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
491	Valves; 2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,372.88				$ 132.88	$ -	$ 1,240.00	3.2 hrs		
492	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 211.49	$ 1,198.45				$ 681.45	$ -	$ 517.00	16.7 hrs		
493	Level sensors		PROC 4.2.1.3		$ -	45%	$ 422.97	$ 5,900.91				$ 1,362.91	$ -	$ 4,538.00	33.3 hrs		
494	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 422.97	$ 4,348.91				$ 1,362.91	$ -	$ 2,986.00	33.3 hrs		
495	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 2,280.08	$ 11,258.18				$ 7,346.93	$ -	$ 3,911.25	179.6 hrs		
496	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 2,280.08	$ 11,258.18				$ 7,346.93	$ -	$ 3,911.25	179.6 hrs		
497	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 365.39	$ 3,199.36				$ 1,177.36	$ -	$ 2,022.00	29.2 hrs		
498	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 417.59	$ 2,453.55				$ 1,345.55	$ -	$ 1,108.00	33.3 hrs		
499	Beetle - Leak Detection - 1 ea		PROC 4.2.1.3		$ -	45%	$ 208.79	$ 1,430.78				$ 672.78	$ -	$ 758.00	16.7 hrs		
500	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
501	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 1,089.00	45%	$ 98.01	$ 1,187.01	20%	60%	20%	$ 237.40	$ 712.21	$ 237.40	3.5 hrs		
502	Item - 100 - Transfer System Feed Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
503	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	39,560.93	$ 39,560.93	45%	$ 7,120.97	$ 46,681.90	40%	0%	60%	$ 18,672.76	$ -	$ 28,009.14	270.2 hrs		
	CLEAN Up D2O Tank (3 ea)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
504	Tanks 25 Mg 38500 SS 304 Class 3		PROC 4.2.5.4	264,000.00	$ 792,000.00	45%	$ -	$ 792,000.00	0%	100%	0%	$ -	$ 792,000.00	$ -	-		Prorated
505	Tanks 25 Mg 38500 - Installation		PROC 4.2.5.4	13,500.00	$ 40,500.00	45%	$ -	$ 40,500.00	0%	85%	15%	$ -	$ 34,425.00	$ 6,075.00	-		Prorated
506	Tanks 25 Mg 38500 - Commissioning		PROC 4.2.5.4	4,050.00	$ 32,400.00	45%	$ 10,206.00	$ 42,606.00	70%	15%	15%	$ 29,824.20	$ 6,390.90	$ 6,390.90	443.5 hrs		From previous estimate
507	Valves; 2"		PROC 4.2.1.2		$ -	45%	$ 123.72	$ 4,118.65				$ 398.65	$ -	$ 3,720.00	9.7 hrs		
508	Pressure sensors		PROC 4.2.1.3		$ -	45%	$ 634.46	$ 3,595.36				$ 2,044.36	$ -	$ 1,551.00	50.0 hrs		
509	Level sensors		PROC 4.2.1.3		$ -	45%	$ 1,268.91	$ 17,702.73				$ 4,088.73	$ -	$ 13,614.00	100.0 hrs		
510	Pressure Gauges		PROC 4.2.1.3		$ -	45%	$ 1,268.91	$ 13,046.73				$ 4,088.73	$ -	$ 8,958.00	100.0 hrs		
511	Piping - S Steel - Inlets - 3 " for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 6,899.72	$ 33,966.19				$ 22,232.44	$ -	$ 11,733.75	543.5 hrs		
512	Piping - S Steel - Outlet - 3" for 100 Mg Tanks		PROC 4.2.1.1		$ -	45%	$ 6,899.72	$ 33,966.19				$ 22,232.44	$ -	$ 11,733.75	543.5 hrs		
513	Switches - 2 level		PROC 4.2.1.3		$ -	45%	$ 1,096.16	$ 9,598.08				$ 3,532.08	$ -	$ 6,066.00	87.5 hrs		
514	Transmitters - 2 ea		PROC 4.2.1.3		$ -	45%	$ 1,252.76	$ 7,360.66				$ 4,036.66	$ -	$ 3,324.00	100.0 hrs		
515	Beetle - Leak Detection - 1 ea		PROC 4.2.1.2		$ -	45%	$ 626.38	$ 4,292.33				$ 2,018.33	$ -	$ 2,274.00	50.0 hrs		
516	Isolation Valve		PROC 4.2.1.2		$ -	45%	$ 61.86	$ 7,930.33				$ 199.33	$ -	$ 7,731.00	4.9 hrs		
517	Data Cables to Control room		Bldg 4.1.3.1	12.10	$ 3,267.00	45%	$ 294.03	$ 3,561.03	20%	60%	20%	$ 712.21	$ 2,136.62	$ 712.21	10.4 hrs		
518	Item - 75 & 76 - Clean up Product Transfer Pump Suction 1 1/2" Discharge 1 1/2" including Item 78 & 79 Pump motor 4 HP		PROC 4.2.2.4		$ -	45%	$ 422.97	$ 29,272.91				$ 1,362.91	$ -	$ 27,910.00	33.3 hrs		
519	Item - 77 - Oxidation unit Feed Pump Suction 1" Discharge 1/2" including Item 80 Oxidation Pump Motor 1 HP		PROC 4.2.2.4		$ -	45%	$ 211.49	$ 14,636.45				$ 681.45	$ -	$ 13,955.00	16.7 hrs		
520	Item - 81 - Cover Gas Vent Control Valve Pnuematic Valve & Accessories 2 "		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 856.44				$ 66.44	$ -	$ 790.00	1.6 hrs		
521	Item - 82 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
522	Item - 83 - Inlet Control Valve Pnuematic Control Valve & Accessories 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
523	Item - 84 & 85- Outlet Control Valve Pnuematic Control Valve & Accessories 1"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,712.88				$ 132.88	$ -	$ 1,580.00	3.2 hrs		
524	Item - 86 - Cover Gas Relief Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 686.44				$ 66.44	$ -	$ 620.00	1.6 hrs		
525	Item - 87, 88,& 89 - Relief Valve 3/4"		PROC 4.2.1.2		$ -	45%	$ 61.86	$ 4,012.33				$ 199.33	$ -	$ 3,813.00	4.9 hrs		
526	Item - 90 - Station Upgrader Feed Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
527	Item - 91 - Vent Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
528	Item - 92 - Cover Gas Supply Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 66.44				$ 66.44	$ -	$ -	1.6 hrs		
529	Item - 93 - Isolation Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
530	Item - 94 - Cover Gas Drain Valve 2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
531	Item - 95 - Feed Isolation Valve 2 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
532	Item - 96, 97, 98 & 99 - Isolation Valve 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 82.48	$ 10,573.77				$ 265.77	$ -	$ 10,308.00	6.5 hrs		
533	Item - 101 & 102 - Discharge Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 1,292.88				$ 132.88	$ -	$ 1,160.00	3.2 hrs		
534	Item - 103 - Isolation Valve - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 2,643.44				$ 66.44	$ -	$ 2,577.00	1.6 hrs		
535	Item - 104 - Clean Up Feed Isolation Valves - 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 20.62	$ 646.44				$ 66.44	$ -	$ 580.00	1.6 hrs		
536	Item - 105 - Vacuum Relief Valve 2"		PROC 4.2.1.2		$ -	45%	$ 237.92	$ 2,037.64				$ 766.64	$ -	$ 1,271.00	18.7 hrs		
537	Item - 106 Recirculation Flow Orifice 1"		PROC 4.2.1.2		$ -	45%	$ 17.45	$ 56.22				$ 56.22	$ -	$ -	1.4 hrs		
538	Item - 107 & 108 - Commissioning Strainer 1 1/2"		PROC 4.2.1.2		$ -	45%	$ 41.24	$ 132.88				$ 132.88	$ -	$ -	3.2 hrs		
539	Item - 109 - Cover Gas Pressure Transmitter		PROC 4.2.1.2		$ -	45%	$ 20.36	$ 582.60				$ 65.60	$ -	$ 517.00	1.6 hrs		

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate		Indirect Costs		Total Cost	All-in Rate Split			Labour	Materials	Construction Equipment	Total DFL Hours	Estimate Class	Assumptions
				[$/unit]	All-in Total [$]	% of Labour Total [%]	Indirect Total [$]	[$]	Lab [%]	Mat [%]	Equip [%]	[$]	[$]	[$]	[hours]		
540	Item - 110 & 111 - Level Transmitter		PROC 4.2.1.2		$ -	45%	$ 40.71	$ 4,669.19				$ 131.19	$ -	$ 4,538.00	3.2 hrs		
541	Main Contractor's mark-up for storage, freight, transportation and profit. Say, 14% of material cost.		PROC 4.2.5.4	116,893.35	$ 116,893.35	45%	$ 21,040.80	$ 137,934.16	40%	0%	60%	$ 55,173.66	$ -	$ 82,760.49	798.3 hrs		
	TIE-ins for new tanks with Exstg tanks (at Exstg bldg)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	PHT D20 Supply 38110 - 100 Mg (8 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
542	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 17,391.60	$ 141,839.58				$ 56,039.58	$ -	$ 85,800.00	1,370.0 hrs		
	Moderator D20 Supply 38110 - 100 Mg (7 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
543	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 15,217.65	$ 124,109.64				$ 49,034.64	$ -	$ 75,075.00	1,198.8 hrs		
	TRF/SUP Feed 38110 - 100 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
544	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 35,459.90				$ 14,009.90	$ -	$ 21,450.00	342.5 hrs		
	TRF/SUP Product 38110 - 100 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
545	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 35,459.90				$ 14,009.90	$ -	$ 21,450.00	342.5 hrs		
	Downgraded D20 38500 - 50 Mg (2 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
546	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 4,347.90	$ 32,159.90				$ 14,009.90	$ -	$ 18,150.00	342.5 hrs		
	Downgraded D20 38500 - 25 Mg (1 Tank)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
547	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 2,173.95	$ 15,254.95				$ 7,004.95	$ -	$ 8,250.00	171.3 hrs		
	D20 Clean up - 38410 - 25 Mg (3 Tanks)				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
548	Cutting/new 3 M pipe/Butt weld/Cut Off Valve/elbows/Tees/Testing/Tagging		STIE 4.2.11.1		$ -	45%	$ 6,521.85	$ 45,764.84				$ 21,014.84	$ -	$ 24,750.00	513.8 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
549	Rubber mats at all likely spill locations (25 ea) (6X4ft)		STIE 4.2.11.1	500.00	$ 12,500.00	45%	$ -	$ 12,500.00	0%	100%	0%	$ -	$ 12,500.00	$ -	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
550	Cathodic protection including all accessories (25 ea)		Bldg 4.1.5.1		$ -	45%	$ 5,365.67	$ 79,164.39				$ 17,289.39	$ -	$ 61,875.00	428.1 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
551	Crane Heavy duty Rental (for 3 months @ $40,000/month)		Bldg 4.2.4.1	40,000.00	$ 120,000.00	45%	$ -	$ 120,000.00	0%	0%	100%	$ -	$ -	$ 120,000.00	-		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
552	Stack Monitor (installation, electrical connections, switches)		PROC 4.2.2.6	275,000.00	$ 550,000.00	45%	$ 74,250.00	$ 624,250.00	30%	60%	10%	$ 187,275.00	$ 374,550.00	$ 62,425.00	2,769.6 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
553	Stainless Steel Ducts in Effluent Stack (14" dia) - ALL		PROC 4.2.2.6	190.00	$ 26,600.00	45%	$ 3,591.00	$ 30,191.00	30%	60%	10%	$ 9,057.30	$ 18,114.60	$ 3,019.10	134.0 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
554	Stainless Steel hoods and cover		PROC 4.2.2.6	50,000.00	$ 150,000.00	45%	$ 20,250.00	$ 170,250.00	30%	60%	10%	$ 51,075.00	$ 102,150.00	$ 17,025.00	755.4 hrs		
	COMMON GENERAL ITEMS				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
555	Cable Trays c/w hanging supports and metal brackets		Bldg 4.1.3.1		$ -	45%	$ 6,263.79	$ 24,377.62				$ 20,183.32	$ -	$ 4,194.30	499.8 hrs		
556	Pipe supports c/w supports and rawl plugs		STIE 4.2.1.1		$ -	45%	$ 2,918.50	$ 12,348.07				$ 9,404.07	$ 460.00	$ 2,484.00	229.9 hrs		
557	Instrumentation - SCADA (tanks to Control Room)		PROC 4.3.5.1	22,000.00	$ 550,000.00	45%	$ 74,250.00	$ 624,250.00	30%	60%	10%	$ 187,275.00	$ 374,550.00	$ 62,425.00	2,709.7 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Tie-ins to existing services				$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
558	X-ray scanning of tie-in locations		STIE 4.2.11.1	1,200.00	$ 4,800.00	45%	$ 432.00	$ 5,232.00	20%	10%	70%	$ 1,046.40	$ 523.20	$ 3,662.40	17.3 hrs		
					$ -	45%	$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 18,197,268.74**		**$ 1,536,141.21**	**$ 22,840,585.80**				**$ 4,586,535.78**	**$ 15,395,038.81**	**$ 2,859,011.21**	**96,310.4 hrs**		
	ELECTRICAL CONTROL SYSTEMS																
559	Main Control Panel (600 wide x 800deep); 2000A		Bldg 4.1.1.6	20,000.00	$ 20,000.00	45%	$ 2,700.00	$ 22,700.00	30%	60%	10%	$ 6,810.00	$ 13,620.00	$ 2,270.00	99.8 hrs		
560	Main Control Panel (600 wide x 800deep); 2500A		Bldg 4.1.1.6	25,000.00	$ 25,000.00	45%	$ 3,375.00	$ 28,375.00	30%	60%	10%	$ 8,512.50	$ 17,025.00	$ 2,837.50	124.8 hrs		
561	Main Control Panel (600 wide x 800deep); 3000A		Bldg 4.1.1.6	30,000.00	$ 30,000.00	45%	$ 4,050.00	$ 34,050.00	30%	60%	10%	$ 10,215.00	$ 20,430.00	$ 3,405.00	149.7 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
562	Panel Boards; 2000A		Bldg 4.1.1.6		$ -	45%	$ 208.79	$ 19,053.86				$ 672.78	$ -	$ 18,381.08	16.7 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 75,000.00**		**$ 10,333.79**	**$ 104,178.86**				**$ 26,210.28**	**$ 51,075.00**	**$ 26,893.58**	**390.9 hrs**		
	SPECIALIST EQUIPMENT																
563	Mono rail system; 1T		Bldg 4.2.4.3	4,115.00	$ 4,115.00	45%	$ 185.18	$ 4,300.18	10%	80%	10%	$ 430.02	$ 3,440.14	$ 430.02	6.4 hrs		
564	Mono rail system; 5T		Bldg 4.2.4.3	9,897.00	$ 9,897.00	45%	$ 445.37	$ 10,342.37	10%	80%	10%	$ 1,034.24	$ 8,273.89	$ 1,034.24	15.4 hrs		
					$ -		$ -	$ -				$ -	$ -	$ -	-		
	Sub-Total				**$ 14,012.00**		**$ 630.54**	**$ 14,642.54**				**$ 1,464.25**	**$ 11,714.03**	**$ 1,464.25**	**21.8 hrs**		
	TOTAL				**$ 28,567,039.86**		**$ 5,058,990.91**	**$ 45,604,124.36**				**$ 15,017,645.98**	**$ 21,968,886.81**	**$ 8,617,591.56**	**343,230.9 hrs**		
	LIFE CYCLE COSTINGS																
	Replacement roof materials				$ -		$ -	$ -									
565	Built up Roof at Lvl 115.00 - Re-roof at 25 years	2.3.1.3	Bldg 4.4.5.1	447.22	$ 268,329.60		$ -	$ 268,329.60									
566	Epoxy floor coatings (1 re-coat)		Bldg 4.4.6.3	47.35	$ 49,374.21		$ -	$ 49,374.21									
567	Duct controllers (15 years)		PROC 4.2.1.3	25,000.00	$ 25,000.00		$ -	$ 25,000.00									
568	Control valves (15 years)		PROC 4.2.1.2	90,000.00	$ 90,000.00		$ -	$ 90,000.00									
569	Valves (20 years)		PROC 4.2.1.2	73,000.00	$ 73,000.00		$ -	$ 73,000.00									
570	SCADA (25 years)		PROC 4.3.5.1	120,000.00	$ 120,000.00		$ -	$ 120,000.00									
571	Office furniture		Bldg 4.4.6.14-O	172,293.00	$ 172,293.00		$ -	$ 172,293.00									
572	Office flooring		Bldg 4.4.6.3-O	110.00	$ 27,500.00		$ -	$ 27,500.00									

DNGS Heavy Water Management Building - Construction Cost Estimate

Ref	Item	NRM Ref	PBS	All-in Rate [$/unit]	All-in Total [$]	Indirect Costs % of Labour Total [%]	Indirect Total [$]	Total Cost [$]	All-in Rate Split Lab [%]	Mat [%]	Equip [%]	Labour [$]	Materials [$]	Construction Equipment [$]	Total DFL Hours [hours]	Estimate Class	Assumptions
573	Washroom appliances		Bldg 4.4.6.14-O	57,200.00	$ 57,200.00		$ -	$ 57,200.00									
574	Pumps (20 years) - overhaul and new impellers		PROC 4.2.2.4	118,702.00	$ 118,702.00		$ -	$ 118,702.00									
575	Replacement of valves and controls to HVAC systems		PROC 4.2.1.7	155,000.00	$ 155,000.00		$ -	$ 155,000.00									
					$ -		$ -	$ -									
	Sub-Total				**$ 1,156,398.81**		**$ -**	**$ 1,156,398.81**									

11 Appendix E – Productivity Factors

11.1 Productivity Factor - Unzoned

The following represents the productivity factor for 'unzoned' areas:

Unzoned

Item	Event Description	Event Time		Events per Shift	Total Non-productive Time	Total Productive Time
		minutes	per			
1	Basic Shift					10.00 hrs
	Less					
2	Food	30 mins	4 hours	1 nr	0.50 hrs	
3	Restroom Breaks	15 mins	Shift	1 nr	0.25 hrs	
4	Walking Time	7 mins	Regulated Break	2 nr	0.23 hrs	
5	Wash Time	15 mins	Shift	2 nr	0.50 hrs	
6	Non RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
7	RP Change Time	-	Shift	2 nr	-	
8	Tools and Elecrical Tools Check	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
9	TCR's and Blanket Hot Work Permits, DCN83057 Work Plan, FME F	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
10	Job Brief Specific Hazards and JSAP Prior to Start	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
11	Job Brief Secific Hazards and JSAP Post Complete	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
12	Houskeeping	30 mins	Shift (at end of shift)	1 nr	0.50 hrs	
13	Working In Rubber Area (What is Max REM? Assume 5 Mins Per Hr	-	Hour	10 nr	-	
14	Constraints due to Night Shift	-	Shift (during shift)	1 nr	-	
15	Overtime Day and Saturday and Sunday	-	Shift (during shift)	1 nr	-	
16	Monitoring (Allow 5 events per shift @ 3mins)	-	Shift (during shift)	5 nr	-	
	Total To Work Site				**3.98 hrs**	**6.02 hrs**
17	Congestion Trade (Multi Trade in Same Area)	-	Mid	1 nr	-	
18	Congestion Physical (Limited Space)	-	Mid	1 nr	-	
19	Learning Curve	9 mins	Mid	1 nr	0.15 hrs	
	Total At Work Site				**0.15 hrs**	**-0.15 hrs**
	Total Productive Time					**5.87 hrs**
					Productivity	59%
					Factor Multiplier	**1.70**

11.2 Productivity Factor – Zone 3

The following represents the productivity factor for 'Zone 3' areas:

ZONE 3

Item	Event Description	Event Time		Events per Shift	Total Non-productive Time	Total Productive Time
		minutes	per			
1	Basic Shift					10.00 hrs
	Less					
2	Food	30 mins	4 hours	1 nr	0.50 hrs	
3	Restroom Breaks	15 mins	Shift	1 nr	0.25 hrs	
4	Walking Time	7 mins	Regulated Break	2 nr	0.23 hrs	
5	Wash Time	15 mins	Shift	2 nr	0.50 hrs	
6	Non RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
7	RP Change Time	15 mins	Shift	2 nr	0.50 hrs	
8	Tools and Elecrical Tools Check	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
9	TCR's and Blanket Hot Work Permits, DCN83057 Work Plan, FME P	15 mins	Shift (at start of shift)	1 nr	0.25 hrs	
10	Job Brief Specific Hazards and JSAP Prior to Start	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
11	Job Brief Secific Hazards and JSAP Post Complete	30 mins	Shift (at start of shift)	1 nr	0.50 hrs	
12	Houskeeping	30 mins	Shift (at end of shift)	1 nr	0.50 hrs	
13	Working In Rubber Area (What is Max REM? Assume 5 Mins Per Hr	5 mins	Hour	10 nr	0.83 hrs	
14	Constraints due to Night Shift	-	Shift (during shift)	1 nr	-	
15	Overtime Day and Saturday and Sunday	-	Shift (during shift)	1 nr	-	
16	Monitoring (Allow 5 events per shift @ 3mins)	3 mins	Shift (during shift)	5 nr	0.25 hrs	
	Total To Work Site				**5.57 hrs**	**4.43 hrs**
17	Congestion Trade (Multi Trade in Same Area)	-	Mid	1 nr	-	
18	Congestion Physical (Limited Space)	-	Mid	1 nr	-	
19	Learning Curve	9 mins	Mid	1 nr	0.15 hrs	
	Total At Work Site				**0.15 hrs**	**-0.15 hrs**
	Total Productive Time					**4.28 hrs**
					Productivity	43%
					Factor Multiplier	**2.33**

12 Appendix F – Crew Rates

DNGS Heavy Water Management Building - Crew Rates

(single 10 hour shifts, 5 days per week)

Crew	Rate	Rate (inc. Profit)
Groundworks	$ 53.22	$ 58.54
Fencing	$ 61.13	$ 67.24
Concrete	$ 56.49	$ 62.13
External Lighting	$ 58.53	$ 64.38
Roadworks Crew	$ 53.22	$ 58.54
Plumbers	$ 60.43	$ 66.47
Electrical Workers	$ 62.03	$ 68.23
Pipefitters	$ 62.83	$ 69.11
Building Works	$ 54.94	$ 60.43
Structural Steelwork	$ 61.13	$ 67.24
Roofers	$ 53.07	$ 58.38
Cladding	$ 61.47	$ 67.62
Masonry	$ 55.90	$ 61.49
Flooring	$ 57.83	$ 63.61

Crew Build-ups

Groundworks	Rate	%	Total
Laborer	$ 53.22	100%	$ 53.22
			$ -
		Crew rate	**$ 53.22**

Fencing	Rate	%	Total
Ironworker	$ 61.13	100%	$ 61.13
			$ -
		Crew rate	**$ 61.13**

Concrete	Rate	%	Total
Rodmen	$ 61.03	30%	$ 18.31
Carpenters	$ 57.83	20%	$ 11.57
Laborer	$ 53.22	50%	$ 26.61
			$ -
		Crew rate	**$ 56.49**

External Lighting	Rate	%	Total
Electrical worker	$ 62.03	25%	$ 15.51
Laborer	$ 53.22	25%	$ 13.31
Carpenters	$ 57.83	25%	$ 14.46
Rodmen	$ 61.03	25%	$ 15.26
			$ -
		Crew rate	**$ 58.53**

Roadworks Crew	Rate	%	Total
Laborer	$ 53.22	100%	$ 53.22
			$ -
		Crew rate	**$ 53.22**

Plumbers	Rate	%	Total
Laborer	$ 53.22	25%	$ 13.31
Plumbers and pipefitters	$ 62.83	75%	$ 47.12
			$ -
		Crew rate	**$ 60.43**

Electrical Workers	Rate	%	Total
Electrical worker	$ 62.03	100%	$ 62.03
			$ -
		Crew rate	**$ 62.03**

Pipefitters	Rate	%	Total
Plumbers and pipefitters	$ 62.83	100%	$ 62.83
			$ -
		Crew rate	**$ 62.83**

Building Works	Rate	%	Total
Laborer	$ 53.22	60%	$ 31.93
Carpenters	$ 57.83	30%	$ 17.35
Painters	$ 56.56	10%	$ 5.66
			$ -
		Crew rate	**$ 54.94**

Structural Steelwork	Rate	%	Total
Ironworker	$ 61.13	100%	$ 61.13
			$ -
		Crew rate	**$ 61.13**

Roofers	Rate	%	Total
Roofers	$ 53.07	100%	$ 53.07
			$ -
		Crew rate	**$ 53.07**

Cladding	Rate	%	Total
Sheet metal works	$ 61.47	100%	$ 61.47
			$ -
		Crew rate	**$ 61.47**

Masonry	Rate	%	Total
Cement mason	$ 55.90	100%	$ 55.90
			$ -
		Crew rate	**$ 55.90**

Flooring	Rate	%	Total
Carpenters	$ 57.83	100%	$ 57.83
			$ -
		Crew rate	**$ 57.83**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.68	$ 41.52	$ 55.36
Vacation Pay - See note (2)	$ 1.11	$ 1.66	$ 2.21
Holiday Pay - See note (3)	$ 1.66	$ 2.49	$ 3.32
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 39.98**	**$ 59.97**	**$ 79.96**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.59	$ 0.89	$ 1.19
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 47.52**	**$ 61.04**	**$ 81.32**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Carpenter - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Carpenter	Carpenter	Carpenter	Carpenter		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$59.20	$57.52	$55.28	$47.52		
		$13,321	**$77,655**	**$447,760**	**$96,225**		**$634,961**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$78.57	$76.04	$72.68	$61.04		
		$4,714	**$27,375**	**$156,985**	**$32,960**		**$222,035**
TOTAL	**50**					**14,820**	**$856,996**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$57.83**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.10	$ 57.15	$ 76.20
Vacation Pay - See note (2)	$ 1.52	$ 2.29	$ 3.05
Holiday Pay - See note (3)	$ 2.29	$ 3.43	$ 4.57
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 51.44**	**$ 77.16**	**$ 102.88**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.82	$ 1.23	$ 1.63
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 59.20**	**$ 78.57**	**$ 104.69**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 34.60	$ 51.90	$ 69.20
Vacation Pay - See note (2)	$ 1.38	$ 2.08	$ 2.77
Holiday Pay - See note (3)	$ 2.08	$ 3.11	$ 4.15
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 47.59**	**$ 71.39**	**$ 95.18**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.74	$ 1.11	$ 1.48
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 55.28**	**$ 72.68**	**$ 96.84**

Carpenter EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Carpenter - SubForeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.60	$ 54.90	$ 73.20
Vacation Pay - See note (2)	$ 1.46	$ 2.20	$ 2.93
Holiday Pay - See note (3)	$ 2.20	$ 3.29	$ 4.39
Welfare $2.74 - See note (4)	$ 2.74	$ 4.11	$ 5.48
Pension $5.83 - See note (4)	$ 5.83	$ 8.75	$ 11.66
Union Funds $0.96 - See note (4), (5) & (6)	$ 0.96	$ 1.44	$ 1.92
Total Wage Package	**$ 49.79**	**$ 74.69**	**$ 99.58**
Admin Traning Fund	$ 0.03	$ 0.03	$ 0.03
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.57
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.52**	**$ 76.04**	**$ 101.33**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 31.77	$ 47.66	$ 63.54
Vacation Pay - See note (2)	$ 1.27	$ 1.91	$ 2.54
Holiday Pay - See note (3)	$ 1.91	$ 2.86	$ 3.81
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 41.40**	**$ 62.10**	**$ 82.79**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.68	$ 1.02	$ 1.36
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 49.00**	**$ 63.27**	**$ 84.31**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Cement Mason - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3		
		Cement Mason	Cement Mason	Cement Mason	Cement Mason		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$56.32	$54.64	$52.95	$49.00		
		$12,672	**$73,759**	**$428,928**	**$99,216**		**$614,574**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$74.25	$71.73	$69.21	$63.27		
		$4,455	**$25,822**	**$149,484**	**$34,165**		**$213,927**
TOTAL	**50**					**14,820**	**$828,501**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$55.90**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Cement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Cement Mason - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.30	$ 57.45	$ 76.60
Vacation Pay - See note (2)	$ 1.53	$ 2.30	$ 3.06
Holiday Pay - See note (3)	$ 2.30	$ 3.45	$ 4.60
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 48.58**	**$ 72.87**	**$ 97.16**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.82	$ 1.23	$ 1.64
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 56.32**	**$ 74.25**	**$ 98.95**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 35.30	$ 52.95	$ 70.60
Vacation Pay - See note (2)	$ 1.41	$ 2.12	$ 2.82
Holiday Pay - See note (3)	$ 2.12	$ 3.18	$ 4.24
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 45.28**	**$ 67.92**	**$ 90.56**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.76	$ 1.14	$ 1.51
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 52.95**	**$ 69.21**	**$ 92.22**

ement Mason EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGI

Description	Cement Mason - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.80	$ 55.20	$ 73.60
Vacation Pay - See note (2)	$ 1.47	$ 2.21	$ 2.94
Holiday Pay - See note (3)	$ 2.21	$ 3.31	$ 4.42
Welfare - See note (4) included below	$ -	$ -	$ -
Pension - See note (4) included below	$ -	$ -	$ -
Union Funds $6.45 - See note (4), (5) & (6) welfare, pension, training, organizer fund	$ 6.45	$ 9.68	$ 12.90
Total Wage Package	**$ 46.93**	**$ 70.40**	**$ 93.86**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.58
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 54.64**	**$ 71.73**	**$ 95.59**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Apprentice (3rd year)		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 23.44	$ 35.16	$ 46.88
Vacation Pay - See note (2)	$ 0.94	$ 1.41	$ 1.88
Holiday Pay - See note (3)	$ 1.41	$ 2.11	$ 2.81
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 35.73**	**$ 53.60**	**$ 71.47**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.50	$ 0.75	$ 1.01
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 43.10**	**$ 54.46**	**$ 72.57**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Electrical Worker- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Elect Worker	Elect Worker	Elect Worker	Elect Worker		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$66.33	$63.69	$60.63	$43.10		
		$14,924	**$85,986**	**$491,119**	**$87,285**		**$679,314**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$89.29	$85.34	$80.75	$54.46		
		$5,358	**$30,722**	**$174,415**	**$29,406**		**$239,901**
TOTAL	**50**					**14,820**	**$919,214**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$62.03**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 44.15	$ 66.23	$ 88.30
Vacation Pay - See note (2)	$ 1.77	$ 2.65	$ 3.53
Holiday Pay - See note (3)	$ 2.65	$ 3.97	$ 5.30
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 58.52**	**$ 87.77**	**$ 117.03**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.95	$ 1.42	$ 1.89
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 66.33**	**$ 89.29**	**$ 119.02**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.07	$ 58.61	$ 78.14
Vacation Pay - See note (2)	$ 1.56	$ 2.34	$ 3.13
Holiday Pay - See note (3)	$ 2.34	$ 3.52	$ 4.69
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 52.93**	**$ 79.39**	**$ 105.85**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.26	$ 1.68
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.63**	**$ 80.75**	**$ 107.63**

Elect Worker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Elect Worker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.80	$ 62.70	$ 83.60
Vacation Pay - See note (2)	$ 1.67	$ 2.51	$ 3.34
Holiday Pay - See note (3)	$ 2.51	$ 3.76	$ 5.02
Welfare - See note (4) included in Union funds	$ -	$ -	$ -
Pension - See note (4) included in Union funds	$ -	$ -	$ -
Union Funds $9.95 - See note (4), (5) & (6)	$ 9.95	$ 14.93	$ 19.90
Total Wage Package	**$ 55.93**	**$ 83.90**	**$ 111.86**
JAC FUNDS	$ 0.10	$ 0.10	$ 0.10
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.90	$ 1.34	$ 1.79
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.69**	**$ 85.34**	**$ 113.75**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.85	$ 41.78	$ 55.70
Vacation Pay - See note (2)	$ 1.67	$ 2.51	$ 3.34
Holiday Pay - See note (3)	$ 1.11	$ 1.67	$ 2.23
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 40.72**	**$ 61.07**	**$ 81.43**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.60	$ 0.90	$ 1.19
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 48.23**	**$ 62.12**	**$ 82.77**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Ironworker- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd		
		Ironworker	Ironworker	Ironworker	Ironworker		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$63.64	$61.44	$58.64	$48.23		
		$14,319	$82,944	$474,954	$97,664		$669,881
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$85.23	$81.93	$77.73	$62.12		
		$5,114	$29,496	$167,895	$33,544		$236,049
TOTAL	**50**					**14,820**	$905,930
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.13**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.59	$ 62.39	$ 83.18
Vacation Pay - See note (2)	$ 2.50	$ 3.74	$ 4.99
Holiday Pay - See note (3)	$ 1.66	$ 2.50	$ 3.33
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 55.83**	**$ 83.74**	**$ 111.66**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.89	$ 1.34	$ 1.78
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.64**	**$ 85.23**	**$ 113.59**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.13	$ 55.70	$ 74.26
Vacation Pay - See note (2)	$ 2.23	$ 3.34	$ 4.46
Holiday Pay - See note (3)	$ 1.49	$ 2.23	$ 2.97
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 50.92**	**$ 76.38**	**$ 101.85**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.19	$ 1.59
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 58.64**	**$ 77.73**	**$ 103.59**

Ironworker EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.63	$ 59.45	$ 79.26
Vacation Pay - See note (2)	$ 2.38	$ 3.57	$ 4.76
Holiday Pay - See note (3)	$ 1.59	$ 2.38	$ 3.17
Welfare $3.19 - See note (4)	$ 3.19	$ 4.79	$ 6.38
Pension $6.34 - See note (4)	$ 6.34	$ 9.51	$ 12.68
Union Funds $0.55 - See note (4), (5) & (6)	$ 0.55	$ 0.83	$ 1.10
Total Wage Package	**$ 53.67**	**$ 80.51**	**$ 107.35**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.85	$ 1.28	$ 1.70
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.44**	**$ 81.93**	**$ 109.20**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Apprentice (3rd year)		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.14	$ 48.21	$ 64.28
Vacation Pay - See note (2)	$ 1.29	$ 1.93	$ 2.57
Holiday Pay - See note (3)	$ 1.93	$ 2.89	$ 3.86
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 43.83**	**$ 65.75**	**$ 87.67**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.69	$ 1.03	$ 1.38
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 51.44**	**$ 66.94**	**$ 89.20**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Laborer- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Laborer	Laborer	Laborer	Laborer		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$52.84	$51.44	$49.48	$51.44		
		$11,889	**$69,444**	**$400,770**	**$104,167**		**$586,270**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$69.04	$66.94	$63.99	$66.94		
		$4,142	**$24,097**	**$138,221**	**$36,145**		**$202,605**
TOTAL	**50**					**14,820**	**$788,875**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$53.23**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 33.39	$ 50.09	$ 66.78
Vacation Pay - See note (2)	$ 1.34	$ 2.00	$ 2.67
Holiday Pay - See note (3)	$ 2.00	$ 3.01	$ 4.01
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 45.21**	**$ 67.81**	**$ 90.42**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.72	$ 1.07	$ 1.43
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 52.84**	**$ 69.04**	**$ 92.00**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 30.39	$ 45.59	$ 60.78
Vacation Pay - See note (2)	$ 1.22	$ 1.82	$ 2.43
Holiday Pay - See note (3)	$ 1.82	$ 2.74	$ 3.65
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 41.91**	**$ 62.86**	**$ 83.82**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.65	$ 0.98	$ 1.30
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 49.48**	**$ 63.99**	**$ 85.27**

Labourer EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Labourer - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.14	$ 48.21	$ 64.28
Vacation Pay - See note (2)	$ 1.29	$ 1.93	$ 2.57
Holiday Pay - See note (3)	$ 1.93	$ 2.89	$ 3.86
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $5.58 - See note (4)	$ 5.58	$ 8.37	$ 11.16
Union Funds $0.50 - See note (4), (5) & (6)	$ 0.50	$ 0.75	$ 1.00
Total Wage Package	**$ 43.83**	**$ 65.75**	**$ 87.67**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.69	$ 1.03	$ 1.38
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 51.44**	**$ 66.94**	**$ 89.20**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Painters - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.43	$ 56.15	$ 74.86
Vacation Pay - See note (2)	$ 1.50	$ 2.25	$ 2.99
Holiday Pay - See note (3)	$ 2.25	$ 3.37	$ 4.49
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 49.87**	**$ 74.81**	**$ 99.75**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.20	$ 1.61
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.59**	**$ 76.16**	**$ 101.50**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 27.54	$ 41.31	$ 55.08
Vacation Pay - See note (2)	$ 1.10	$ 1.65	$ 2.20
Holiday Pay - See note (3)	$ 1.65	$ 2.48	$ 3.30
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 38.99**	**$ 58.49**	**$ 77.99**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.59	$ 0.89	$ 1.18
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 46.50**	**$ 59.53**	**$ 79.32**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Painters- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Painters	Painters	Painters	Painters		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$57.59	$55.63	$54.23	$46.50		
		$12,958	**$75,101**	**$439,250**	**$94,166**		**$621,475**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$76.16	$73.22	$71.12	$59.53		
		$4,570	**$26,359**	**$153,613**	**$32,145**		**$216,687**
TOTAL	**50**					**14,820**	**$838,162**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$56.56**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 34.43	$ 51.65	$ 68.86
Vacation Pay - See note (2)	$ 1.38	$ 2.07	$ 2.75
Holiday Pay - See note (3)	$ 2.07	$ 3.10	$ 4.13
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 46.57**	**$ 69.86**	**$ 93.15**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.74	$ 1.11	$ 1.48
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 54.23**	**$ 71.12**	**$ 94.77**

Painters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Ironworker - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 35.68	$ 53.52	$ 71.36
Vacation Pay - See note (2)	$ 1.43	$ 2.14	$ 2.85
Holiday Pay - See note (3)	$ 2.14	$ 3.21	$ 4.28
Welfare $2.30 - See note (4)	$ 2.30	$ 3.45	$ 4.60
Pension $5.25 - See note (4)	$ 5.25	$ 7.88	$ 10.50
Union Funds $1.15 - See note (4), (5) & (6)	$ 1.15	$ 1.73	$ 2.30
Total Wage Package	**$ 47.95**	**$ 71.92**	**$ 95.90**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.77	$ 1.15	$ 1.53
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 55.63**	**$ 73.22**	**$ 97.58**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 25.29	$ 37.94	$ 50.58
Vacation Pay - See note (2)	$ 1.52	$ 2.28	$ 3.03
Holiday Pay - See note (3)	$ 1.01	$ 1.52	$ 2.02
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 38.37**	**$ 57.55**	**$ 76.74**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.54	$ 0.81	$ 1.08
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 45.83**	**$ 58.52**	**$ 77.97**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Plumbers/Pipefitters- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd year)		
		Plumbers/Pipefitters	Plumbers/Pipefitters	Plumbers/Pipefitters	Plumbers/Pipefitters		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$65.46	$63.29	$61.10	$45.83		
		$14,730	$85,441	$494,930	$92,802		$687,903
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$87.97	$84.71	$81.43	$58.52		
		$5,278	$30,495	$175,885	$31,599		$243,258
TOTAL	**50**					**14,820**	$931,161
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$62.83**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 42.80	$ 64.20	$ 85.60
Vacation Pay - See note (2)	$ 2.57	$ 3.85	$ 5.14
Holiday Pay - See note (3)	$ 1.71	$ 2.57	$ 3.42
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 57.63**	**$ 86.45**	**$ 115.26**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.92	$ 1.38	$ 1.84
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 65.46**	**$ 87.97**	**$ 117.25**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 38.91	$ 58.37	$ 77.82
Vacation Pay - See note (2)	$ 2.33	$ 3.50	$ 4.67
Holiday Pay - See note (3)	$ 1.56	$ 2.33	$ 3.11
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 53.35**	**$ 80.03**	**$ 106.70**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.83	$ 1.25	$ 1.67
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.10**	**$ 81.43**	**$ 108.52**

Plumbers/Pipefitters EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Plumbers/Pipefitters - SubForeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.86	$ 61.29	$ 81.72
Vacation Pay - See note (2)	$ 2.45	$ 3.68	$ 4.90
Holiday Pay - See note (3)	$ 1.63	$ 2.45	$ 3.27
Welfare $2.40 - See note (4)	$ 2.40	$ 3.60	$ 4.80
Pension $6.22 - See note (4)	$ 6.22	$ 9.33	$ 12.44
Union Funds $1.93 - See note (4), (5) & (6)	$ 1.93	$ 2.90	$ 3.86
Total Wage Package	**$ 55.50**	**$ 83.24**	**$ 110.99**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.88	$ 1.31	$ 1.75
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.29**	**$ 84.71**	**$ 112.89**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 32.68	$ 49.02	$ 65.36
Vacation Pay - See note (2)	$ 1.96	$ 2.94	$ 3.92
Holiday Pay - See note (3)	$ 1.31	$ 1.96	$ 2.61
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 45.71**	**$ 68.56**	**$ 91.42**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.70	$ 1.05	$ 1.40
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 53.33**	**$ 69.76**	**$ 92.97**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Rodmen - 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	rentice (3rd y		
		Rodmen	Rodmen	Rodmen	Rodmen		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$61.60	$60.76	$57.40	$53.33		
		$13,860	**$82,027**	**$464,914**	**$107,985**		**$668,786**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$82.18	$80.92	$75.87	$69.76		
		$4,931	**$29,130**	**$163,879**	**$37,672**		**$235,612**
TOTAL	**50**					**14,820**	**$904,398**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.03**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.06	$ 60.09	$ 80.12
Vacation Pay - See note (2)	$ 2.40	$ 3.61	$ 4.81
Holiday Pay - See note (3)	$ 1.60	$ 2.40	$ 3.20
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 53.83**	**$ 80.74**	**$ 107.65**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.86	$ 1.29	$ 1.72
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 61.60**	**$ 82.18**	**$ 109.52**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.31	$ 54.47	$ 72.62
Vacation Pay - See note (2)	$ 2.18	$ 3.27	$ 4.36
Holiday Pay - See note (3)	$ 1.45	$ 2.18	$ 2.90
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 49.70**	**$ 74.55**	**$ 99.40**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.78	$ 1.17	$ 1.56
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 57.40**	**$ 75.87**	**$ 101.11**

Rodmen EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Rodmen - Subforeman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.31	$ 58.97	$ 78.62
Vacation Pay - See note (2)	$ 2.36	$ 3.54	$ 4.72
Holiday Pay - See note (3)	$ 1.57	$ 2.36	$ 3.14
Welfare $2.95 - See note (4)	$ 2.95	$ 4.43	$ 5.90
Pension $6.27 - See note (4)	$ 6.27	$ 9.41	$ 12.54
Union Funds $0.54 - See note (4), (5) & (6)	$ 0.54	$ 0.81	$ 1.08
Total Wage Package	**$ 53.00**	**$ 79.50**	**$ 106.00**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.26	$ 1.69
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.76**	**$ 80.92**	**$ 107.84**

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Apprentice 3Y		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 29.40	$ 44.10	$ 58.80
Vacation Pay - See note (2)	$ 1.18	$ 1.76	$ 2.35
Holiday Pay - See note (3)	$ 1.76	$ 2.65	$ 3.53
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 7.48	$ 11.22	$ 14.96
Union Funds $1.04 - See note (4), (5) & (6)	$ 1.04	$ 1.56	$ 2.08
Total Wage Package	**$ 40.86**	**$ 61.29**	**$ 81.72**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.63	$ 0.95	$ 1.26
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 48.41**	**$ 62.39**	**$ 83.13**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Roofers- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd		
		Roofers	Roofers	Roofers	Roofers		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$62.01	$0.00	$58.02	$48.41		
		$13,952	**$0**	**$469,922**	**$98,025**		**$581,899**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$82.79	$0.00	$76.80	$62.39		
		$4,967	**$0**	**$165,882**	**$33,688**		**$204,538**
TOTAL	**50**					**14,820**	**$786,437**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$53.07**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 40.29	$ 60.44	$ 80.58
Vacation Pay - See note (2)	$ 1.61	$ 2.42	$ 3.22
Holiday Pay - See note (3)	$ 2.42	$ 3.63	$ 4.83
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 8.61	$ 12.92	$ 17.22
Union Funds $1.30 - See note (4), (5) & (6)	$ 1.30	$ 1.95	$ 2.60
Total Wage Package	**$ 54.23**	**$ 81.34**	**$ 108.46**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.86	$ 1.30	$ 1.73
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 62.01**	**$ 82.79**	**$ 110.34**

Roofers EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Roofers- Journeyman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 36.79	$ 55.19	$ 73.58
Vacation Pay - See note (2)	$ 1.47	$ 2.21	$ 2.94
Holiday Pay - See note (3)	$ 2.21	$ 3.31	$ 4.41
Welfare - See note (4) included below	$ -	$ -	$ -
Benefits/Admin (welfare, Pension)	$ 8.61	$ 12.92	$ 17.22
Union Funds $1.30 - See note (4), (5) & (6)	$ 1.23	$ 1.85	$ 2.46
Total Wage Package	**$ 50.31**	**$ 75.46**	**$ 100.62**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.79	$ 1.18	$ 1.58
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 58.02**	**$ 76.80**	**$ 102.35**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 21.45	$ 32.18	$ 42.90
Vacation Pay - See note (2)	$ 0.86	$ 1.29	$ 1.72
Holiday Pay - See note (3)	$ 1.29	$ 1.93	$ 2.57
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 4.14	$ 6.21	$ 8.28
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 32.01**	**$ 48.01**	**$ 64.01**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.46	$ 0.69	$ 0.92
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 39.38**	**$ 48.85**	**$ 65.08**

Hourly Rate Calculation: 10 Hrs / Shift, 1 Shift (Appendix A, 5 day Coverage)

Description	Gross Hour Working Time	Sheet metal Workers- 100% (Effective Date: 01 May 2012 to 30 April 2013)				Net Hours	Total Cost
		Foreman	Subforeman	Journeyman	Apprentice (3rd yea		
		Sheet Metal Workers	Sheet Metal Workers	Sheet Metal Workers	Sheet Metal Workers		
No. of workers		6	36	216	54		
Percentage		100%	100%	100%	100%		
First Shift							
Regular Hours Mon. to Fri.	40	240	1440	8640	2160		
Lunch Time	2.5	15.0	90.0	540.0	135.0		
Workhours Mon. to Fri.	**37.5**	**225.0**	**1,350.0**	**8,100.0**	**2,025.0**	**11,700**	
Plain rate		$65.47	$63.05	$60.98	$39.38		
		$14,730	**$85,124**	**$493,938**	**$79,749**		**$673,541**
Overtime (Mon - Fri)							
Regular Hours Mon. to Fri.	10	60	360	2160	540	**3120**	
Overtime Rate (x1.5) Rate		$87.97	$84.36	$81.24	$48.85		
		$5,278	**$30,368**	**$175,489**	**$26,378**		**$237,513**
TOTAL	**50**					**14,820**	**$911,054**
Labour Rate - EPSCA (10 hrs per shift x 1 shifts per day x 5 days per week) - $/hr							**$61.47**

Mon-Fri (First Shift): Regular scheduled hours of work of up to 10 hours per shift
Mon-Fri (Second Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Mon-Fri (Third Shift): Regular scheduled hours of work of up to 10 hours per shift plus a shift differential of 1/5 of the straight time hourlt rate
Sat: 2 times for all hours worked.
Sun & Hol: 2 times for all hours worked.
Overtime: first two hours of overtime worked as an extension to the regularly scheduled hours of work (Mon-Fri) shall be paid 1-1/2 times the base hourly rate.

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 41.49	$ 62.24	$ 82.98
Vacation Pay - See note (2)	$ 1.66	$ 2.49	$ 3.32
Holiday Pay - See note (3)	$ 2.49	$ 3.73	$ 4.98
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 57.66**	**$ 86.49**	**$ 115.32**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.89	$ 1.33	$ 1.78
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 65.47**	**$ 87.97**	**$ 117.25**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 37.49	$ 56.24	$ 74.98
Vacation Pay - See note (2)	$ 1.50	$ 2.25	$ 3.00
Holiday Pay - See note (3)	$ 2.25	$ 3.37	$ 4.50
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 53.26**	**$ 79.89**	**$ 106.52**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.80	$ 1.21	$ 1.61
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 60.98**	**$ 81.24**	**$ 108.28**

Sheetmetal EPSCA Wage Schedule - APPENDIX "A" (5 DAY COVERAGE)

Description	Sheetmetal - Foreman		
	Plain Time	Overtime	Doubletime
Base Hourly rate from 01 May 2012 TO 30 April 2013	$ 39.34	$ 59.01	$ 78.68
Vacation Pay - See note (2)	$ 1.57	$ 2.36	$ 3.15
Holiday Pay - See note (3)	$ 2.36	$ 3.54	$ 4.72
Welfare $4.11 - See note (4)	$ 4.11	$ 6.17	$ 8.22
Pension $7.75 - See note (4)	$ 7.75	$ 11.63	$ 15.50
Union Funds $0.16 - See note (4), (5) & (6)	$ 0.16	$ 0.24	$ 0.32
Total Wage Package	**$ 55.29**	**$ 82.94**	**$ 110.59**
EPSCA Association Funds $0.15 - See note (5)	$ 0.15	$ 0.15	$ 0.15
CPP - See note (7)	$ 1.75	$ -	$ -
EI - See note (8)	$ 0.87	$ -	$ -
Employer Health Tax (EHT) - See note (9)	$ 0.84	$ 1.27	$ 1.69
Workplace Safety Insurance Board (WSIB) - See note (	$ 4.15	$ -	$ -
Union Dues or/and Union Administration - See note (1	$ -	$ -	$ -
Shift Differential Payment - See note (12)	$ -	$ -	$ -
Total Rate Chargeable	**$ 63.05**	**$ 84.36**	**$ 112.43**

13 Appendix G – Indirect Cost Breakdown

DNGS Heavy Water Management Building - Indirect Costs

Item	Description	Typical Allowance	Allowance for D2O Storage
1	Average Trade Rate		
2	Construction Equipment	18.00%	10.00%
3	Small Tools and Consumables	10.00%	Inc. Elsewhere
4	Subcontractors Staff	6.00%	6.00%
5	Temporary Facilities	2.00%	Inc. Elsewhere
6	Indirect Supplies	5.00%	5.00%
7	Business Expenses	2.00%	2.00%
8	Non Productive Labor	3.00%	Inc. Elsewhere
9	Training	0.50%	0.50%
10	Safety Training	5.00%	5.00%
11	General Foreman	2.00%	2.00%
12	Dedicated Material Handling Team	3.00%	Inc. Elsewhere
13	Scaffold	3.00%	3.00%
14	Welder Testing	0.10%	0.10%
15	Premium Time over 40Hr Week	6.50%	Inc. Elsewhere
16	Profit	10.00%	Inc. Elsewhere
		76.10%	**33.60%**
	Union Security - Employers EPSCA	0.00%	0.00%
	Protective Clothing	0.16%	0.16%
	Call In Pay	0.12%	0.12%
	Reporting Pay	0.12%	0.12%
	Inclement Weather Pay	0.06%	0.00%
	Replacement Tools	0.01%	0.01%
	Rubber Suits	0.15%	0.00%
	Work ing Premiums	0.00%	0.00%
	Fire Duty	27.13%	5.00%
	Zone 3 Meal Allowance	0.28%	0.00%
	Zone 3 Rest Allowance	1.54%	0.00%
	Other Zone Rest Allowance	0.00%	0.00%
	Other Meals in Overtime	4.42%	4.42%
	Daily Travel Allowance (i.e. NOT receivir	3.19%	1.00%
	Room and Board (in effect Travel Allowa	0.00%	0.00%
	Room and Board (in effect Subsistence b	5.04%	0.00%
	Subsistence Allowance (Temp Accommo	2.04%	0.00%
	Initial Travel and Transportation	0.11%	0.11%
	Bill 162 Contributions	0.00%	0.00%
	Trade Improvement Plan	0.00%	0.00%
	Stabilization Fund	0.00%	0.00%
		44.36%	**10.94%**

Total		**44.54%**

14 Appendix H – AACE Estimate Classification

The following represents an assessment of the AACE Estimate classification:

	ESTIMATE CLASSIFICATION				
GENERAL PROJECT DATA :	**CLASS 5**	**CLASS 4**	**CLASS 3**	**CLASS 2**	**CLASS 1**
Project Scope Description	General	Preliminary	Defined	Defined	Defined
Plant Production / Facility Capacity	Assumed	Preliminary	Defined	Defined	Defined
Plant Location	General	Approximate	Specific	Specific	Specific
Soils & Hydrology	None	Preliminary	Defined	Defined	Defined
Integrated Project Plan	None	Preliminary	Defined	Defined	Defined
Project Master Schedule	None	Preliminary	Defined	Defined	Defined
Escalation Strategy	None	Preliminary	Defined	Defined	Defined
Work Breakdown Structure	None	Preliminary	Defined	Defined	Defined
Project Code of Accounts	None	Preliminary	Defined	Defined	Defined
Contracting Strategy	Assumed	Assumed	Preliminary	Defined	Defined
ENGINEERING DELIVERABLES :					
Block Flow Diagrams	Started / Prelim.	Prelim. / Complete	Complete	Complete	Complete
Plot Plans	None	Started	Prelim. / Complete	Complete	Complete
Process Flow Diagrams (PFD's)	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Utility Flow Diagrams (UFD's)	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Piping & Instrumentation Diagrams (P&ID's)	None	Started	Prelim. / Complete	Complete	Complete
Process Equipment List	None	Started	Prelim. / Complete	Complete	Complete
Electrical Line Diagrams	None	Started / Prelim.	Prelim. / Complete	Complete	Complete

Specifications and Data Sheets	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
General Equipment Arrangement Drawings	None	Started / Prelim.	Prelim. / Complete	Complete	Complete
Spare Parts List	None	Started	Prelim. / Complete	Complete	Complete
Mechanical Drawings	None	Started	Prelim. / Complete	Complete	Complete
Electrical Drawings	None	None	Started / Prelim.	Preliminary	Complete
Instrument and Control System Drawings	None	None	Started	Preliminary	Prelim. / Complete
Civil Drawings	None	None	Started	Preliminary	Prelim. / Complete
Structural Drawings	None	None	Started	Preliminary	Prelim. / Complete
Other discipline trade drawings	None	None	Started	Preliminary	Prelim. / Complete

CONSTRUCTIVE EXPERTISE

FGOULD.COM

	Times Notes	Times Notes		
Project	**D20**	**D2O**		
Date	14/08/2018	16/08/2018		
Vendor	Canatom (Braemar)	Canatom		
Trade	Electricians	Fitters		
Start of Shift	7:00	7:00		
PJB time	7:02	7:25		
PreWork Activities	7:27	7:50		
Start of Work	8:04	8:30		
1st Break	8:55	9:17		
1st Restart of Work	9:20	10:15		
Lunch	11:50	12:15		
2nd Restart of Work	12:45	13:36		
2nd Break	13:57			
3rd Restart of work	15:20			
Additional delay 1 start				
Additional delay 1 stop				
Additional delay 2 start				
Additonal delay 2 stop				
Post Work Activities	16:44	15:03		
End of Day	17:03	17:15		
End of shift	17:03	17:15		**ALL**
A) Wrench time	5:57	4:14		**4:29**
B) Morning start delay	1:04	1:30		
C) Lunch Break Length	0:55	1:21		**1:38**
D) All Break Times incl delays	1:48	3:10		
E) End of day stoppage	0:00	0:00		**0:38**
Sum of A+B+C+D+E	9:44	10:15	Check	
Work Day Shift Length	10:03	10:15		
Percentage wrench time	59%	41%		**47%**

Projects (July 7-Aug 16)		
Average Wrench Time		
Average Lunch		
Average end of day lost time		
Average Wrench %	3.8	hrs average in a 8 hr work day

CME Interrogatory #22

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 3, page 18.
Bates and White stated that their "opinion regarding their (vendor invoices) reasonableness rests upon four considerations."

(a) With respect to competitive procurements, please explain the comment in the first bullet point. Does it mean that while Bates and White did attempt to replicate the competitive procurement and got certain results?
(b) If the answer to (a) is yes, confirm if Bates and White compared the results to the actual purchases.
(c) In its analysis, how does Bates and White reconcile the starting position of perfect knowledge, with the additional amounts provided for contingency. Please explain.

Response

This response was prepared by Bates White:

a) and b) No. Bates White did not endeavor to replicate such competitive procurements. As explained elsewhere in our four considerations, we reviewed documents from the subject procurements, along with background documents that described OPG's EPC contractor's procurement process. We determined that the procurement process described in the documents represented a formal process appropriate for the scope and scale of the D2O Storage Project. Our review of the evidence provided by actual procurement documents provided evidence of the EPC contractor executing procurements in accordance with those procedures.

c) We used the term "perfect knowledge" to describe the fact that we had access to the fully defined project scope, a final design, and an understanding of actual site conditions encountered during the execution of the project. Such information provided details that estimates early in the execution of a project would not have access to; however, knowledge of this type does not eliminate all potential sources of uncertainty in a cost estimate. For example, as noted on p. 9 of the Bates White report, variability in such factors as labour productivity, weather, and the need for modest rework is an unavoidable part of any construction project.

CME Interrogatory #23

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 1

Dr. Galloway stated: "As noted during the Unit 2 assessment regarding OPG's policies and procedures, I found that the set of policies and procedures used to govern the execution of the Program *often* matched or exceeded industry standards and practice in their thoroughness and are appropriate for a Program of this size and complexity." Please provide a description of all instances where the policies and procedures used to govern the execution of the Program did not match or exceed industry standard and practice.

Response

The following response was prepared by Pegasus-Global Holdings Inc. ("Pegasus-Global"):

The findings from the review of OPG's individual policies and procedures are discussed within Section III of Dr. Galloway's testimony (Ex. D2-2-11, Attachment 1). While policy and procedure language may not have exactly "matched" an industry standard, Pegasus-Global found that the policies and procedures aligned with the intent and in many cases, exceeded industry standards. There were no policies or procedures reviewed that were found to not be in alignment with industry standards.

Energy Probe Interrogatory #19

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 1, Pages 6 and 7

Preamble: "Any ultimate variance to the $12.8B caused by the COVID-19 pandemic would be tracked separately and addressed through the CRVA in a future proceeding."

a) Please describe the process that OPG plans to use to track and record COVID-19 variances.

b) Does the schedule for the remaining units assume that COVID-19 pandemic will end in 2021? Please explain your answer.

Response

a) In recognition that there would be incremental cost impacts due to the deferral of the Unit 3 refurbishment, OPG established a process with appropriate guidelines to define, identify, track, review, challenge and record COVID-19 impacts for the DRP shortly after the onset of the pandemic. To facilitate separate tracking and recording of the COVID-19 impacts, a detailed set of accounts was issued to project staff, based on the DRP's work breakdown structure.

As part of the process, only expenditures considered incremental are eligible for recognition as a COVID-19 impact, such as those related to re-planning and ensuring readiness for the Remaining Units' refurbishment outages as a result of the Unit 3 refurbishment deferral, as well as the costs of retaining highly trained trades during the period of delay. Resources working on deliverables that were originally scheduled later in the project plan were not considered a COVID-19 impact. Amounts captured in the COVID-19 related accounts are subject to review by Project Managers, Project Controls and Finance controllers, as appropriate.

Vendors must quantify and itemize any proposed COVID-19 impact, demonstrating that such costs could not be avoided or mitigated. Vendor-submitted force majeure/delay claims are only allowed as a COVID-19 related excusable delay upon proper review and challenge by the OPG Project Manager, with any appropriate concurrence and guidance from Supply Chain or Commercial Management.

COVID-19 related interest impacts are calculated as the difference in interest costs between the pre-COVID-19 and post-COVID-19 project baseline. Similarly, COVID-

19 related escalation impacts are determined with reference to the incremental annual cash flows for the years 2021 onwards.

b) To date, the major impact on the DRP of the COVID-19 pandemic has been OPG's decision to defer the start dates of the refurbishment outages of Units 3, 1, and 4, by four months each, thereby also deferring the end dates of those refurbishment outages (see Ex. L-D2-02-Staff-135). This deferred schedule is the underlying basis of the Unit 3 Execution Estimate. To date, there has been no assumption of overall increased refurbishment outage durations in OPG's plans for Units 3, 1, and 4 as a result of the pandemic, although some schedule impacts have been observed within the Unit 3 refurbishment outage. As OPG notes in Ex. D2-2-7, given the inherent uncertainty associated with the on-going pandemic, its ultimate impact on the DRP cannot be forecasted.

Energy Probe Interrogatory #20

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 4, Page 8

Preamble: "Specifically, if OPG's total Program costs through to the RTS of Unit 2 were less than $5,623M, CanAtom would have been entitled to 100% of the first $6M of such savings, and 50% of any of such savings above $6M ("Unit 2 Cost Incentive")."

a) Please explain how the $6 million amount was derived.

b) Has CanAtom paid OPG $6 million or is OPG just withholding $6 million in payment to CanAtom?

Response

a) The $6M is derived according to the terms of the Infrastructure Team Agreement for the Darlington Generating Station Refurbishment Program between CanAtom and OPG (the "ITA"), as stated in Ex. D2-2-4, Attachment 6, p. 2. The $6M is a negotiated outcome based on the maximum payable by OPG to CanAtom under the ITA for CanAtom's additionally appointed management team which provided dedicated support for CanAtom's work and the overall Darlington Refurbishment Program.

b) As stated in Ex. D2-2-4, p. 7, lines 10-17, OPG had paid the $6M cost to CanAtom. The current terms of the Retube and Feeder Replacement, Engineer, Procure, Construct ("RFR EPC") contract detailed at Ex. D2-2-4, p. 13. set out how CanAtom is to repay the $6M to OPG as a result of not having earned the Unit 2 Cost Incentive established by RFR EPC Amendment 9 (see Ex. D2-2-4, p. 7, lines 1-8).

Energy Probe Interrogatory #21

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 6, Page 8 and Schedule 7, page 7

Please file a table showing the continuity of contingency, starting with contingency approved by the OEB in EB-2016-0152, showing the amounts of contingency used each year since the start of the DRP and the forecast of remaining contingency for each year of the DRP. For each year please explain why the contingency was used and what it was used for.

Response

The contingency included in the amount approved by the OEB in EB-2016-0152 for Unit 2, including the Definition Phase, was $694.1M. As discussed in Ex. D2-2-2, Section 2, in August 2016, OPG prepared the Unit 2 Execution Estimate ("U2EE") which was then used by OPG as the baseline against which the performance of Unit 2 was measured. The contingency included in the U2EE was $677.5M (see EB-2016-0152, Ex. L-4.3-1 Staff-055, Attachment 1). Therefore, OPG monitored contingency usage against the U2EE baseline amount of $677.5M.

Attachment 1 provides the derived contingency usage by year for the Unit 2 refurbishment. Attachment 1 also provides the major critical path activities which were underway in each period and the major contingency disbursements in each period. OPG's process for the control and approval of contingency is described in Ex. D2-2-6, Section 3.3, p. 9.

OPG cannot provide a forecast of usage of the remaining contingency, by year, until the end of the DRP. To do so would require perfect foreknowledge, both of when the risks OPG has used to develop the contingency requirement may arise, as well as the timing and impact of any unforeseen risks which may arise and, therefore, exactly how much contingency would be required to mitigate these risks.

Attachment 1: Unit 2 Contingency Usage – 2016 to 2020

Period	Balance ($M)		Major Critical Path (CP) Activities in Period / Contingency Uses
2016 Oct to 2017 Dec	Start:	677.5	**Segments 1 and 2: Defuelling, Containment Isolation and Reactor Disassembly** • **Major CP Activities:** Defuelling, Installation of Bulkheads, Remove Fuelling Machine Bridge and Installation of Retube Tooling Platforms, Feeder Cabinet and Feeder Removal, Severing of Pressure Tubes and Bellows • Disbursements of Contingency Included: Increases to waste management costs; critical path delays; additional funding for breathing air work; increased execution oversight
	Amt. Used:	105.6	
	End:	571.9	
2018 Jan to 2018 Dec	Start:	571.9	**Segment 2 Completed/Segment 3 Starts: Reactor Disassembly / Reassembly Begins** • **Major CP Activities:** End Fittings Removal, Pressure and Calandria Tube Removal, Inspections, Bellows Inspections an Replacement, Calandria Tubes Installed; Upper Feeder Installation was proceeding off-critical path • Disbursements of Contingency Included: Increased costs for Owner Supplied Materials; Balance of Plant Major Work Bundle schedule delays; Moderator / Lower Pressure Service Water / Shutdown Cooling Valve rehabilitation; increased radiation personal protective equipment (PPE) and other PPE costs
	Amt. Used:	207.7	
	End:	364.2	
2019 Jan to 2019 Dec	Start:	364.2	**Segment 3 Completed/Segment 4 Starts: Reactor Reassembly Completed/Refuelling** • **Major CP Activities:** Fuel channels installed, Lower feeders installed; Fuel loaded; Scaffolds removed; Retube Tooling Platform removal begun; Upper and Middle Feeder Installation proceeded off-critical path for majority of installation period • Disbursements of Contingency Included: Re-alignment of Retube and Feeder Replacement Major Work Bundle budget mainly due to critical path delays caused by feeder installation challenges
	Amt. Used:	329.5	
	End:	34.6	
2020 Jan to 2020 Oct[1]	Start:	34.6	**Segment 4 Completed: Plant Restoration and Start-up** • **Major CP Activities:** Completion of Retube Tooling Platform Installation; Fuelling Machine Bridge Installation; Removal of Shielding; Closure of Airlocks; Bulkhead Removal; Heat-up and Hot Conditioning; Lower Power Escalation; Run-up to Full Power and Synchronize to the grid • Uses of Contingency Included: Critical Path delays, additional PMT costs during schedule extension, increased interest costs due to schedule extension.
	Amt. Used:	34.6	
	End:	0.0	

See Notes to Attachment 1 on following page.

Notes to Attachment 1:

1. Unit 2 returned to service on June 4, 2020; however, due to on-going closeout activities, contingency usage period extends beyond that date.
2. As the Unit 2 refurbishment outage began on October 15, 2016, the 2.5 month period in 2016 is combined with the year 2017.
3. While the focus is on critical path activities, contingency is also disbursed for non-critical path work. Contingency disbursements do not necessarily align with the derived contingency usage in a particular period, as contingency is disbursed when the risk is recognized. When contingency is actually expended may be in a different time period from when it is disbursed

Energy Probe Interrogatory #22

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, page 13, Chart 3

Please explain the reasons for the increases in OPG Project Management costs for Units 1 and 4.

Response

Please see Ex. L-D2-02-SEC-081.

Energy Probe Interrogatory #23

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Page 15, Chart 4

Please explain why the cost for Turbine Generators - Engineering Services and Equipment Supply and Field Services (General Electric) is much lower for Unit 1 than for Units 3 and 4.

Response

The primary reason why the cost for "Turbine Generators – Engineering Services and Equipment Supply and Field Services (Generic Electric)" shown in Ex. D2-2-7, Chart 4, p. 15, is lower for Unit 1 than for Units 3 and 4, is that the generator stators are being rewound in Units 3 and 4, but not in Unit 1. See Ex. D2-2-4, Section 3.3.1, p. 18, line 25, and Ex. D2-2-7, Section 3.2, p.11, lines 1 - 2.

Other contributors to the difference in cost is that Unit 3, being the first unit on which the turbine-generator digital control upgrades are being installed, bears the cost of the full scope simulator, specialized technical training, and has higher engineering modifications costs. Additionally, because of the higher Unit 3 cost, there is a larger component of interest on Unit 3 than on Unit 1.

Energy Probe Interrogatory #24

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Page 17, Chart 6

Chart 6: Remaining Units Fuel Handling and Defuelling Bundle Costs

Description	Forecast Costs ($M)					
	Unit 3 2024	%	Unit 1 2025	%	Unit 4 2026	%
Defuelling	6.6	38%	1.1	13%	1.2	22%
Fuel Handling	1.4	8%	0.0	0%	0.0	0%
OPG Project Management	9.4	54%	7.3	87%	4.2	78%
Total	**17.3**	**100%**	**8.5**	**100%**	**5.4**	**100%**
Note that all numbers are in dollars of the year, i.e. including interest and escalation in each line item.						

a) Please explain why the Defueling cost for Unit 3 is much higher than for Units 1 and 4.

b) Please explain why there are no costs for Fuel Handling for Units 1 and 4.

c) Please explain why OPG Project Management costs are much higher for Units 3 and 1 than for Unit 4.

Response

a) The cost of defueling shown in Ex. D2-2-7, p. 17, Chart 6, is projected to be higher for Unit 3 than for Units 1 and 4 because, by applying Lessons Learned from Units 2 and 3, the need for engineering, technical support and additional tools and equipment is projected to be substantially reduced for Units 1 and 4 compared to Unit 3. Further, there are items purchased to mitigate potential risks during Unit 3 defueling that are expected to be available for re-use on Units 1 and 4.

b) Both Fuel Handling and OPG Project Management in the referenced chart are OPG resources. At the time of this estimate, the costs labelled Fuel Handling in the above chart had not been separated out from the remainder of the OPG Project Management costs for Units 1 and 4. The Fuel Handling costs are in the row of the table labelled “OPG Project Management” for Units 1 and 4.

c) Please see part a) re: Lessons Learned. Also contributing to the OPG Project Management costs being higher for Unit 3 than for Units 1 and 4 was the delayed start of Unit 3 (prior to the deferrals as a result of COVID-19) as a result of the delayed finish of the Unit 2 refurbishment outage. During this period, experienced staff were retained and continued to prepare for defueling Unit 3 as it is the first activity in a refurbishment outage and is on the critical path.

Energy Probe Interrogatory #25

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Attachment 2, Page 8

Preamble: "Contingency: The DR Team has reduced contingency on Unit 3 from $524M at RQE to $305M for its U3EE."

Please explain why the contingency on Unit 3 was decreased by that precise amount.

Response

OPG provided a description of the factors driving the need for reduced contingency since the Release Quality Estimate ("RQE")/ Unit 2 Execution Estimate ("U2EE") in Ex. D2-2-6, Sections 3.1 and 3.2, pp. 5-8.

In Chart 1, below, OPG provides a comparison of the amounts allocated to the major risk areas of cost estimate uncertainty, schedule estimate uncertainty and discrete risks. As discussed in EB-2016-0152, at the time of RQE, OPG had not specifically allocated its contingency for Unit 3 into the categories below.[1] By the U2EE, analysis on Unit 3 contingency had progressed. Chart 1 compares the U2EE completed in August 2016 to the U3EE risk assessment. At the time of the U2EE, the amount of contingency assigned to Unit 3 was $557M, thus the difference is $252M.

As shown in Chart 1 below, the largest percentage reduction was in cost uncertainty.

Chart 1: Comparison of U2EE to U3EE Contingency in Ex. D2-2-7 Attachment 2, p. 8

Contingency Category	U2EE ($M) (Aug 2016)	U3EE ($M) (Mar 2019)	Difference ($M)	Reduction
Discrete Risks	302	182	120	40%
Cost Uncertainty	67	27	40	60%
Schedule Uncertainty	143	60	83	58%
Interest and Escalation	45	36	9	20%
Total	557	305	252	45%

[1] EB-2016-0152, Ex. L-4.3-2-AMPCO-074.

Energy Probe Interrogatory #26

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Attachment 3, page 2

Preamble: "As Unit 3's planning has matured, the base cost estimate has increased while contingency has decreased. In the period since the March DRC Meeting, Unit 3's base cost has increased by $72M (2.8%), contingency has been reduced by $48M and the Working Schedule has been extended to 1099 calendar days (930 working days)."

Please explain why the contingency was reduced by $48 million and not some other amount and reconcile it to Exhibit D2, Tab 2, Schedule 7, Attachment 2, Page 8.

Response

See Ex. L-D2-02-Energy Probe-025.

The reduction in contingency by $48M from $305M in March 2019 to $257M in November 2019 is an outcome of the detailed re-assessment of the risks and uncertainties in the Unit 3 refurbishment. Please see also Ex. D2-2-3, p. 8, line 24 to p. 9, line 5, which explains that two important changes were incorporated into the planning for the Unit 3 refurbishment outage between March 2019 and November 2019.

In Chart 1 below, OPG provides a comparison of the amounts allocated to the major risk areas of cost estimate uncertainty, schedule estimate uncertainty and discrete risks.

Chart 1: Comparison of U3EE Contingency in Ex. D2-2-7 Attachment 3, p. 2

Contingency Category	U3EE ($M) (Mar 2019)	U3EE ($M) (Nov 2019)	Difference ($M)	Change
Discrete Risks	182	115	67	-36%
Cost Uncertainty	27	47	-20[1]	+74%
Schedule Uncertainty	60	66	-6[2]	+10%
Interest and Escalation	36	28	8	-22%
Total	305	257	48[3]	-16%

Notes to Chart 1:

1. The amount of contingency allocated to cost uncertainty went up primarily because of the two significant changes (See Ex. D2-2-3, p. 8, line 24 to p. 9, line 5) that were incorporated into the planning for Unit 3, i.e., the combined pressure tube/calandria tube removal (a Darlington 3 Innovations Project tooling improvement) and the introduction of the Hybrid Schedule. See discussion in Note 2 re: schedule uncertainty.
2. Schedule uncertainty went up primarily because of the incorporation of the combined pressure tube / calandria tube removal into the baseline schedule. While this innovative tooling improvement resulted in an estimated 34 days savings to the schedule, schedule risk was increased, given the first-of-a-kind nature of this activity for OPG.
3. Numbers may not add due to rounding.

Energy Probe Interrogatory #27

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Attachment 3, pages 10 and 11

Preamble: "As shown above, the Upper Feeder work series slow ramp-up was impacted by One Time Events, performance issues, supply and logistical issues that have been addressed and should not be repeated."

Please describe the One Time Events, performance issues, supply, and logistical issues and explain how they impacted the slow ramp-up.

Response

Issues that caused a slow ramp-up of the upper feeder work series on Unit 2 are described below. These issues have been addressed through application of Lessons Learned and are not expected to impact the Remaining Units' refurbishments. See Ex. D2-2-3, Attachment 6 for additional information on the Lessons Learned regarding feeder installation.

1) One Time Events

- The qualification and subsequent fabrication of Inconel 690 components used in the feeder pipes took longer than planned on Unit 2. The qualification process does not need to be repeated on the Remaining Units. Feeder fabrication and delivery was advanced and the majority of feeders are already delivered for Unit 3 (see Ex. L-D2-02-Staff 134, part a)).

- New seismic requirements for cantilevers took longer than planned. For the Remaining Units' refurbishment outages, seismic qualification of the cantilevers will be based on Unit 2 and thereby avoiding the delays experienced on Unit 2.

2) Construction/Performance Issues

- Actual field conditions could not be exactly mimicked in the mock-up. Examples include the air flow in the reactor vault and Primary Heat Transport ("PHT") header temperatures, which both impacted the weld failure rate, and which led to lower productivity than planned in the earlier portion of the feeder work series. Upgrades have been implemented to mock-up training facilities to more accurately mimic "in

plant" conditions. Mock-up rehearsal time was also expanded to ensure proficiency beyond qualification.

- Tooling quality issues encountered in the field required retrofitting. This resulted in lower productivity than planned in the earlier portion of the feeder work. Enhanced tooling has since been acquired to improve productivity.

- A higher than planned number of welds failures occurred in the earlier portions of the feeder work. Fit-up checks before welding, changes to various welding parameters, assignment of additional welding engineers and additional technicians to verify tooling condition and set-up prior to each weld, were all implemented to address weld failure challenges.

- Inspections of the feeders uncovered fabrication issues that necessitated the modification of welding machines to prevent introduction of foreign material into the feeders. Since the discovery of these issues, all feeders have been subjected to additional review and approval by a designated OPG engineering team prior to leaving the fabrication facility.

3) Trades Supply Issues

- As a result of a longer than planned upper feeder installation, leading directly into lower feeder installation, higher than anticipated trades absenteeism affected productivity. In response, local and international trades union business agents were engaged to address issues and changes to the crew size and shift patterns were made. Expectations were reiterated and additional monitoring measures implemented to address the issue.

4) Logistical Issues

- The high degree of accuracy required of the feeder installation work, exacerbated by the technical and resource challenges described above, revealed the need for additional experienced contractor project managers to manage the complex detailed logistics, organization, resource planning, and resource coordination between OPG and the contractor. Additional construction management, quality control resources and scaffold subject matter experts were also brought in to resolve the above noted logistical challenges.

Energy Probe Interrogatory #28

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Attachment 3, page 27

Preamble: "The major risks for Unit 3 appear at this time to be: ¬ The Turbine Generator work, including the controls change out and stator installation, that have not been done to date at Darlington and are more time-sensitive due to the unit overlaps…"

a) Please confirm that the Turbine Generator work was not part of the scope of work for Unit 2.

b) Will Turbine Generator work for Unit 2 take place concurrently with Turbine Generator work for Unit 3? Please explain your answer.

Response

a) Confirmed. The turbine and generator controls work were not part of the Unit 2 refurbishment scope. The generator stator work is not required on Unit 2.

b) No. See Ex. L-E2-01-Staff-189, part a).

Energy Probe Interrogatory #29

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 7, Attachment 3, page 28

Have there been instances where OPG has not received full cooperation from CanAtom in the provision timely and accurate cost and schedule information needed for forecasting and estimating? If the answer is yes, please provide a description of each instance and explain what OPG did in response to each instance.

Response

OPG did not experience delays in receiving timely and accurate information from CanAtom due to a lack of full cooperation. The implementation of the Organizational Evolution Strategic Improvement (see Ex. D2-2-3, pp. 20-21), and specifically the One Team approach, has also facilitated a collaborative working relationship with CanAtom on Unit 3 resulting in consistent, timely and accurate reporting of cost and schedule information.

Energy Probe Interrogatory #30

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 8, page 1

Preamble: "This exhibit describes the methods by which OPG, as the Program owner, will manage the delivery of all scope for Units 3, 1, and 4 ("the Remaining Units") safely, on time, on budget, and to the required quality."

a) Does the word "delivery" mean in-service?

b) Does the word "safely" mean with no injuries?

c) What are the "on time" dates for the delivery of each remaining unit?

d) What does the term "on budget" mean? Please provide reference to specific dollar amounts.

Response

a) The word "delivery" means that the scope planned for Unit 3, 1, and 4 ("the Remaining Units") will be executed during their respective refurbishment outages, thereby allowing the units to be returned to service to continue safe and reliable operation.

b) "Safely" means that, OPG will manage the Units 3, 1, and 4 refurbishment outages so that they are executed safely and meet or exceed OPG's safety performance targets.

c) Please refer to Ex. D2-2-5, Section 3.1, Figure 2, p. 6, for each of the Remaining Units' high confidence return-to-service dates. Achievement of these dates equates to "on-time" performance.

d) "On budget" means that the Remaining Units are completed within the high confidence envelope amount of $6,604.2M. See Ex. D2-2-7, p. 2, lines 5-10.

Energy Probe Interrogatory #31

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 8, Page 3

Preamble: "A major change was implementation of the Organizational Evolution Strategic Improvement including the Project Centric Organization, Workstream Specialization and the One Team Approach. Project Centric Organization and Workstream Specialization concepts treat phases of the refurbishment outages of the Remaining Units (e.g., the Lead-in and Removal Phase) as a project, and build and maintain a specialized work team which is focused solely on executing that phase of each refurbishment outage."

a) What is "Organizational Evolution Strategic Improvement"? What were the deficiencies with the original organization? Does the implementation of the Organizational Evolution Strategic Improvement reduce the risk that the Program will not be completed on time and on budget?

b) What is "Project Centric Organization"? What did the original organization center on?

c) What is "One Team Approach"? Were there multiple teams in the original organization?

Response

a) The Organizational Evolution Strategic Improvement is fully described in Ex. D2-2-3, Section 5.1.1. There were no deficiencies with the original organization. OPG and its contractors saw opportunities to improve the organization to enhance project performance, particularly in light of the fact that the Remaining Units' (Units 3, 1, and 4) refurbishments are planned to be executed in an overlapped manner.

   The Organizational Evolution Strategic Improvement, in combination with all of the other Strategic Improvements and Lessons Learned described in OPG's pre-filed evidence, is expected to result in higher assurance of Program completion on budget, on schedule, safely and with quality.

b) The Project Centric Organization is a component of the Organizational Evolution Strategic Improvement and is described in Ex. D2-2-3, Section 5.1.1, p. 20, lines 13-18. See also, Ex. D2-2-8, Section 2.2.1.1, p. 8, lines 16-22.

The organization of the project team for Unit 2 was centered on the Unit 2 project such that the project team worked on all phases of the refurbishment outage. A key difference implemented for the Remaining Units, which is a Lessons Learned from Unit 2, is the creation of specialized project teams for each major phase of the refurbishment outages.

c) The One Team Approach is also a component of the Organizational Evolution Strategic Improvement and is described in Ex. D2-2-3, Section 5.1.1, p. 20, line 28 to p. 21, line 15. Additional details are provided in Ex. D2-2-4, Section 2.1.1 and Ex. D2-2-8, p. 3. See Ex. D2-2-4, p. 1, which describes how the DRP is being executed under a “multi-prime” contractor model, with OPG as the Project Owner.

Energy Probe Interrogatory #32

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 8, page 7, Figure 3

a) Please file Figure 3 with the number of staff shown in each box.

b) Please confirm that the positions shown will not be filled for the duration of the project. For example, after the feeders are removed will the position of Area Manager Feeder Removal be eliminated?

Response

a) The purpose of providing Ex. D2-2-8, Figure 3 (reproduced below as Figure 1 for ease of reference), was to provide a simplified view of how the Retube and Feeder Replacement ("RFR") Major Work Bundle Project Management Team is organized. This was done primarily to illustrate how the Project Centric approach and Workstream Specialization are being implemented for the Remaining Units. The actual organization chart is more complicated than the schematic shown.

The Darlington Refurbishment Program is a project, as opposed to regular station operations and therefore, the number of people in any particular part of the organization peaks when the work in that area peaks and declines to a trough when the work in that particular area is also in a trough. Thus, there is not a stable number of people in each part of the organization.

In each part of the organization shown in Ex. D2-2-8, Figure 3, there are Project Management Team ("PMT") members who report to each of the managers shown, and there are also large numbers of skilled trades who report to certain positions, such as the Construction Manager and the Area Managers, and who move on to other work when the peak of work for that area has passed. As explained in Ex. D2-2-8, p. 10, lines 6-12, the exception to this pattern is that a core team will remain with each particular Workstream to help incorporate Lessons Learned into the Comprehensive Work Packages for the next unit, to help train the new trades and returned trades for the next unit, and otherwise improve the readiness to execute the next unit.

Many of the personnel that make up the working level of the PMT members are "matrixed" roles, i.e., they are assigned to support one or more of the functions shown in Ex. D2-2-8, Figure 3, and those assignments change from time to time as

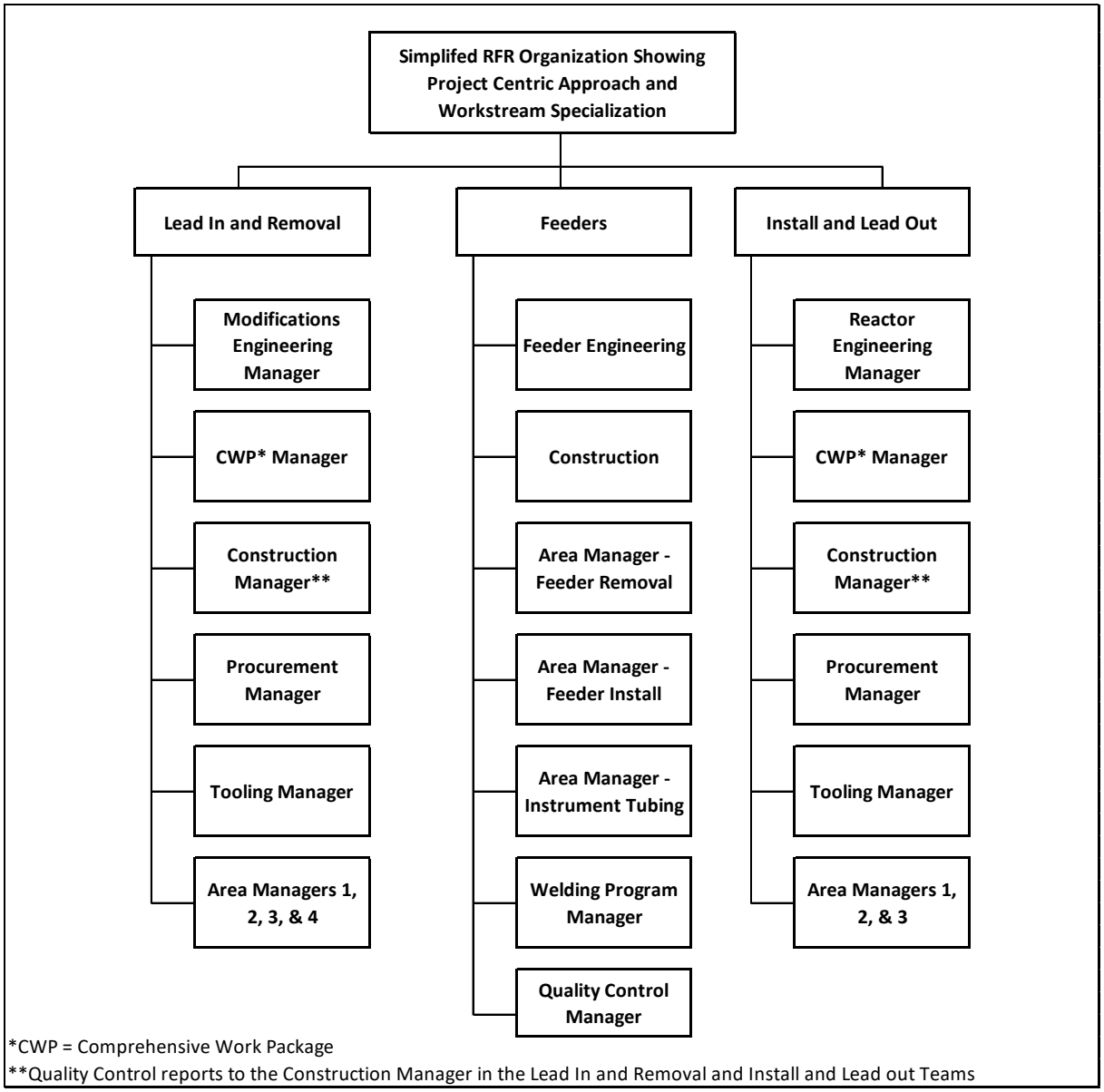
the refurbishment of each unit passes through different work series. Many others are in support roles that provide the project infrastructure, i.e., they are not assigned to a particular Workstream, but support all three. As such, it is not possible to answer by filling in Ex. D2-2-8, Figure 3 to show the number of staff in each of the boxes.

However, OPG can provide the following staffing details. Collectively, the CanAtom and OPG "One Team" RFR PMT organization is planned to have approximately 400 full-time equivalent ("FTE") roles, with 359 FTE roles being CanAtom employees, and an additional 35 to 40 OPG personnel from the OPG PMT organization. This does not include training personnel. The OPG personnel numbers may include both leadership and working roles, but do not include a further 5 to 7 oversight roles that represent OPG and provide general RFR oversight and thus are not embedded into the three Workstreams depicted in the referenced chart.

Of the 359 CanAtom PMT FTE:

- 33 FTE support the Leadership Team shown on the chart, plus the Business Services and Human Resources teams.
- 17 FTE support Project Controls and Finance.
- 78 FTE support the Construction Management roles.
- 33 FTE support the Comprehensive Work Package functions.
- 45 FTE support Quality Control functions; a further 8 support Quality Assurance/Surveillance in procurement.
- 13 FTE support Document Control.
- There are 41 FTE in Engineering roles, collectively covering the engineering functions depicted in the chart, and they also support procurement.
- There are 54 FTE in tooling-support roles, collectively covering the tooling functions depicted in the chart (they also support tooling for feeders, which is not shown on Figure 3).
- 22 FTE support the Procurement and Warehousing roles
- 15 FTE support Health and Safety and Radiation Protection planning functions (for clarity, this does not include the field radiation protection technicians, who are provided directly by OPG)

Figure 1
Copy of Ex. D2-2-8, Figure 3: RFR Project Management Team Organization



b) See part a). Confirmed that the positions shown will not be filled for the duration of the DRP. Please see Ex. D2-2-8 p. 9, Figure 4 which illustrates how the specialized work teams will transition from Unit 3 to Unit 1 to Unit 4. As the field activities are completed on Unit 4, the teams will be demobilized except for any personnel needed to support project closeout.

Energy Probe Interrogatory #33

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 8, page 14

Preamble: "This team is also responsible for identifying trends and opportunities across the Program and industry and facilitating collaboration between OPG and Bruce Power. This collaboration includes identifying efficiencies and opportunities for innovation, sharing of Lessons Learned, and leveraging economies of scale. Ensuring that Lessons Learned and Strategic Improvements are identified and implemented, and that the expected performance gains are verified, is critical to achieving the planned unit-over-unit efficiencies as the Program moves through the refurbishments of Units 3, 1, and 4."

Please describe the efficiencies, innovations and economies of scale implemented through collaboration with Bruce Power.

Response

There have been many efficiencies and innovations implemented in the DRP through collaboration with Bruce Power. There have also been many examples of leveraging OPG's and Bruce Power's joint goals to achieve economies of scale. Each year since 2018, OPG and Bruce Power have issued publicly available status updates summarizing the benefits of the collaboration efforts in the previous year. The 2018 and 2019 Collaboration reports were provided in Ex. D2-02-03, Attachments 7 and 8. The OPG-Bruce Power 2020 Collaboration Report is included as Attachment 1.

The following are specific examples of innovations, efficiencies, and leveraging of economies of scale as a result of the OPG-Bruce Power collaboration:

Innovations and Efficiencies:

- Modified Installation Work Table: See Ex. D2-2-3, pp. 22-23. Collaboration with Bruce Power on the development of a modified work table is forecast to increase production by doubling the number of tools available to install calandria tubes and allowing for parallel work and more efficient transition between work activities. Savings are estimated to be up to 26 days on each of the Units 3, 1, and 4 refurbishment outages.

- Bellows Cut Tool Improvements: OPG and Bruce Power have continuously shared Lessons Learned on the performance of the bellows cut tools, ranging from factory acceptance and tool testing, to performance in the field. Building on the experience from each utility, OPG and Bruce Power were able to improve the speed and efficiency of the tool through their respective bellows removal series. With these improvements, OPG is expecting to save at least four days of critical path on each of the Units 3, 1, and 4 refurbishment outages.

- Film-Forming Amines: OPG and Bruce Power have collaborated through combined benchmarking and the confidential sharing of technical information to implement the Film-Forming Amines initiative for Unit 3. This initiative involves injection of the secondary side system of the nuclear units (condensers, heat exchangers, etc) during the lay-up process with an organic material that forms a nano-thin protective layer through adhesion to the inner surface of the secondary side components and vessels. The film-forming amine inhibits corrosion and assists in maintaining a dry lay-up condition of the secondary side throughout each unit's refurbishment outage. The project is projected to save OPG approximately $8M across Units 3, 1, and 4 from reduction in secondary side layup costs, including reduction in the number of de-humidifying skids by half compared to the Unit 2 refurbishment outage.

- Upper Feeder Removals: As a result of experience shared by Bruce Power, OPG implemented a hanging scaffold above the retube tooling platform that allowed cantilever removal to be executed in parallel with upper feeder removal. The ability to execute this work in parallel and the re-sequencing of certain other work is projected to save approximately eight days on critical path on each of the Units 3, 1, and 4 refurbishment outages.

Leveraging Economies of Scale:

- Trades Capacity Initiative: OPG and Bruce Power continue to collaborate to properly assess the trades availability risk and develop strategies to help mitigate it. The main focus of the OPG / Bruce Power collaboration has been to develop comprehensive trades demand profiles and supply and demand data on skilled trades. Trade demand forecasts are continually being updated and work is ongoing with trades unions, EPSCA, and other stakeholders to help improve the forecasted supply, as referenced above.

- Job-Ready Dispatch Initiative: OPG and Bruce Power have launched an initiative to allow the transfer of training credits for building trades staff. This initiative avoids unnecessary retraining of staff and reduces the time required to get building trades working at site. To date, 20 course credits have been identified that can be automatically transferred between OPG and Bruce Power, with only 9 of these requiring minor gap training. Further, in 2021, OPG and Bruce Power engaged the

trades unions to collaborate in the assessment and identification of union courses that are equivalent to those required at OPG and BP, which could help further reduce the time required to get the trades working at site, with no reduction in skills and/or proficiencies.

- Inter-Utility Security Clearance Agreement: OPG has an inter-utility agreement with its Canadian partners, including Bruce Power, that allows for the transfer of a security screening certificate for any individual that holds a valid security clearance. This reduces the time required to get trades cleared to work at OPG sites, including Darlington Refurbishment, without compromising security.

Ontario Nuclear Collaboration

Report 2020

Bruce Power™
Innovation at work

ONTARIO POWER GENERATION

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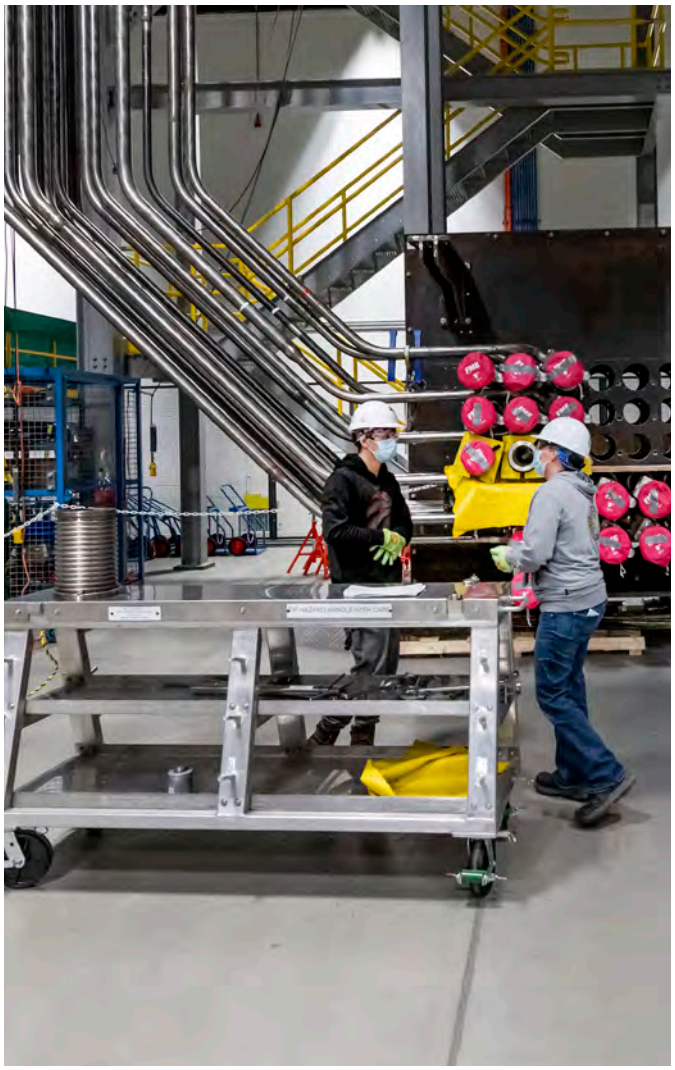
We're all in this Together

More than a decade ago, when Bruce Power and OPG began planning our individual nuclear refurbishment programs, neither organization could have foreseen the world-wide disruption to lives that would be caused by the COVID-19 pandemic. Like most companies around the world, we had to respond swiftly and effectively to ensure the health and safety of our workers while continuing safe power generation and maintaining momentum on critical projects underway.

The results of our actions were work environments with increased safety and health precautions and the continued and steady generation of electricity for the province. With Darlington Unit 1 setting a world record for continuous operations over 1,000 days and Bruce Power Unit 1 setting a site record of 694 days of continuous operations.

This agile and immediate response was enabled by our robust individual business continuity plans and by the on-going spirit of collaboration between our two organizations — a collaborative approach that has been central to our various efforts over the years and continues to drive success during our refurbishments.

In this report, along with highlighting our responses to the pandemic, we detail how Bruce Power and OPG continue to work in alignment to meet our commitments on the Major Component Replacement Program and the Darlington Refurbishment Project through an established practice of knowledge-sharing, applying lessons learned and leveraging economies of scale. We also highlight our work in areas that will have a positive impact on the collective future of Ontarians. Notably, our individual agreements with BWXT Canada and ISOGEN to harvest Molybdenum-99 and Lutetium 177, life-saving radioisotopes used in diagnostic and medical treatments around the world each year, helping to detect illnesses such as cancer and heart disease.



We're all in this Together.

This is a sentiment that has been echoed around the world as we all seek to recover from the dual health and economic crises brought on by COVID-19. It's also a sentiment that has been shared by our two organizations long before the pandemic and prior to our refurbishments.

Our economic development impacts are unparalleled in Ontario, so as we continue to implement Canada's second and third largest infrastructure projects, this economic engine will continue to support thousands of jobs across Ontario and produce billions of dollars in economic activity. These highly-skilled jobs in the STEM fields and trades are providing the people of Ontario with the ability to work in an innovative and technical field, tackling today's biggest challenges like climate change and decarbonization, right here at home.

As Ontario rebuilds its nuclear fleet in the years ahead, Bruce Power and OPG will continue to work together to support our communities and deliver on our commitments on the Major Component Replacement Program and the Darlington Refurbishment Project, generating decades more of low-cost, reliable and clean energy for the province of Ontario.

Ken Hartwick
OPG
President and
Chief Executive Officer

Michael W. Rencheck
Bruce Power
President and
Chief Executive Officer

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By the Numbers

The COVID-19 pandemic was a call to community action for Bruce Power and OPG. In addition to the continued safe operations of our plants, ensuring the well-being of our host communities remained one of greatest priorities. Our organizations each responded with several individual initiatives, the impact of which has been far-reaching and has inspired on-going community support.

As at September 30, 2020

Ontario Power Generation

Personal Protective Equipment (PPE) donations

- 1 million surgical masks
- 75,000 N95 masks
- 17,500 Tyvek protective suits
- 9,000 cloth masks
- 10 Power Assisted Air Purification Respirators to Sunnybrook Health Sciences Centre;
- 22,000 face shields (built in partnership with others)

Emergency support

- $500,000 to Feed Ontario to help launch their province-wide emergency food box program
- $250,000 to the Regional Food Distribution Association of Northwestern Ontario to distribute emergency food support to First Nations
- $150,000 to Feed the Need to buy and distribute food to organizations across Durham Region;

- $150,000 to 15 other partner and neighbour First Nation communities
- $250,000 to Jack.org to promote the *Be There* mental health online program to youth (year-long campaign)
- $200,000 to TVO to promote online children's education programming to help engage and educate kids at home, during the pandemic
- $10,000 to support teacher recruitment and training for First Nations communities
- $200,000 to the Prosperity Project, as lead sponsor of the campaign encouraging women, who have been disproportionately impacted by COVID-19 job losses, and girls to consider careers in STEM and the skilled trades

Bruce Power

Personal Protective Equipment (PPE) donations

- 2.5 million pieces of PPE to front line workers
- 21,550 pieces of PPE for recovery centres in Grey and Bruce Counties.
- Enough isotopes in 2020 to sterilize between 20-25 billion pairs of surgical gloves or COVID swabs

Emergency support

- $120,000, raised by employees, present and past, to support 38 local food banks
- $1 million to food banks in the Grey-Bruce County region
- 3,000+ care packages distributed within the Grey-Bruce County region
- 50,000 litres of hand sanitizer distributed to local businesses, community organizations, food banks and Indigenous communities
- $400,000 from Bruce Power and the Power Workers' Union to the University Health Network to accelerate research in COVID-19 prevention, diagnostics, anti-viral therapies and cures.
- 190,000 community updates issued, in partnership with local health units, to raise awareness and stop the spread of the virus.
- Formed the 101-member Retooling and Economic Recovery Council (RERC), of which OPG is a member. RERC is committed to leveraging the province's robust nuclear supply chain to continue to assist in Ontario's fight against COVID-19 and to aid in economic recovery.

Bruce Power's role in helping Ontario during the fight against the COVID-19 health crisis was recognized by Canadian Manufacturing magazine as the Services award winner of the Responding to COVID-19: Industry Leadership Honours.

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Ontario's Nuclear Fleet

Bruce Power

Bruce Power is a Canadian-owned public-private partnership of TC Energy, Ontario Municipal Employees Retirement Systems (OMERS), the Power Workers' Union and The Society of United Professionals. The company employs more than 4,000 people and, over the past 15 years, has been one of the largest investors in Ontario's electricity infrastructure, providing billions in private dollars to the Bruce Power site — which continues to be owned by the province.

Major Component Replacement Program

In December 2015, Bruce Power reached an agreement with the Independent Electricity System Operator (IESO) to advance a long-term investment program which would refurbish its nuclear fleet and help secure the site's operation until 2064. Bruce Power's Life-Extension Program started in 2016, enabling the completion of asset management and maintenance outages. The program has been executed on plan with over $2 billion invested, creating and sustaining 22,000 jobs annually and contributing over $4 billion per year to provincial GDP. 90% of Bruce Power's spend on this project is in Ontario and 98% in Canada, making it truly a Canadian-led infrastructure project. Over 250 supply chain companies across Ontario and hundreds more across Canada are supported through this initiative.

As part of the Life-Extension Program, Bruce Power began its intensive Major Component Replacement (MCR) Program in January 2020. This program focuses on the replacement of key reactor components in Units 3 to 8 and enables the completion of asset management and outage maintenance on a range of nuclear and non-nuclear

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systems during the shutdown period. A number of key vendor partners were awarded contracts to complete various scopes of work including Black & McDonald, SGRT — a joint venture formed among AECOM, Aecon and Framatome, Shoreline Power Group - a consortium of Aecon, AECOM and SNC-Lavalin, and Nuvia Canada Inc.

The first MCR in Unit 6 is scheduled to be completed in 48 months with each subsequent refurbishment taking less time and costing less money.

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Ontario Power Generation

Ontario Power Generation produces about half of the electricity Ontarians rely on every day. Our power is clean, reliable and costs an average of 40 per cent less than other generators. With operations that span the province from Cornwall to Kenora, we value the safety and health of our communities and 9,000+ employees above all else.

Darlington Refurbishment Project

One of Canada's largest clean energy projects, the Darlington Refurbishment Project will extend the operating life of OPG's Darlington Nuclear Generating Station and generate another 30-plus years of clean energy for the province. The four-unit refurbishment is a $12.8 billion project that is expected to generate nearly $90 billion in economic benefits for Ontario by its completion in 2026 and from a clean energy perspective take the equivalent of two million cars off Ontario's roads, per year.

OPG has been executing a large number of refurbishment related projects since 2010. Since 2016, with our project partners, OPG has shut down Unit 2, refurbished the reactor and returned it to commercial service on June 4, 2020 - on time and on budget. Following a brief delay due to the global pandemic, OPG took Darlington Unit 3 offline on July 30, 2020 and began the first stages of reactor disassembly on September 3, 2020.

The four-unit Darlington Refurbishment Project is scheduled for completion by 2026.

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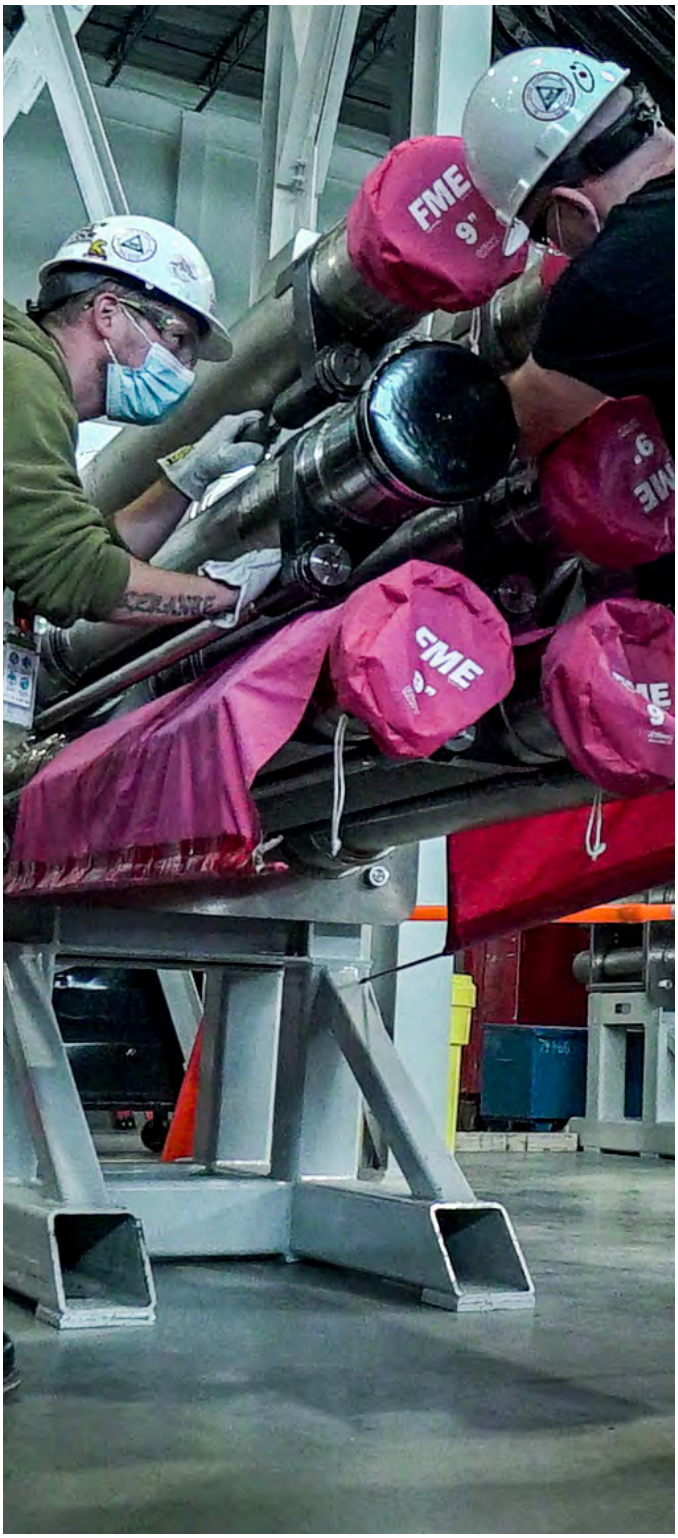

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Areas of Nuclear Collaboration

Pandemic Response Alignment

When COVID-19 brought global activity to a pause in March 2020, Bruce Power and OPG were at critical points in our individual refurbishment programs. OPG was nearing the completion of refurbishment of Darlington Unit 2 and Bruce Power had just begun execution of its Major Component Replacement (MCR) Program on Unit 6. In order to mitigate the pandemic's impact on these projects, our two companies established several virtual forums for knowledge-sharing and alignment.

One of these initiatives was a joint committee with Commercial Management and Supply Chain team members, which met on a biweekly basis between March and June to review common supplier concerns, discuss mitigating strategies and help ensure our pool of nuclear suppliers were engaged and supported by both organizations during the early months of the pandemic.

Topics at these meetings included suspension of non-critical construction, at-risk suppliers and the implementation of increased health and safety measures across the projects.

At the beginning of June, the focus of these meetings shifted to return-to-work plans and best practices for restarting suspended work.

Bruce Power and OPG Collaborate on new Dosimetry Tool

Managing worker radiation dose is vital to ensuring worker safety at our nuclear power plants. To monitor worker dose limits during parallel refurbishments at Bruce Power and OPG, our two organizations have worked together to develop a dosimetry tracking tool to monitor workers' one- and five-year dose histories across both sites, and in accordance with governing privacy requirements.

The new tool will provide the most up-to-date and accurate reporting of dose accumulation while continue to keep workers safe.

The tracking tool was rolled out in June and the confidential dose information is being stored in a secured digital location with limited access, and oversight provided by Bruce Power and OPG.

Improved efficiencies through document and information sharing

Continual improvement and process efficiencies continue to be a focal point between Bruce Power and OPG.

Through Executive weekly calls between Bruce Power and OPG, information was effectively and efficiently shared to address and mitigate any concerns or risks to the project schedules.

Both companies were able to leverage one another to improve efficiencies across our individual projects.

Collective interactions during 2020, (as of September 30):

- Documents requested by Bruce Power: 135. Out of these requested documents 108 were disclosed by OPG. 27 Documents are pending or non-releasable.
- Documents requested by OPG: 85. Out of these requested documents 52 were disclosed by Bruce Power. 33 documents are pending or non-releasable.
- Via weekly calls between the OPG and Bruce Power Project teams, information was effectively and efficiently shared, including lessons learned and addressing threats to the projects.

Sharing Assets

In the spirit of collaboration, Bruce Power and OPG have gone beyond sharing lessons learned and documents and established a process to share critical resources, subject matter experts, tooling and equipment.

In 2020, Bruce Power and OPG developed a Secondment Program between two of our primary contractors CanAtom Power Group (supporting Darlington Refurbishment) and Shoreline (supporting Bruce Power, MCR Program).

The Secondment Program was used earlier in 2020 when Shoreline leveraged the knowledge from the CanAtom Power Group to support Bruce Power's MCR Program. Leaning on previous experience and lessons learned through Darlington, employees of CanAtom were temporarily transferred over to Shoreline to share expertise and lessons learned to work alongside and support Bruce Power's MCR feeder platform installation, fuel channel installation, tool testing and other refurbishment critical tasks.

Shared tooling was also jointly developed to optimize feeder replacement. Since the original development of the tooling set, Bruce Power took the initiative to make further enhancements to the tools which resulted in a 50 per cent reduction to welding time, reduced cutting and fitting process time, and provide visual control of the welding process through the addition of cameras.

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A Welding Centre of Excellence was established in 2020 to improve the welding programs at both sites. As a critical process used during both refurbishment programs, it was essential to establish a solid program that focused on commonalities between projects so Welders had an understanding of excellences for both sites. Through this program, Welders are qualified at the centre prior to executing work for each refurbishment and understand the tooling, supplies and procedures that are specific to each project. The Centre of Excellence program provides the hands on learning for this group to practice and ensure readiness prior to execution.

Another efficiency realized through our sharing of assets was demonstrated through the exchange of operating experience on reactor tooling to progressively improve the tooling unit over unit. This ultimately reduced the total duration of each unit's refurbishment and improved overall tool performance.

This was demonstrated through the successful refurbishment of Darlington Unit 2 and applying the lessons learned with Bruce Power to support Unit 6 Major Component Replacement.

These arrangements have proven key to reducing duplication of effort and increasing cost and time efficiencies for both projects.

OPG and Bruce Power agreed to share in the latest enhancement costs and coordinate their efforts for the upcoming planned outages, leveraging economies of scale and resulting in significant costs savings for both companies.

These joint collaborative arrangements have proven to be a success to reduce duplication of effort and increase cost and time efficiencies for both projects.

Moving forward in 2021, Bruce Power will provide both technical support and the feeder replacement tooling set needed to support for the planned Pickering outages throughout the year.

Supply Chain

Supply Chain departments from both OPG and Bruce Power have worked in close collaboration on a number of large open market sourcing competitions as well as in the sharing of information about scopes of work, forecasts and Operating Experience. The collaboration programs cut across nuclear and conventional materials and services and are intended to drive value for the rate payers of Ontario by ensuring safety, reliability, quality and sustainable commercial terms for major materials and services procurement at both companies. The largest of these opportunities currently include contaminated laundry, high voltage electrical services, valves, and turbine and generator program collaborations.

Waste Management

OPG and Bruce Power have been working together on a number of waste management initiatives to ensure efficiencies between our organizations.

- Under our Heavy Water Management collaboration, OPG loaned 80 mega grams of primary heat transport heavy water from Bruce Power's MCR to OPG's Darlington Station to support operations to mitigate impact to their nuclear operations.

- Through the companies engineering collaboration, it was determined that MCR waste can be stored in OPG's existing Waste Storage Buildings, thereby, avoiding the need to build another storage building; maximizing the use of OPG's facility ultimately reducing the waste management environmental footprint and lowering the overall caretaking cost for Bruce Power.
- Bruce Power and OPG continue to work collaboratively to ensure Ontario's supply and inventory of heavy water is optimally managed to provide an adequate supply and storage capacity during the MCR and Darlington Refurbishment Projects.
- OPG and Bruce Power collaborated on the development of a Hybrid Construction Island concept that will enable Bruce Power to store their removed Unit 6 steam generators at OPG's Waste Storage Building. By using OPG's facility, our organizations will reduce efforts caused by multiple vendor/owner hand-offs and increase cost-savings.

Labour, Training and Schedules

To ensure workers on both refurbishments have the necessary credentials to work safely and effectively between sites, Bruce Power and OPG are driving initiatives to share training credentials and reduce the duplication of training time, effort and cost.

One example of these initiatives is the Job Ready Dispatch Program, which was launched by the organizations in January 2020. As of October, the program facilitated a total of 20 training courses for which credits were transferred between sites, allowing both companies to take advantage of overlap between training and avoid a significant amount of cost. OPG and Bruce Power are expanding this cost avoidance by working with third-party training vendors so the training they are already delivering to trades will be credited as part of this program, if applicable and to the correct standards. The program is expected to avoid millions in training costs at both sites each year.

Additionally, as part of ongoing energy sector collaboration, OPG, Bruce Power and the Electrical Power Systems Construction Association (EPSCA) started to review the industry-wide demand for trades in 2018 and have started to work with trade unions to ensure skilled tradespeople are available for nuclear work programs, including refurbishment and MCR. To date, work has largely focused on ensuring boilermaker capacity as this group is considered to be the skilled trade of highest demand. In 2019, OPG and Bruce Power worked with the boilermakers union on the development of a pre-apprentice program, which resulted in over 100 new apprentices entering the union to support nuclear work.

Bruce Power and OPG are working together in partnership with the Independent Electricity System Operator (IESO) to ensure optimal scheduling of outages between Bruce Power and OPG to safeguard against any reliability issues and help manage costs for the Ontario consumer.

This coordination has helped address future scheduling concerns that might have arisen during peak refurbishment outages and are critical in maintaining system reliability to keep costs down.

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The Future of Ontario

Throughout the unprecedented circumstances of this past year, Bruce Power and OPG have remained focused and aligned in our commitment to the future of Ontario. In addition to our refurbishment programs that will generate decades more of clean and reliable energy for the province, we continue to work on innovative initiatives leading toward a brighter tomorrow for all.

The next evolution in nuclear power is the Small Modular Reactor (SMR). These nuclear fission reactors are designed to be smaller than traditional reactors, yet will be built in larger numbers than most of the world's current nuclear fleet. A key action in Canada's efforts to combat climate change, SMRs can replace diesel and provide safe, reliable and low-carbon baseload power to remote, off-grid communities, mines and heavy industry.

OPG's new partnership with Ottawa-based Global First Power and Ultra Safe Nuclear Corporation (USNC) will build, own, and operate a proposed Micro Modular Reactor™ at the Chalk River Laboratories site, northwest of Ottawa. This ground-breaking joint venture, equally owned by OPG and USNC, represents the first commercial partnership on an SMR in Canada.

Bruce Power is a founding partner of the Nuclear Innovation Institute (NII), which seeks to accelerate the pace of innovation in the Canadian nuclear industry, embracing new thinking, new technologies and new business opportunities that can drive the shift to a low-carbon future. In August, the NII launched the Centre for Next Generation Nuclear Technologies to identify post-COVID economic, environmental and health-care opportunities. The new centre will focus on next generation nuclear technologies by advancing the existing expertise of suppliers, regulators and operators to support future economic, environmental and export opportunities.

Innovations

Innovations in nuclear energy will help support new technologies like SMRs, cancer-fighting isotopes and hydrogen development by using infrastructure investments that will drive the economy now and power the world of the future. It will also look at how the current Bruce Power site output can be further enhanced with new technologies and as foundational enablers.

Our initiatives go beyond nuclear to support people in Ontario and around the world.

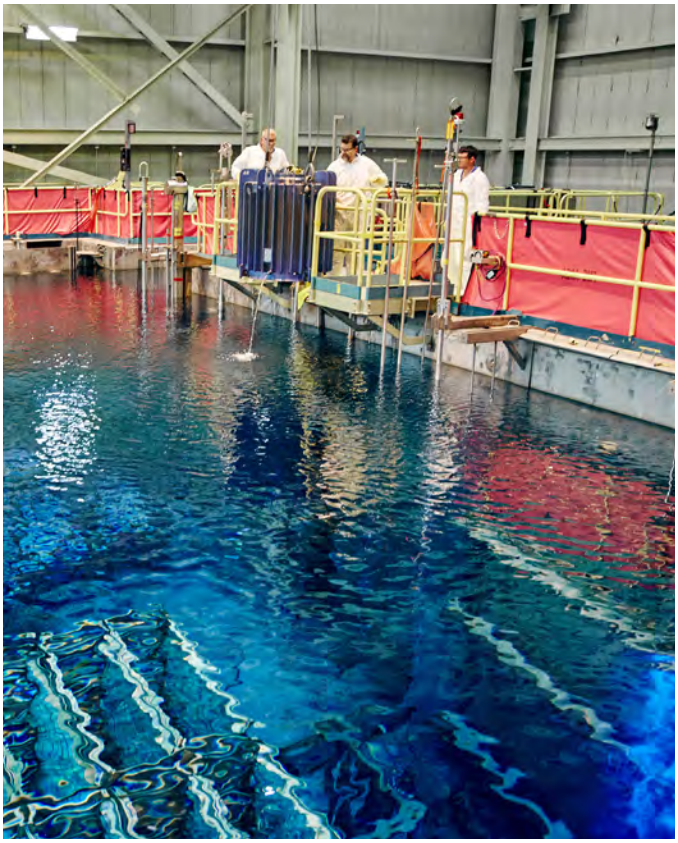
We have also entered into individual agreements to harvest Molybdenum-99 and Cobalt-60, helping to keep millions of people around the world healthy and safe. These life-saving isotopes are used to provide essential health care services such as cancer treatment, sterilization of medical devices and equipment, and self-powered luminescent emergency lighting.

Medical Innovation

Ontario's reliable supply of Cobalt-60 provided by Bruce Power and Ontario Power Generation (OPG) has been critical through 2020 as health-care systems across the world have been under significant pressure due to COVID-19.

Due to high demand, the need for single-use medical equipment has increased over the course of the pandemic and subsequent health crisis.

While other sterilization methods take up to seven days before products are available for use, gamma irradiation technology using Cobalt-60 can process such materials



within a day. Cobalt-60 irradiation sterilizes equipment faster and in larger volumes than other forms of sterilization, ensuring more supplies can get to the front-line health-care workers and hospitals, even as demand for these items has increased.

Both Bruce Power and OPG will continue to play a critical role in ensuring the lights stay on for Ontario's hospitals, operating rooms and life-saving equipment, while also providing a reliable source of Cobalt-60 to keep medical equipment clean and first responders safe.

Individually, our organizations are driving innovations that will help ensure a more sustainable future for all. Together, we're continuing to deliver on our commitments to the province.

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Bruce Power™
Innovation at work

ONTARIO POWER GENERATION

Energy Probe Interrogatory #34

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 8, Page 20

Preamble: "Given the completion of Unit 2, OPG's Board of Directors re-assessed the type of oversight required and decided to engage the Refurbishment Construction Review Board ("RCRB") to continue to provide independent oversight services for the remainder of the Program. RCRB members have experience in senior oversight and/or advisory capacities, with project management related to a "mega-projects", experience with nuclear plant operations, other extensive nuclear power, regulatory, construction management, major contract 8 management, and project controls experience. The RCRB is normally comprised of three to five external members, typically with support from one internal OPG member. It meets approximately three to four times per year, depending on Program status and schedule."

a) Why was the type of oversight re-assessed? Please describe the original oversight type and explain its deficiencies.

b) Does the new oversight type reduce the risk that the program will not be completed on time or on budget?

c) Please provide the names of members of RCRB with the descriptions of their qualifications and experience.

Response

a) There were no deficiencies identified in the oversight provided by Burns/Modus. See Ex. L-D2-02-Staff-132 part a) for further information on the change in oversight.

b) OPG continues to have a robust oversight plan in place that is appropriate for the current stage of the DRP. OPG's oversight plan remains largely the same as it was during EB-2016-0152 with minor adjustments to reflect the maturation of the DRP, including the OPG Board of Directors' appointment of the RCRB as independent oversight advisor to the Darlington Refurbishment Committee ("DRC") of the OPG Board.

   OPG believes that effective oversight has been a significant factor in successful project execution to date. OPG also believes RCRB oversight on behalf of the DRC will contribute to OPG's successful management and mitigation of project risks that

will enable OPG to deliver the DRP on time and on budget. Oversight of the DRP by a highly experienced group of independent project experts who are not immersed in the day-to-day project execution, and their identification of potential risks and opportunities, is expected to be valuable to the Board and to the DRP.

c) Please refer to Ex. L-D2-02-SEC-085, Attachment 1 (confidential).

Energy Probe Interrogatory #35

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 9, pages 4 and 5

a) Please confirm that the OEB approved scope for Unit 2 refurbishment was reduced by the removal of two projects from the scope: the $27.4 million Breathing Air Capacity Enhancement project and the $24.1 million Fuel Handling Power Track Refurbishment project.

b) Please confirm based on the OEB approved scope, Unit 2 refurbishment actually came in over the OEB approved budget.

c) Did OPG staff responsible for Unit 2 refurbishment earn an incentive payment for completing it "under budget"?

d) Please explain the reasons for each of "the higher than planned project spend on the Third Emergency Power Generator (+$35.0M), Containment Filtered Venting System (CFVS) modifications (+$29.4M) and Shield Tank Overpressure Protection (STOP) (+$21.3M)."

Response

a) Not confirmed. All of the scope included within the OEB's approval of $4,800.2M for the Unit Refurbishment – Unit 2 was completed.

b) OPG stated in evidence that compared to the U2EE, OPG completed the refurbishment of Unit 2 itself (i.e. excluding the definition phase) on budget at $3,417M. See Ex. D2-2-2, p. 2, lines 7-8.

Relative to the EB-2016-0152 OEB approved amounts, OPG completed the OEB approved scope with a forecast variance of $132.7M, which is recorded in the Capacity Refurbishment Variance Account.

c) See part b) regarding OPG's total actual cost to complete the scope corresponding to EB-2016-0152 approved amounts. Incentive payments for all eligible Management employees are based on OPG's Stakeholder Return Program ("SRP") that ties to the company's annual Corporate Balanced Scorecard ("Scorecard"). DN Refurbishment cost is a key performance measure of the Scorecard, typically weighted at 10% each year. Any deviation from the target will

have an impact on the overall corporate score. Refer to L-F4-03-AMPCO-176 for a copy of OPG's Corporate Balanced Scorecards.

d) OPG declines to produce the requested information on the basis of relevance. The listed projects are included in the CRVA amounts related to DRP that OPG is not seeking to clear or include in rate base in this application. As such, the information requested is not relevant to any issue in this application.

Energy Probe Interrogatory #36

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, pages 1and 2; Attachment 1, page 13; Attachment 2, pages 1 and 9; Attachment 4, pages 1 and 10

a) Please confirm that Pegasus-Global and Bates White were engaged by Torys LLP and not by OPG.

b) Why were Pegasus-Global and Bates White engaged by Torys LLP and not by OPG?

c) Is OPG required to use Ontario Government's "biddingo" system (https://www.biddingo.com/) for consulting contracts? Please explain your answer.

d) Since Pegasus-Global and Bates White were engaged by Torys LLP, why are they required to conform with OPG's Standard Form Business Expense Schedule for Contractors?

e) Did Pegasus-Global and Bates White submit their invoices to Torys LLP or to OPG for payment? Which entity paid the invoices?

Response

a) Confirmed.

b) See Ex. L-A1-02-CCC-001, part f).

c) The Provincial Procurement Directive does not mandate OPG to utilize "Biddingo" for consultant engagements.

d) See Ex. L-A1-02-CCC-001, part f). In the course of these engagements, Torys bills OPG for disbursements that Pegasus-Global and Bates White incur. In order to prevent OPG from declining to reimburse for any disbursements, Torys requires that its consultants abide by OPG's Standard Form Business Expense Schedule for Contractors as part of its engagement letter.

e) Pegasus-Global and Bates White submitted their invoices to Torys LLP for payment. Torys paid these invoices and all costs were billed to OPG as disbursements.

Energy Probe Interrogatory #37

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, page 2

Preamble: "In September 2019, Bates White Economic Consulting ("Bates White") was retained to complete an estimate of the cost to design, engineer, construct and commission the as-built Heavy Water Storage and Drum Handling Facility ("D2O Storage Project") at OPG's Darlington Nuclear Generating Station taking into consideration:…"

a) Please confirm that D2O Storage Project was completed when Bates White was hired.

b) Why did OPG authorize Torys LLP to hire Bates White to complete a cost estimate of the D2O Storage Project after the project was completed.?

c) What was the actual cost of the D2O Storage Project in September 2019?

d) Was Bates White provided information about the actual cost of the D2O Storage Project?

e) Did Bates White make any site visits to the D2O Storage Project and take any measurements?

Response

a) Not confirmed. Bates White was retained in September 2019 and the facility was declared capable of accepting heavy water in March 2020.

b) See part a).

c) The life to date cost of the D2O Storage Project in September 2019 was $496.4M.

d) See Ex. L-D2-02-CCC-033 part a).

e) As stated in Ex. D2-2-11, Attachment 3, p. 17, the Bates White team members toured the D2O Storage Project in October 2019 and were able to observe and experience the project site and physical layout first-hand. Bates White did not take measurements.

Energy Probe Interrogatory #38

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 10, Page 1

a) Please confirm that the purpose of this exhibit is to provide support for the request that OEB approve the costs of the D2O Storage Project for inclusion in rate base.

b) Please confirm that the prudence review of the D2O Storage Project will take place in a future proceeding when the Darlington Refurbishment Program is completed and OPG requests disposition of the balance in the CRVA.

Response

a) Confirmed. As stated in Ex. D2-2-10, p. 1 lines 1-6, the purpose of the exhibit is to support OPG's request to incorporate the remaining $494.7M of capital cost for the D2O Storage Project into its rate base. See Ex. H1-1-1, p. 20, lines 5-12 for OPG's requested treatment of the CRVA account balance related to the D2O Storage Project.

b) Not confirmed. As OPG stated in EB-2016-0152, Ex. N2-1-1, page 2:

> The actual revenue requirement impact of the D2O Project will be recorded in the nuclear portion of the Capacity Refurbishment Variance Account ("CRVA") once the project enters into productive service. Such entries into the CRVA will continue to be recorded until the OEB-approved D2O Project in-service amount is reflected in the revenue requirement through a subsequent rate setting process. The OEB will have the opportunity to conduct a prudence review in respect of the D2O Project after it has been completed and placed into service.

In this application, OPG is applying to clear the CRVA balances related to the D2O Storage Project, as discussed at Ex. H1-1-1, p. 20, and include the project's capital cost in rate base. OPG filed extensive evidence on the project to allow the OEB to conduct a prudence review of the amounts OPG seeks to place in-service in respect of the D2O Storage project.

Energy Probe Interrogatory #39

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 1, pages 6 and 17

a) Did Pegasus-Global request to review those Policies and Procedures? If the answer is yes, please file the document requesting Policies and Procedures. If the answer is no, how can Pegasus-Global be confident that it reviewed all relevant Policies and Procedures?

b) Please file a list of all other OPG documents that were provided to Pegasus-Global.

Response

This response was prepared by Pegasus-Global Holdings Inc. ("Pegasus-Global"):

a) Yes. The policies and procedures reviewed and discussed within Dr. Galloway's testimony were provided in response to a verbal request from Pegasus-Global for OPG to provide any new or updated policies and procedures from those reviewed during the prior Unit 2 assessment in EB-2016-0152.

b) See Attachment 1.

	Filename	Document Title
1	_Gate 3a - BOP Approval.pdf	OPG NR Gate 3 Progress Form Document Number D-GRB-00120-0777331
2	_Gate 3a - BOP Presentation.pdf	Darlington Refurbishment Gate Review Board; Balance of Plant, Shutdown & Layup, Refurb Support Facilities & Steam
3	_Gate 3a - FH Presentation.pdf	Darlington Refurbishment Gate Review Board; Defueling and Fuel Handling
4	_Gate 3a - RFR Approval.pdf	OPG NR Gate 3 Progress Form, Bundle: RFR & Islanding
5	_Gate 3a - RFR Presentation.pdf	U3 RFR GRB Gate 3A
6	_Gate 3a - SP Approvals -2.pdf	OPG NR Gate 3 Progression Form: SDS Computer Replacement U3SP OPG PM & Overnight U3SP Contingency U3SP
7	_Gate 3a - SP Approvals.pdf	OPG NR Gate 3 Progression Form: Defueling Execution Work U3DF; OPG PM & Oversight U3DF; Defueling (Eng'g & Proc) U3DF; Contingency Defueling U3DF; Contingency Fuel Handling
8	_Gate 3a - SP Presentation.pdf	Darlington Refurbishment Gate Review Board; Specialized Projects Gate 3a: Unit 3; Gate 2: Unit 1 & 4
9	_Gate 3a - TG Approval.pdf	OPG NR Gate 3 Progression Form; Unit 3 TGR Projects
10	_Gate 3a - TG Presentation.pdf	Darlington Refurbishment Gate Review Board Turbine
11	_Health of EcoSys Examples.pdf	Health of EcoSys Metric Dashboard Report
12	01-1 Post U3RR Roadmap Draft.pdf	Road Map to Gate 3a Performance Baseline - Subsequent Unit
13	01-2 Road Map to Rel6c Rev1.pdf	Road Map to Release 6c ("U3EE) - Subsequent Unit Planning
14	01-3 Unit 3 Status Dashboard.pdf	OPG Unit 3 - Status Dashboard
15	02-1 Lessons Learned Overview.pdf	Did We Learn Our Lesson?
16	02-10 - N-GUID-09701-10123 Nuc Projects Risk Mgmt and Oversight (RMO) Tool R000.pdf	Nuclear Projects Risk Management and Oversight (RMO) Tool
17	02-11 - NK38-MAN-09701 - 10005 MLST Refurbishment Unit Planning Milestones.pdf	Refurbishment Unit Planning Milestones
18	02-12 - N-MAN-00120-10001 INT Nuc Project Integration Mgmt R001.pdf	Nuclear Project Integration Management
19	02-2 What is Lessons Learned Excellence (Department Presentation).pptx	Darlington Refurbishment Lessons Learned
20	02-3 NK38-GUID-09701-10054 R001 (Lessons Learned).pdf	Nuclear Refurbishment Lessons Learned
21	02-4 April 2019 LL Status Report.pdf	Monthly Lessons Learned Status Report For: March 2019
22	02-5 COG - Safety Lessons Learned - April 08 2019.pptx	Refurbishment and Return to Service Sharing of Lessons Learned Session
23	02-6 CWP 2124 Bulkheads - Lessons Learned Report (Tiered).pdf	RFR Lessons Learned Report
24	02-7 FC Install Lesson Learned Meeting Presentation.pptx	Fuel Channel Install Lessons Learned
25	02-8 Lessons Learned - BP Collaboration - April 2019.pptx	Lessons Learned
26	02-9 Darlington Refurbishment Lessons Learned (Database only - June 18 2019).xlsx	Unit 2 & 3 Planning - Key Lessons Learned Tracking Log
27	03-1 U3EE Risk and Contingency Calc - V2.pdf	Risk Management & Contingency Unit 3 Execution Estimate
28	03-2 U3 Risk Registry - 05-22-2019.pdf	Risk Report by Project
29	04-1 NK38-REP-09701-0761466 (U3EE Master File).pdf	U3EE Board Funding Release 6c

30	04-2 Unit 3 Execution Board Memo approved.pdf	Darlington Refurbishment - Unit 3 Execution
31	04-3 U3EE - DRC FINAL with Appendices.pptx	Unit 3 Readiness and Unit 3 Execution Estimate (U3EE)
32	04-4 U3 Readiness - RCRB March 2019.pptx	Unit 3 Readiness
33	04-5 U3EE - RFR Gate.pptx	Unit 3 Execution Estimate RFR & Islanding
34	04-6 U3EE -MS Gate.pptx	Unit 3 Execution Estimate Turbine Generators, Defueling, Fuel Handling & Specialized Projects
35	04-7 U3EE - BOP Gate.pptx	Unit 3 Execution Estimate Balance of Plant, Shutdown & Layup, Refurb Support Facilities & Steam Generators
36	101 - OPG-PROC-0094 R004.pdf	Enterprise Risk Management Reporting
37	102 - OPG-STD-0017 R016.pdf	Organizational Authority Register
38	114 - NK38-DAI-09701 - 10008 R004.pdf	Retube Feeder Replacement Project Contractor/Owner Interface Requirements
39	119 - N-MAN-00120-10001-SCOPE R003.pdf	Nuclear Project Scope Management
40	119_COR_MAN_OPG-MAN-00120-0011_0002.pdf	Project Scope Management OPG-MAN-00120-0011-NA-R001
41	13 - RFR EOS Briefing September 6 2019.pdf	OPG RFR Unit 2 Executive Performance Report, Sep 6, 2019
42	14 - Financial Briefing Note - August 2019.pdf	Refurbishment OM&A and Capital Financial Highlights - August 2019
43	15 - DRP Project Assurance Update.pdf	OPG Darlington Refurbishment Program Oversight and Assurance: U2/U3 Plan
44	16 - D-PCH-09701-10000 R005.Charter.pdf	Darlington Refurbishment Charter
45	16 - RROC May 2019.pdf	Risk Management Oversight Committee Meeting, May 28,
46	18 - BOPO Master Tracker LL.xlsx	
47	18 - Lessons Learned Dashboard August 2019.pdf	BOP & Other Lessons Learned - August 2019
48	18 - NK38-GUID-09701-10038 R002.pdf	Darlington Refurbishment Program Quality Surveillance Guide
49	18 - RFR Master Tracker LL.xlsx	
50	18 - TGR Master Tracker LL.xlsx	
51	18 - Window 501 VVRS Unit 3 Pre-Meeting Package and Minutes	Refurbishment Post Execution Lessons Learned meeting - Meeting Package VVRS: Jan 16th 2019
52	19 - CNSC Type II Reactive Insection - DNRU2 FME.pdf	Darlington NGS - CNSC Type II Inspection Report: DRPD-2019-04074 - Darlington Unit 2 Refurbishment Foreign Material Exclusion, New Action Item 19668
53	19-1 - OPG-STD-0148 Project Management.pdf	Project Management
54	19-1_COR_STD_OPG-STD-0148_002.pdf	Ontario Power Generation Standard Project Management
55	19-2 - OPG-MAN-00120-0019 R000 Project Phase-Gate Management.pdf	Project Phase-Gate Management
56	19-3 - N-GUID-00120-10131 Nuclear Project Scheduling Guide.pdf	Nuclear Project Scheduling Guide
57	19-4 - N-MAN-00120-10001 COST Nuclear Project Cost Management.pdf	Nuclear Project Cost Management
58	19-4_COR_MAN_OPG-MAN-00120-0013_001.pdf	Project Cost Management OPG-MAN-00120-0013-R001
59	19-5 - N-MAN-00120-10001 CHNG Nuclear Project Change Management.pdf	Nuclear Project Change Management
60	19-5_COR_MAN_OPG-MAN-00120-0016_001.pdf	Project Integrated Change Control OPG-MAN-00120-0016-R001

61	19-6 - N-MAN-00120-10001 SCH8 Nuclear Projects P6 Schedulers Users Guide.pdf	Nuclear Project P6 Scheduler's User Manual
62	19-7 - NK38-NR-PLAN-09701-10001 SHT 0025 R000.pdf	Darlington Refurbishment Project Office Program Management Plan
63	2.14.2020_VAC DRY_FOAK Proceduress.docx	Nuclear Refurbishment, Unit 3 Heat Transport System Vacuum Dry Project preperations
64	20 - CCF Change Levels Flowchart.pdf	CCF Change Levels Flowchart for Darlington Nuclear
65	2020 Project Assurance Outlook Plan (FINAL R02).docx	Darlington Refurbishment Project Assurance: 2020 Update & 3-YEAR Outlook
66	2020 Project Assurance Outlook Plan DR Signed.pdf	Darlington Refurbishment Project Assurance: 2020 Update & 3-Year Outlook
67	22 - Project Management Governance Map.pdf	Project Management - Governaance Map
68	23 - Phase - Gate Roadmap.pdf	Phase-Gating Roadmap
69	25 - Unit 3 S1 CP Lessons Learned - June 2019 rollup.pptx	
70	26 - RCRB Visit 12 Jun 2019 Final Report.docx	Refurbishment Consturction Review Board Review (June 17 - 20, 2019) Confidential
71	27 - D3IP Tooling Improvements (June Cornerstone, Updated Aug 7)	Update on D3IP Tooling Projects for June 2019 Cornerstone Retube and Feeder Replacement (RFR) Innovation
72	28 - NK38-NR-PLAN-09701-10001 SHT 23 R002.pdf	Darlington Refurbishment Quality Program Management Plan
73	28 0 Refurb Assurance Activities Oct 2016 to Aug 2019.xlsx	
74	29 - Proj Communication and Stakeholder Mgmt (OPG-MAN-00120-0017 R000)	OPG Project Communication and Stakeholder Management
75	50 - NK38-NR-PLAN-09701-10001 SHT 0001 R003.pdf	Darlington Refurbishment Program Management Plan Structure
76	51 - NK38-NR-PLAN-09701-10001 SHT 0002 R003.pdf	Darlington Refurbishment Project Planning and Controls Program Management Plan
77	51_D_PLAN_NK38-NR-PLAN-09701-10001_0002_004.pdf	Darlington Refurbishment Project Planning and Controls Program Management Plan
78	52 - NK38-NR-PLAN-09701-10001 SHT 0003 R002.pdf	Darlington Refurbishment Return to Service Program Management Plan
79	53 - NK38-NR-PLAN-09701-10001 SHT 0004 R002.pdf	Darlington Refurbishment - Environmental Program Management Plan
80	53_D_PLAN_NK38-NR-PLAN-09701-10001_0004_003.pdf	Darlington Refurbishment - Environmental Program Management Plan
81	54 - NK38-NR-PLAN-09701-10001 SHT 0005 R002.pdf	Darlington Refurbishment Health and Safety Program Management
82	54_D_PLAN_NK38-NR-PLAN-09701-10001_0005_003.pdf	Darlington Refurbishment Health and Safety Program Management
83	55 - NK38-NR-PLAN-09701-10001 SHT 0006 R003.pdf	Darlington Refurbishment - Chemistry Program Management Plan
84	55_D_PLAN_NK38-NR-PLAN-09701-10001_0006_004.pdf	Darlington Refurbishment - Chemistry Program Management Plan
85	56 - NK38-NR-PLAN-09701-10001 SHT 0007 R002.pdf	Darlington Refurbishment Licensing Management Plan
86	57 - NK38-NR-PLAN-09701-10001 SHT 0008 R003.pdf	Darlington Refurbishment Engineering Program Management Plan
87	59 - NK38-NR-PLAN-09701-10001 SHT 0010 R004.pdf	Darlington Refurbishment Management Systems and Performance Improvement Program Management Plan

88	60 - NK38-NR-PLAN-09701-10001 SHT 0011 R003.pdf	Darlington Refurbishment Program Assurance Program Management Plan
89	61 - NK38-NR-PLAN-09701-10001 SHT 0012 R007.pdf	Darlington Refurbishment Construction Program Management Plan
90	61_D_PLAN_NK38-NR-PLAN-09701-10001_0012_008.pdf	Darlington Refurbishment Construction Program Management Plan
91	63 - NK38-NR-PLAN-09701-10001 SHT 0014 R003.pdf	Darlington Refurbishment Communications Program Management Plan
92	63_D_PLAN_NK38-NR-PLAN-09701-10001_0014_004.pdf	Darlington Refurbishment Communications Program Management Plan
93	64 - NK38-NR-PLAN-09701-10001 SHT 0015 R002.pdf	Darlington Refurbishment Supply Chain Program Management Plan
94	65 - NK38-NR-PLAN-09701-10001 SHT 0016 R004.pdf	Darlington Refurbishment Staffing Program Management Plan
95	66 - NK38-NR-PLAN-09701-10001 SHT 0017 R003.pdf	Darlington Refurbishment - Operations Program Management Plan
96	67 - NK38-NR-PLAN-09701-10001 SHT 0018 R002.pdf	Darlington Refurbishment - Radiation Protection Program Management Plan
97	68 - NK38-NR-PLAN-09701-10001 SHT 0019 R004.pdf	Darlington Refurbishment - Training Program Management Plan
98	69 - NK38-NR-PLAN-09701-10001 SHT 0020 R004.pdf	Nuclear Refurbishment Human Performance Management Plan
99	70 - NK38-NR-PLAN-09701-10001 SHT 0023 R002.pdf	Darlington Refurbishment Quality Program Management Plan
100	70 - NK38-NR-PLAN-09701-10001 SHT 0023 R002.pdf	Darlington Refurbishment Quality Program Management Plan (duplicate?)
101	71 - NK38-PLAN-00300-10000 R004.pdf	Darlington Refurbishment Program Milestone & Integrated Master Schedule
102	73 - NK38-PLAN-09701 - 10074 R004.pdf	Retube & Feeder Replacement (RFR) Project Management Plan
103	74 - NK38-PLAN-09701 - 10134 R002.pdf	Defueling Project Management Plan
104	75 - NK38-PLAN-09701 - 10159 R005.pdf	Islanding Project Management Plan
105	76 - NK38-PLAN-09701 - 10164 SHT 001 R004.pdf	Steam Generator - Project Management Plan
106	77 - NK38-PLAN-09701 - 10166 R005.pdf	Balance of Plant Project Management Plan
107	80 - NK38-PLAN-09701 - 10238 R002.pdf	Shutdown & Layup / Services / Refurbishment Support Facilities Project Management Plan
108	81 - NK38-PLAN-41000-10001 SHT 0001 R004.pdf	Turbine Generator Project Management Plan
109	83 - N-MAN-00120-10001-EST R003.pdf	Nuclear Project Cost Estimating
110	92 - N-MAN-00120-10001-RISK R004.pdf	Nuclear Project Risk Management
111	93 - N-MAN-00120-10001-SCH R002.pdf	Nuclear Nuclear Project Schedule Management
112	August 2020 U3EE	Darlington Refurbishment - Final Unit 3 Execution Estimate
113	CanAtom RFR Resource Mangement Plan R00 2012.pdf	DNGS RFR Project - Resource Management Plan
114	D_PLAN_NK38-NR-PLAN-09701-10001_0002_004.pdf	OPG Darlington Refurbishment Project Planning and Controls Program Management Plan: NK38-NR-PLAN-09701-10001-
115	D_PLAN_NK38-NR-PLAN-09701-10001_0013_002.pdf	Darlington Refurbishment Contract Program Management Plan
116	D3IP - Cornerstone Update - June2019.pptx	Update on Two Key D3IP Projects for June 2019 Cornerstone Retube and Feeder Replacement (RFR) Innovations
117	Darlington - Generator Rewind & HP-LP Centerline Resources_Redacted.pdf	Darlington - Generator Rewind & HP-LP Centerline Resources

118	Darlington U3 Gen Blowdown Lessons Learned (20200922).pdf	OPG Darlington U3 Gen Blow Down Lessons Learned
119	DNR2 RP Lessons Learned.pdf	DNR2 RP Lessons Learned
120	DNR2 RP Lessons Learned.pdf	DNR2 RP Lessons Learned
121	DNRU2 Consolidated Lessons Learned Aug 2018.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Aug 2018
122	DNRU2 Consolidated Lessons Learned Dec 2018.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Dec 2018
123	DNRU2 Consolidated LL April 2019.pdf	Darlington Nuclear Refurbishment Program Monthly lessons Learned Status Report Mar 2019
124	DNRU2 Consolidated LL July 2019.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Jul 2019
125	DNRU2 Consolidated LL June 2019.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Reprot Jun 2019
126	DNRU2 Consolidated LL May 2019.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report May 2019
127	DNRU2 Lessons Learned Report Mar 2019.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Mar 2019
128	DNRU2 LL Sept 2020 R5.pdf	Ontario Power Generation Lessons Learned (LL) Monthly Report - September 2020
129	DRAS 1011 - 4 month deferral for DNRU3 (FINAL with attachment).pdf	Decision Record and Analysis Summary Form: 4-month Deferral of DNRU3, DNRU 1 and DNRU 4 in Response to the
130	DRAS 975 - 24x7 Schedule vs. Hybrid with Appendices.pdf	Decision Record and Analysis Summary Form: 24x7 Schedule vs. Hybrid Shift Schedule Assessment for U3, U1, U4 Critical
131	DRAS CenterLine Final 2020 03 30.pdf	Decision Record and Analysis Summary Form
132	DRAS In-situ Rewind 2020 03 30 Final.pdf	Decision Record and Analysis Summary Form
133	DRNU2 Consolidated Lessons Learned Feb 2019.pdf	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Feb 2019
134	DRP External Oversight Advisor RFP SOW Feb 2020.pdf	Scope of Services Schedule
135	DRP_2019_Q1_U3_BOARD Subsequent Units.pdf	OPG Darlington Refurbishment Program - Unit 3 Status Report May 15th, 2019
136	DRP_2019_Q2_U2_BOARD.pdf	Darlington Refurbishment Program Summary - Unit 2 Status Aug 14th, 2019
137	DRP_2019_Q2_U2_U3_BOARD_SUMMARY.pdf	Darlignton Refurbishment Program Summary Quarterly Report Q2 - April to June 2019
138	DRP_2019_Q2_U3_BOARD Subsequent Units.pdf	OPG Darlington Refurbishment Program - Unit 3 Status Report August 14th, 2019
139	DRP_reorganizaiton.pdf	Reorganization - What it means to Refurb?
140	Executive Endorsement Package.pdf	Executive Endorsement Package.pdf; Enterprise Projects (PMCoE) - Implementation Strategy
141	Feb 1, 2019 U3 LR Plan - BLANK.xlsx	Succession Planning - Refurb Leadership Long Range View
142	FME - Presentation Aug 2019.pptx	U2 Foreign Material Exclusion (FME) U2 Refurbishment FME Program Overview for Primary Heat Transport System
143	FME Presentation Aug 2019.pptx	U2 Foreign Material Exclusion (FME) U2 Refurbishment FME Program Overview for Primary Heat Transport System
144	FME Presentation Aug 2019.pptx	U2 Foreign Material Exclusion (FME) U2 Refurbishement FME Program Overview for Primary Heat Transport System
145	N_PLAN_NK38-PLAN-09701-10291_003.pdf	Unit 2 Return to Service (RTS) Training Strategy
146	N_PLAN_NK38-PLAN-09701-10291_003.pdf	Unit 2 Return to Service (RTS) Training Strategy
147	OPG Engineering Support.pdf	Refurbishment Support Org Chart

148	OPG Functional Org Chart_August-2020.pdf	OPG Functional Org Chart
149	OPG Talent Placemat_2019.pdf	Talent Assessment and the 9-box defined
150	Organizational Realignment.pdf	Organizational Realigment Email to All OPG Employees
151	Project Centrism - Leading Metrics Update-Sep2020.pptx	Strategic Imperatives Steering Committee Meeting: Improved Project Controls Framework Update
152	Project Excellence Implementation Plan.pdf	Project Excellence Initiative: Enterprise Projects Organization (EPO) Implementation Plan
153	RAD Protection - DNR2 RP Lessons Learned.pdf	DNR2 RP Lessons Learned
154	RCRB Focus Area White Paper Template Aug 31 2017 (002).docx	Succession Planning White Paper
155	RCRB Scope of Work Document Feb 2020.pdf	Consulting Services for Refurbishment Construction Review Board
156	RCRB Scope of Work for DRC Draft to GS Oct2`20.docx	OVERSIGHT SERVICES BY THE REFURBISHMENT CONSTRUCTION REVIEW BOARD SCOPE OF WORK
157	RCRB Scope of Work.pdf	OVERSIGHT SERVICES BY THE REFURBISHMENT CONSTRUCTION REVIEW BOARD SCOPE OF WORK
158	Refurb Change Control Process.pdf	EPET Brief: Revised Refurbishment Change Control Process
159	RFR Amendment 11 (3 November 2020).pdf	AMENDMENT AGREEMENT NUMBER 11 BETWEEN OPG AND SNC-LAVALIN NUCLEAR & AECON CONSTRUCTION GROUP
160	Risk Mgmnt & Contingency (Updated Monte Carlo Analysis).pdf	Risk Management & Contingency Unit 3
161	Skilled Trades initiative Overview.pdf	Skilled Trades Risk Review December 2019
162	Succession Planning @ OPG Workshop.pdf.pptx	Succession Planning @ OPG
163	Succession Planning Guide.pdf	Welcome to your succession planning and talent review guide
164	Training - RTS Strategy N_PLAN_NK38-PLAN-09701-10291_003.pdf	UNIT 2 RETURN TO SERVICE (RTS) TRAINING STRATEGY
165	U3Rev0BaselineScheduleDec9_2019.pdf	Unit 3 Refurbishment - DNRU3 Level 1 Overview
166	Unit 3 Contingency as a Percentage of the Unit 3 Base Estimate.pdf	Unit 3 Contingency as a Percentage of the Unit 3 Base Estimate Less Actuals and Fixed Costs
167	VVRS_Lessons Learned Effectiveness Summary_2.11.2020.pptx	Lesson Learned - VVRS (Vault Vapor Recovery Systems)
168	X_DNRU2 Consolidated Lessons Learned Aug 2018.xlsx	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Aug 2018
169	X_DNRU2 Consolidated Lessons Learned Dec 2018.xlsx	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Dec 2018
170	X_DNRU2 Consolidated Lessons Learned Jan 2019.xlxs	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Jan 2019
171	X_DNRU2 Consolidated Lessons Learned Nov 2018.xlxs	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Nov 2018
172	X_DNRU2 Consolidated Lessons Learned Oct 2018.xlsx	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Oct 2018
173	X_DNRU2 Consolidated Lessons Learned Sep 2018.xlsx	Darlington Nuclear Refurbishment Program Monthly Lessons Learned Status Report Sep 2018

Energy Probe Interrogatory #40

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 1, pages 6, 7 and 15

Has the risk that the Darlington Refurbishment Program will not be completed on schedule or on budget increased, stayed the same or decreased from the time of the previous review by Pegasus-Global in 2016? Please explain your answer.

Response

This response was prepared by Pegasus-Global Holdings Inc. ("Pegasus-Global"):

An assessment of individual risks, such as the risks with potential cost and/or schedule impacts, was not part of Pegasus-Global's scope in either its EB-2016-0152 Unit 2 or its current assessment. However, as discussed in each assessment, OPG has developed and implemented a robust set of policies, procedures, and tools that will continue to assist in the execution of the Program. Additionally, in the current assessment, it was identified that the cost and schedule estimates for the Remaining Units have gone through thorough reviews by OPG and its partners, including incorporation of actual performance and lessons learned from the Unit 2 execution, that reduces the uncertainty that existed at the onset of the Program and provides confidence in OPG successfully completing the Program.

Energy Probe Interrogatory #41

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 3, Page 5

a) Were any forms of contract other than EPC considered by Bates White? Please explain your answer.

b) Please confirm that under an EPC contract, the contractor assumes more risk than under alternative forms of contract and that as a result EPC contracts are generally more costly than other forms of contract.

Response

This response was prepared by Bates White:

a) No. Bates White was tasked with developing an independent cost estimate for the D2O Storage Project. Its task did not involve evaluating other types of contract that OPG may have considered. Bates White developed its estimate without regard to a choice of contract vehicle.

b) Not confirmed. While it is true that the "sticker price" of a project may vary depending on the form of contract utilized, reflecting in part (but only in part) the division of risk in the contract, two factors should be underscored. First, merely labeling a contract "EPC" versus any of a variety of alternatives provides insufficient detail to make the generalization implied by the question. Second, the underlying cost of construction (as calculated, for example, in the Bates White report) is generally independent of the form of contract.

Energy Probe Interrogatory #42

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 3, Pages 8 and 15; D2, Tab, 2, Schedule 10, page 11

Preamble: "In developing the cost estimate, we assumed that we had perfect knowledge of project scope, design requirements (e.g., the need for seismic design), and actual site conditions, including previously contaminated soil, a constrained work area, cold weather, and water ingress."

Please discuss the reasons for the difference between the $517.7 million cost estimated by Bates White and the $509.3 million actual cost of the D2O Storage Project considering that Bates White assumed perfect knowledge and OPG did not have the benefit of perfect knowledge.

Response

As explained in Ex. L-D2-02-CME 22(c), the assumption of "perfect knowledge" does not mean certainty over all elements of cost.

Bates White "assumes what might be called 'perfect knowledge' with respect to project scope, design requirements, and actual site conditions encountered" (Ex. D2-2-11, Attachment 3, p. 5). However, Bates White goes on to say: "Despite perfect knowledge, variability in some factors—including labour productivity, weather, and the need for modest rework, inter alia—is an unavoidable part of any construction project" (Ex. D2-2-11, Attachment 3, p. 9). Thus, even in the absence of the complexities and challenges of the D2O Storage Project detailed in Ex. D2-2-10, differences between actual costs and a cost estimate would be expected.

Energy Probe Interrogatory #43

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 11, Attachment 3, Page 17

Preamble: "The labour costs in the RSMeans database are premised on a 66% productivity rate typical for a non-nuclear industrial construction project. This rate is substantially higher than the achievable productivity rate on the D2O Storage Project. Based on our experience on numerous other nuclear construction projects, and our review and extrapolation of the findings in two OPG-sponsored labour productivity studies, it is our expert opinion that an average 39% productivity factor would be appropriate for the D2O Storage Project."

a) Please explain how the productivity rate is used in estimating.

b) Please explain how 39% productivity factor was determined. Please show all calculations.

c) Please discuss the sensitivity of the estimate to the productivity factor for each 1% change in productivity.

Response

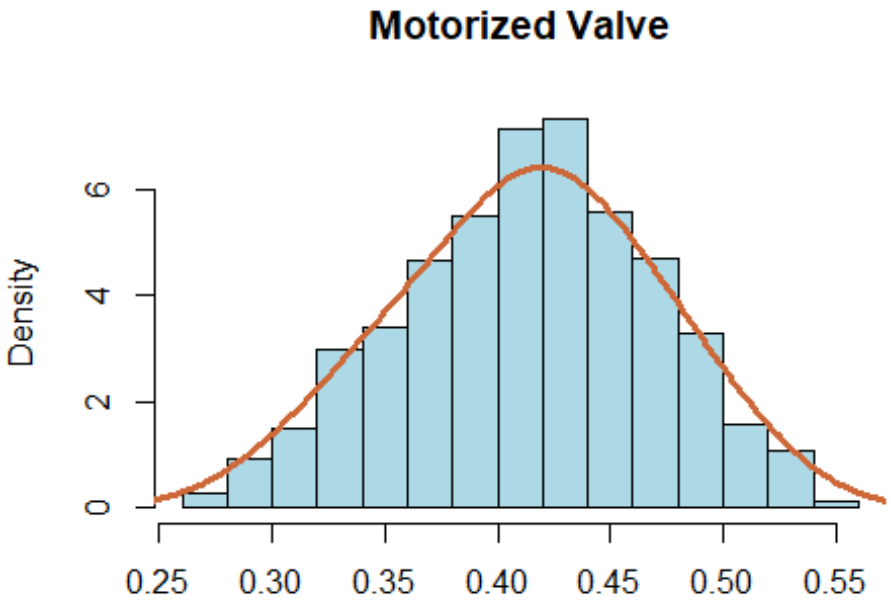
The following response was prepared by Bates White:

a) As envisioned in the Economic Modelling Working Group ("EMWG") Guidelines, which Bates White used to frame its overall approach, "site-specific productivity" estimates, such as the one developed for the Bates White D2O Storage Project cost estimate, are used to adjust site-neutral cost estimates (such as those developed using the EMWG process) to account for local conditions. In the Bates White estimate, this adjustment was applied to direct labor cost estimates on a line-item-by-line-item basis, as illustrated in Appendix D.

b) We took the raw data from the "wrench time" studies and computed productivity distributions using a Monte Carlo simulation and running 1,000 realizations using the R software package. Because the data were sparse, we modeled the data using a simplified triangular distribution. We used three parameters from the data in the "wrench time" studies: a most likely value, a lower bound, and an upper bound. An example of the results of this calculation, which was repeated for each data set, is provided below.

Figure 1: Probability Density Distribution

(Calculated for "Motorized Valve" example,
input values: median = 0.4154, spread = 0.2730 to 0.5465)



We then added the six distributions, again using a Monte Carlo simulation involving 1,000 realizations, to compute a composite productivity distribution. We used the mean value of this distribution as the point estimate for productivity in our subsequent computations.

c) Please see response to Ex. L-D2-02-Staff-172, part (c).

Environmental Defence Interrogatory #5

Interrogatory

Reference:
Ex. D2-2-7

Question:

(a) According to Ex. D2-2-7, Attachment 1, page 4: the forecast total budget for the Darlington Refurbishment Project is $12.8 billion. Please provide OPG's forecast cumulative capital spending on the Darlington Refurbishment Project, by quarter, from the first quarter of 2021 to the last quarter of 2026.

Response

a) The requested information is provided in Chart 1 below based on the Unit 3 Execution Estimate. Note that, as OPG continues to execute Unit 3, and to implement further Lessons Learned and any additional Strategic Initiatives that may be identified into the planning and execution of Units 1 and 4, the forecast quarterly expenditure profile may change.

Chart 1

Darlington Refurbishment Program Forecast Cumulative Expenditures 2021 - 2026 ($M)			
Q1 2021	7,746	Q1 2024	11,101
Q2 2021	8,048	Q2 2024	11,380
Q3 2021	8,324	Q3 2024	11,617
Q4 2021	8,575	Q4 2025	11,829
Q1 2022	8,849	Q1 2025	11,982
Q2 2022	9,153	Q2 2025	12,126
Q3 2022	9,438	Q3 2025	12,283
Q4 2022	9,735	Q4 2025	12,439
Q1 2023	10,050	Q1 2026	12,577
Q2 2023	10,327	Q2 2026	12,662
Q3 2023	10,576	Q3 2026	12,723
Q4 2023	10,836	Q4 2026	12,800

Environmental Defence Interrogatory #6

Interrogatory

Reference:
Ex. D2-2-7

Questions:

(a) Please provide a table comparing the Darlington refurbishment schedule: (i) at the time of the previous payment amounts application; and (ii) currently. Please provide this on a unit-by-unit basis.
(b) Please describe the dates at which off-ramps can be exercised with respect to the units at Darlington (if any).
(c) Who will decide whether to exercise any off-ramps?
(d) What factors will be considered?
(e) Please provide any reports to the OPG Board of Directors regarding potential off-ramps for the Darlington units.

Response

a) See Ex. L-D2-02-Staff-135.

b) At this time, OPG has no expectation of exercising “off-ramps” with respect to the refurbishment of the subsequent units at Darlington, nor any expectation that the Government of Ontario would direct OPG to off-ramp and cancel the refurbishment of the subsequent units.

c) As provided in EB-2016-0152, L-4.3-1 Staff-44, OPG would expect that any decisions regarding the on-going feasibility of the schedule or the plan to refurbish the subsequent units at Darlington would only be made after a rigorous process of evaluation similar to the one which was undertaken on the decision to proceed with the refurbishment of the Darlington units. OPG expects the evaluations and decision-making would involve OPG, the Independent Electricity System Operator, the Ministry of Energy, the Ministry of Finance, other relevant Ministries, and the Cabinet.

d) As discussed in EB-2016-0152, Ex. L-4.3-1 Staff-44, beyond being guided by the 2013 LTEP principles for nuclear refurbishment, OPG has no insights into what factors the Government of Ontario would consider in making a decision to direct OPG to take an off-ramp.

e) OPG declines to provide the requested information on the basis of relevance. The Province of Ontario through “its most recent Long-Term Energy Plan, and through a specific endorsement to proceed with the refurbishment of Unit 3" (Ex. D2-1-1, p. 6), has indicated its continuing support for DRP and has not invoked an off-ramp. As such, an investigation into off-ramps is not within the scope of this proceeding.

Environmental Defence Interrogatory #8

Interrogatory

Reference:
Exhibit D2, Tab 2, Schedule 1, Page 3

Preamble:

> "The successful completion of the Unit 2 refurbishment on budget and reasonably on schedule represented a significant achievement in mega-project execution for OPG."

Questions:

(a) Please provide the total budget figures and total actual spending figures underlying the above statement. Please provide this in a summary table, not a reference to another portion of the evidence.
(b) Please provide the forecast completion date versus the actual completion date. Please provide these in as much specific detail as possible.
(c) Please provide the interest cost arising from the schedule delay. Please confirm whether that amount is included in the amount referred to in (a).
(d) Please estimate the MWh that would have been produced by Unit 2 had it been completed on schedule versus the actual date.
(e) Please estimate the value of the MWh referred to in (d). Please confirm whether that amount is included in the amount referred to in (a).
(f) Please provide the total days out of service for Unit 2 forecast versus actual days out of service for the refurbishment.
(g) How many MWh can Unit 2 produce in 24 hours?

Response

a) The basis for the quoted statement is OPG's performance relative to the Unit 2 Execution Estimate, which is the baseline against which OPG measured its performance during the execution of the Unit 2 refurbishment. The requested table is provided below in Chart 1:

Chart 1

Description	Budget ($M)	Actual ($M)	Evidence References
Unit 2 itself (i.e. excluding the Definition Phase); includes both Capital and OM&A	3,417	3,417	Ex. D2-2-2, p. 2 and pp. 11-12

b) The forecast completion date of Unit 2 was February 15, 2020.[1] The actual completion date was June 4, 2020.

c) The interest included in the final cost of Unit 2 attributed to the unit being placed in-service on June 4, 2020 rather than February 15, 2020 is $46M. This amount is included in the amount provided in part a).

d) This is a hypothetical question which OPG must necessarily make assumptions to answer. In addition, the incremental production of Unit 2 should not be looked at in isolation as the return to service of Unit 2 directly impacted the start of Unit 3 refurbishment.

Had Unit 2 achieved its target return to service date of February 15, 2020, the Unit 3 refurbishment outage was scheduled to begin that same day. Instead, OPG made the decision to defer the Unit 3 shutdown date and Unit 3 would have operated until April 2, 2020.[2] Therefore, the net impact from the later return to service of Unit 2 and the resulting additional operating days for Unit 3 on Darlington production would have been approximately 1,214,000 MWh (1.2TWh). This net impact is the combined effect of an estimated 2,227,000 MWh (2.2 TWh) of reduced production from Unit 2 (based on actual performance for the first 110 days following the actual return to service), offset by an estimated 1,013,000 MWh (1.0 TWh) of additional production from Unit 3 (based on actual performance during the period February 15 – April 2).

e) OPG interprets the word “value” to mean the value of the generation to the Ontario electricity system. OPG cannot provide this information. Evaluation of the value of electricity to the Ontario electricity system is not an OPG accountability. Simulating the Ontario electricity market for past events would be the accountability of the Independent Electricity System Operator (“IESO”). OPG does not have access to

[1] As discussed in Ex. D2-2-2, Section 2, OPG measured its performance on Unit 2 versus the U2EE which was completed subsequent to the submission of the pre-filed evidence in EB-2016-0152. The high confidence target date for completion of Unit 2 against which OPG measured its performance was February 27, 2020. See Ex. D2-2-2, pp. 4-5.
[2] Subsequently, the Unit 3 refurbishment outage start date was deferred by a further 4 months as part of OPG’s response to the COVID-19 pandemic. See Ex. L-D2-02-Staff-135.

the historical data required to simulate the electricity market for the requested hypothetical historical analysis.

What OPG can provide is an estimate of the forgone revenue to OPG of the hypothetical change in generation. Based on OPG's nuclear net revenue margin (at base payment amount of $85.00/MWh for 2020 less fuel costs of $12M), the net forgone revenue from the approximately 2.2 TWh that would have been produced by Unit 2 during the period February 15, 2020 to June 4, 2020 as per part d) above is estimated at $177M, in isolation. When partly offset by approximately 1.0 TWh that would not have been generated by Unit 3 as per part d) above, the net forgone revenue value of the two impacts is approximately $97M.

This hypothetical revenue impact is not included in the costs shown in part a), as revenue impacts are not costs. This revenue shortfall was borne by OPG's shareholder and is not otherwise recoverable from customers.

f) The number of forecast out of service days for the refurbishment of Unit 2 was 1,218 and the actual out of service days was 1,328.

g) In 24 hours, Darlington Unit 2 can produce 21,072 MWh, if operating at 100% full power for the entire time, subject to any generation losses.