BUSINESS CASE SUMMARIES AND SUPPORTING INFORMATION

1.0 BUSINESS CASE SUMMARIES

Section 3.0 below provides a list of capital projects with a total project cost (actual or forecast) of $20M or greater. The business case summaries ("BCS") for the projects listed are attached[1]. Business case summaries are provided for all projects, with the exception of Security projects, as discussed in section 2.0 below.

2.0 SECURITY PROJECT DESCRIPTION AND NEED

This section provides a brief project description of any security-classified nuclear projects included in Ex. D2-1-3 Table 1, for which BCSs are not provided.

In all cases, the need for these projects is the requirement to meet Canadian Nuclear Safety Commission ("CNSC") security requirements, which are common to both Pickering and Darlington.

There is one security-related project included in Ex. D2-1-3 Table 1, as follows:

- Project 25609, Security Physical Barrier System: Install improved perimeter fencing system at Pickering and Darlington, including lighting, perimeter monitoring, and other required functions.

[1] OPG has requested confidential treatment of certain business case summaries under the OEB's Practice Direction for Confidential Information.

3.0 NUCLEAR BUSINESS CASE SUMMARY INDEX

Tab No.	Project Number	Business Case Summary (BCS) Title	BCS Approval Date
		ONGOING PROJECTS FROM EB-2013-0321	
1	25619	Darlington Operations Support Building Refurbishment	Aug-15
2	31412	Darlington Class II Uninterruptible Power Supplies Replacement	Sep-15
3	31508 49158 49299*	Darlington Fukushima Phase 1 Beyond Design Basis Event Emergency Mitigation Equipment	May-15
4	31717	Darlington Improve Maintenance Facilities	Mar-12
5	33621	Darlington Secondary Control Area Air Conditioning Unit Replacement	Aug-15
6	33631	Darlington Chiller Replacement to Reduce CFC Emissions	Sep-10
7	33819	Darlington Major Pump-sets Vibration Monitoring System Upgrades	Oct-15
8	33955	Darlington Shutdown System Computer Aging Management	Feb-15
9	33973	Darlington Standby Generator Controls Replacement	May-15
10	33977	Darlington Digital Control Computer Replacement / Refurbishment / Upgrades	Jun-13
11	34000	Darlington Auxiliary Heating System	Jul-15
12	36001	Darlington Primary Heat Transport Pump Motor Capital Spares	May-13
13	41023 49247	Pickering Unit 1 & 4 Fuel Channel East Pressure Tube Shift/Reconfigure	Sep-14
14	46634	Pickering A Fuel Handling Single Point of Vulnerability Equipment Reliability Improvement	May-12
		COMPLETED/DEFERRED/CANCELLED PROJECTS FROM EB-2013-0321	
15	49109	Pickering B Standby Generator Governor Upgrade	Mar-07
16	49285	Pickering Modify/Replace Fiber Reinforced Plastic Components During 2010 Vacuum Buiding Outage	Apr-10
17	62568	Feeder Repair by Weld Overlay	May-09
		PROJECTS NOT IN EB-2013-0321	

Tab No.	Project Number	Business Case Summary (BCS) Title	BCS Approval Date
18	31518	Darlington Restore Emergency Service Water and Firewater Margins	Feb-14
19	31524	Darlington Station Roofs Replacement	Nov-12
20	31532	Darlington Powerhouse Water Air Conditioning Units Replacement	Feb-15
21	31535	Darlington Water Treatment Plant Replacement	Oct-12
22	31542	Darlington Transformer Multi-Gas Analyzer Installation	May-15
23	31544	Darlington Radiation Detection Equipment Obsolescence	Jan-14
24	31552	Darlington Condenser Circulating Water and Low Pressure Service Water Travelling Screens Replacement	Jun-15
25	31710	Darlington Shutdown Cooling Heat Exchanger Replacement	Apr-14
26	31716	Darlington Neutron Overpower & Ion Chamber Amplifier Replacement (Reactor Regulating System, Shutdown System 1 & Shutdown System 2)	Oct-15
27	38948	Darlington Zebra Mussel Mitigation Improvements	Oct-15
28	73706	Darlington Highway 401 and Holt Road Interchange	Nov-13
29	80022	Darlington OH180 Aging Management Hardware Installation	Dec-14
30	80078	Darlington Digital Control, Common Process and Sequence of Events Monitoring Computer Aging Management	Nov-15
31	80111	Darlington Generator Stator Core Spare	Sep-15
32	82816	Darlington Vault Cooling Coil Replacement	Dec-15
33	73566 80144	Darlington Primary Heat Transport Pump Motor Replacement/Overhaul	Jul-15
34	40976	Pickering B Fuel Handling Reliability Modifications	Jun-15
35	41027	Pickering Fukushima Phase 2 Beyond Design Basis Event Emergency Mitigation Equipment	Aug-15
36	66600	Pickering IMS Machine Delivered Scrape	Jul-15

* Projects 31508, 49158 and 49299 are listed as two projects on Ex. D2-1-3 Table 1 (as #31508 and #49158/49299, and are combined in a single Business Case Summary).

ONTARIO POWER GENERATION

Records File Information:
Final Security Classification of the completed form is determined below
00120.3 - P For Nuclear
08707.021 - P For All Others

OPG-FORM-0077-R001*

Project Over-Variance Approval

Final Security Classification of the BCS: **OPG Confidential**

This form should not be used for over-variances in excess of 20% of cost or schedule or both. Submit this form with attachment of the latest approved Business Case Summary.

Part A: Project Information

Project #:	16-25619	**Title:**	Operations Support Building Refurbishment		
Phase:	Execution	**Class:**	Capital	**Records File:**	D-BCS-28110-10004

	LTD	2015	2016	2017	Future	Total
Current Approval	28,233k	23,949k	848k			53,030k
Amount Requested	-	8,773k	890k			9,663k
New Total Release	**28,233k**	**32,722k**	**1,738k**			**62,693k**

Brief Description of the Project:

The OSB was constructed in 1982 with the third floor added in 1988. It is an important facility that houses technical services essential to the business operations of Darlington (DNGS). These technical services include: site security systems, site information technology (IT) and telephone network hubs, quality assurance vault, station domestic water piping and radiological public domain access to the powerhouse via the bridge. A unique requirement for this project is to maintain the operation of these technical services amidst construction activities.

The facility has the capacity to house approximately 375 Darlington employees who provide daily operations, maintenance and administrative support to station and control room staff. An assessment by an external engineering firm determined that many of the existing building systems were expected to be life expired by 2015. These systems needed to be replaced to maintain a healthy environment for employees and essential technical services, as well as to minimize corrective maintenance on expired systems. The refurbished building is designed with energy efficiency and occupancy comfort in mind.

Reason for Schedule Variance:

The project is currently scheduled to meet the Available for Service milestone of October 30, 2015 as committed to in the execution-full BCS. There is a risk that challenges during the commissioning phase of the project could threaten this milestone. This risk is being mitigated through the hiring of a commissioning agent to execute this work in an efficient manner.

Reason for Cost Variance:

The EPC contract value budgeted in the execution-full business case summary (BCS) was $37.7M. The contractor is now forecasting to spend a total of $51.8M, not including any additional discovery issues and challenges during commissioning not yet known by the project team (for which $1.5M in contingency is now being requested to cover).

Of the $14.4M contract cost variance, $11.7M is attributed to the EPC Contractor underestimating the effort required to complete the contract scope. OPG is required to pay these additional costs since the contract is cost reimbursable. The variance is summarized by the following issues:

1) The design subcontractor was required to complete revisions to the design packages due to incomplete details from the original documentation.
2) The procured equipment and construction work required to complete the design revisions has now increased significantly beyond budget due to the design packages being complex.
3) The contractor is behind schedule compared to their original plan as documented in the contract, which has resulted in additional contractor project management and engineering field support.

The remainder of the contract cost variance can be linked to a few contract scope changes, totalling $2.7M. These changes include:

1) Upgrade of motor control electrical distribution equipment
2) Additional cabling and hardware to support changes to IT and telephone requirements
3) Changes to furniture and building layout requirements as requested by building occupants

*Associated with OPG-STD-0076, Developing and Documenting Business Cases

Project Over-Variance Approval

4) Upgrades to the fire separation of civil structures that were previously hidden
5) Repairs to the exterior walk ways and soffits
6) Other minor architectural, mechanical, electrical changes

In the execution- full release, $2.6M of specific contingency was included to cover the above EPC contract issues including the discovery of unknowns as well as the under-estimation of effort required to complete a building refurbishment.

During construction the project has realized some other specific risks, requiring the partial use of the contingency from the execution-full BCS.

1) Discovery and planned remediation of mould: $0.4M increase to budget ($0.7M contingency specified in BCS)
2) Hiring of a commissioning agent to ensure an efficient building start-up, minimizing the impact of commissioning issues on the overall project: $0.1M increase to budget ($1.1M contingency specified in BCS)
    a. The remainder of the commissioning risk has not yet been realized as this process is just beginning.

The remaining risks with specific contingency allocated from the execution-full BCS have either not yet been realized or have been mitigated without the need for utilizing contingency funding.

The project has also required additional support from OPG engineering to provide oversight of the EPC contract design subcontractor as they completed the design revisions. This has resulted in an increase of $0.5M to the project budget.

The project is still developing a list of spare inventories that will need to be procured by OPG to operate and maintain this facility once the project is complete. An initial list is being reviewed by the operations and maintenance team to ensure only required spares are eventually purchased. A preliminary estimate of the spare inventory costs is $50k.

Options Considered to Mitigate Overruns:

The project team has been performing weekly reviews of the EPC contractor's project cost, schedule and risks to validate assumptions and to help overcome challenges. As an example, the project team reduced the impact on critical path created by the fire detection design package revisions by securing stakeholder concurrence to procure and install fire detection devices with minimal probability that the design would change.

The project has also been having frequent meetings and walk downs with the project sponsor and other stakeholders to seek early resolution of deficiencies that would otherwise delay eventual turnover of the building to the operations and maintenance team.

As the design and construction work has evolved, the OPG project team has continually reviewed the project scope and removed specific scope items where possible. This includes:

1) The simplification of internal governance documentation requirements to align with commercial building applications
2) Utilizing more cost effective ceiling tiles
3) The removal of exterior light distribution shelves around the perimeter of the office space

The hiring of the expert commissioning agent is expected to yield efficiencies in the commissioning process as well as reduce the impact of discovered challenges when energizing equipment.

The project actual costs to date include invoices submitted by the EPC contractor that are being disputed by OPG. As such, there is an opportunity to remove $1.0M from the project costs if OPG is successful with the disputes.

When the project removed the existing motor control centre equipment prior to their replacement, the existing circuit breakers and associated electrical equipment were transferred to the maintenance department as useful spares. This obsolete equipment has become costly for the nuclear station to have reverse engineered. This effort may not mitigate the project overruns directly however it is expected to yield overall savings to OPG.

Project Status:

At the time of execution-full business case summary approval in May 2014, the project had been completing demolition and procuring schedule critical equipment and materials. Since then, the project has progressed with significant procurement and construction work, including:

1) Procurement of all schedule critical equipment and materials
2) Installation of the new exterior curtain wall and roof membrane, leaving the building water tight
3) Mechanical, electrical, instrumentation and controls systems installation throughout the 1st, 2nd and 3rd floors

Project Over-Variance Approval

4) Elevator and associated controls are fully operational with all regulatory approvals received
5) Substantial completion of furniture installation on the 2nd and 3rd floors
6) The motor control centres have been replaced and are operational.
7) Major mechanical equipment and associated piping such as chillers, ventilation units, pumps located in the basement has been installed.
8) Routing of IT and telephone cabling throughout the building in progress
9) Fire sprinkler system pipe work installation completed on 1st, 2nd and 3rd floors
10) Kitchen/cafeteria architectural finishes and mounting of equipment is complete.
11) Overhead lighting on the 1st, 2nd and 3rd floors is operational
12) Heating, ventilation and air conditioning system flushing and equipment commissioning is in progress

The above work has progressed with a good safety and environmental record and has been completed with no impacts to the essential services located in the building, nor creating an impact to the nuclear station electrical and mechanical systems that the OSB systems depend on.

ONTARIO POWER GENERATION

Records File Information:
Final Security Classification of the completed form is determined below
00120.3 - P For Nuclear
08707.021 - P For All Others

OPG-FORM-0077-R001*

Project Over-Variance Approval

Part B: Variance Detail				
k$	Current Approval	Amount Requested	Variance	Comments
OPG Project Management	4,298	3,627	(671)	Project management oversight on the project has required less effort than initially planned.
OPG Engineering (Including Design)	662	1,162	500	Revisions to the designs based on field challenges during construction have required an increase in the OPG design oversight.
OPG Procured Non-Fixed Assets (IT/Telephone)	895	1,000	105	Building occupants have identified additional IT equipment to be purchased.
OPG IT/Telephone Service Provider Installation Costs	470	500	30	Building occupants have identified additional IT equipment to be installed.
Design Contract(s)	596	596	0	All standalone design contracts have been completed.
Construction Contract(s)	0	0	0	All construction work is being completed as part of the EPC contract.
EPC Contract(s)	40,278	49,119	8,841	As discussed in the cost variance section.
Consultants	0	0	0	
EPC Procured Non-Fixed Assets (Furniture)	2,500	2,712	212	Building occupants have identified changes to the ground floor layout that requires some additional furniture to be procured. There were also minor changes to the design requiring changes to the furniture procured.
Interest	3,331	2,477	(854)	The amount of interest required was overestimated in the previous release. The updated interest from now until project completion is based on most recent cash flows.
Subtotal	53,030	61,193	8,163	
Contingency	0	1,500	1,500	Contingency is required for estimate inaccuracy and for the possible realization of unknowns, particularly during the commissioning phase.
Total	53,030	62,693	9,663	
Removal Costs Included	2,540	983	(1557)	The amount requested is based on the actual spent; no further removal costs planned.

*Associated with OPG-STD-0076, Developing and Documenting Business Cases

ONTARIO POWER GENERATION

Records File Information:
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08707.021 - P For All Others

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Project Over-Variance Approval

Part C: Review/Approvals			
	Signature	Comments	Date
Recommended by: Glenn Jager Chief Nuclear Officer Project Sponsor			August 7, 2015
Finance Approval: Beth Summers Chief Financial Officer		• REQUEST FOLLOW-UP TO UNDERSTAND ROOT CAUSES FOR FINAL VARIANCE	August 7, 2015.
Approved by: Tom Mitchell President and CEO Per OAR Element 1.1			AUG 8 2015

• This is over performance. A C2 SRR is to be issued and the results of the review to be presented to the CWO. In addition Art Rob is to present to the CWO where performance variance follow-up is required with OPG and vendor staff ~~management~~. At this point there is little opportunity to offset the costs.

Agree

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ONTARIO POWER GENERATION

Records File Information:
Records SCI/USI Retention
- See Guidance Section

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OPG-FORM-0076-R005*

Type 3 Business Case Summary

To be used for investments/projects meeting Type 3 criteria in OPG-STD-0076.

Executive Summary and Recommendations

Project Information			
Project #:	16-31412	**Document #:**	D-BCS-50320-10003
Project Title:	Darlington Class II Uninterruptible Power Supply Replacement		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Sustaining
Phase:	Execution	**Release:**	Partial
Facility:	Darlington	**Target In-Service or Completion Date:**	June 2025

Project Overview

We recommend the release of $10,450k including [redacted] contingency. The total release to date is $31,138k including [redacted] contingency.
The estimated total project cost is $55,064k including [redacted] of contingency.

The quality of the estimate for this release is Class 2, and for the total project is Class 3.

This release will fund the following scope of work:

- Installation Planning for Units 0, 1, 2, 3 and 4
- Installation of Uninterruptible Power Supplies (UPS) and associated equipment in the following Units and Channels:
  - Unit 0 120/208V Channel 'C'
  - Unit 0 347/600V Channel 'C'
  - Unit 1 120/208V Channel 'A'
  - Unit 1 347/600V Channel 'A'
  - Unit 2 120/208V Channel 'A' & 'B' & 'C'
  - Unit 2 347/600V Channel 'A' & 'B'
  - Unit 4 120/208V Channel 'B'
  - Unit 4 347/600V Channel 'B'

Scope remaining to be completed under the previous approved release includes:

- Unit 0, 1, 2, 3, 4 and Darlington Learning Centre (DLC) detail design and procurement of all UPS
- DLC test trainer UPS Installation

Problem Statement/Business Need:

The objective of this project is to restore the uninterruptible power supply equipment of the Class II Power system across the station to a reliable and maintainable state.

Restoration of the current UPS equipment of the Class II Power system to a reliable and maintainable state is necessary due to the following issues:

- Decrease in UPS equipment reliability.
- Insufficient number of spare parts.
- No support from the original equipment manufacturer (OEM).

Summary of Preferred Alternative:
The UPS equipment of the Class II Power system must be replaced in the near future with new reliable and maintainable UPS equipment as the existing UPS equipment is starting to reach the end of its service life. It is expected that the new equipment will allow for 20 years of operation after Darlington Refurbishment.

The Class II UPS supplies critical loads, including safety system instrumentation, digital control computers, emergency lighting,

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Type 3 Business Case Summary

Project #: 16-31412 Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Project Overview

cooling for critical equipment and others. It has the ability to switch between Class III supply and battery fed inverters.

History of BCS releases and project cost estimates:

- A partial definition phase D-BCS-50320-10001 was approved on 11 Jan 2011 releasing $1,057 k [redacted] base costs plus [redacted] contingency) to complete preliminary engineering and prepare the next execution phase business case summary (BCS). The total estimated cost of the project at the time was $19,370k (including [redacted] contingency)
- A subsequent partial definition and execution D-BCS-50320-10002 was approved on December 2, 2013 for $19,631k (including [redacted] contingency) for a total release of $20,688k (including [redacted] contingency). Total project cost was estimated at $38,442k (including [redacted] contingency).
- The total project cost is now estimated at $55,0644k including [redacted] of contingency, compared to $38,442k including [redacted] of contingency in previous release. This cost estimate is increased due to below reasons.

  (1) As per unit condition and installation window availability, the project schedule has been extended to six years for completion. Now it is planned to complete last installation in Q4-2023 compared to complete last installation in Q2-2018 as planned in previous BCS.
    a. Additional $1,498k in escalation due to delayed delivery of UPS equipment and vendor on site support as a result of the extended schedule.
    b. Additional $2,669k in escalation for EPC vendor to support extended project schedule.
  (2) $1,697k for additional engineering studies, testing and necessary modifications to existing equipments.
  (3) $585k for commissioning work plan.
  (4) $1,032k of vendor core team cost.
  (5) $3,295k additional OPG oversight required to support six years extended project schedule, additional project scope and $500K of underestimated cost in previous BCS.
  (6) $889k additional interest for increased project budget and extended schedule.

History of scope and schedule changes:

As per previous approved BCS it was planned to:

- Install Unit 0 Channel C (347/600V) UPS replacement in 2016 Tritium Removal Facility (TRF) outage.
- Install Unit 1, 2, 3 and 4 Channel A and B (120/208V and 347/600V) UPS replacement in planned station outages and Unit 1, 2, 3 and 4 Channel C (120/208V and 347/600V) UPS replacement online.
- Complete project in Q2-2019.

As per unit condition, detailed assessment and installation strategy meeting with System Responsible Engineer, Operations, Work Management, Control Maintenance and Outage Management the installation strategy has been revised as follows:

- Installation of Unit 0 Channel 'C' 347/600V UPS replacement during the 2017 TRF outage;
- Unit 0 Channel 'C' 120/208V UPS replacement to be executed online.
- Unit 0 Channel 'A' & 'B' 120/208V and 347/600V UPS replacement to be executed online.
- Unit 1, 2, 3 and 4 Channel 'A' & 'B' & 'C' 120/208V UPS replacement to be executed one at a time in unit outage or refurbishment
- Channel 'A' & 'B' 347/600V UPS replacement online or during refurbishment.
- Complete project in Q4-2023

Key Assumptions and Risks:

Exact dates for refurbishment outages for odd and even electrical buses are not known at this time. It is assumed that the installation window will be provided in the first year of each unit refurbishment outage. Any change will be treated as directed change.

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Type 3 Business Case Summary

Project #: 16-31412
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Document #: D-BCS-50320-10003

Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	3,793	3,734	5,914	1,915	4,771	561			20,888
Requested Now		1,072	570	8,808					10,450
Future Required					263	7,881	7,229	8,553	23,926
Total Project Cost	3,793	4,806	6,484	10,723	5,034	8,442	7,229	8,553	55,084
Ongoing Costs			35						
Grand Total	3,793	4,806	6,519	10,723	5,034	8,442	7,229	8,553	55,099

Estimate Class:	Class 2	**Estimate at Completion:**	[redacted]
NPV:	N/A	**OAR Approval Amount:**	$55,099k

Additional Information on Project Cash Flows (optional):
Financial evaluation was not performed as the project is classified as sustaining. For this release estimate is Class 2, and for the total project is Class 3.

Approvals

	Signature	Comments	Date
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Glenn Jager, President OPG Nuclear, Chief Nuclear Officer			15 JUL 2015
I concur with the business decision as documented in this BCS.			
Finance Approval: Beth Summers, Senior Vice President & Chief Financial Officer			AUG 10, 2015
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: ~~Tom Mitchell~~ Jeff Lyash, President & Chief Executive Officer, per OAR 1.1			Sept 3, 2015

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Records File Information:
Records SCI/USI Retention
- See Guidance Section

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OPG-FORM-0076-R005*

Type 3 Business Case Summary

Project #: 16-31412
Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Business Case Summary

Part A: Business Need

The purpose of this project is to restore the uninterruptible power supply (UPS) equipment of the Class II Power system across the station to a reliable and maintainable state.

Restoration of the current UPS equipment of the Class II Power system to a reliable and maintainable state is necessary due to the following issues:

- Decrease in UPS equipment reliability.
- Insufficient number of spare parts.
- No support from the original equipment manufacturer (OEM).

The UPS equipment must be replaced with new reliable and maintainable equipment during the next available planned outages in order to prevent future equipment failures and allow Darlington to operate for another 20 years after the Darlington Refurbishment program is complete.

The Class II UPS supplies critical loads, including safety system instrumentation, digital control computers, emergency lighting, cooling for critical equipment and others. It has the ability to switch between Class III supply and battery fed inverters. Twenty seven individual systems currently support Units 0, 1, 2, 3 and 4.

The oldest of these systems have been in-service for 26 years and represent 1970s era design. The design life of this equipment is 20-30 years [NK38-REP-50320-10008]. Five other CANDU plants have already replaced similar equipment on or before this nominal design life.

Significant declines in system reliability were arrested by a refurbishment program in 2006 [per EPRI - UPS Maintenance & Application Guide TR-100491 8-16]. A review of the frequency of corrective work orders demonstrated that this program significantly improved reliability but did not restore it to where it had been previously. Several key elements of the system were not subject to refurbishment due to parts issues. To recover reliability and maintain margins complete replacement of inverters, regulators, rectifiers and transfer switches is recommended.

Legacy design deficiencies were identified during the preliminary engineering phase (currently released). Project scope now includes resolution of Class II fuses not meeting clearing requirements listed in the system design requirements [Maximum feeder fuse size limited to UPS clearing capacity in ¼ cycle or 10% of full load current].

Part B: Preferred Alternative: Replace Class II power UPS equipment

Description of Preferred Alternative:

Replace the UPS equipment of the Class II Power system with new reliable and maintainable equipment in the existing location and footprint with the reactor unit online and during the next available planned, TRF or refurbishment outage with no or minimal distruption to the Class II Power system.
The UPS equipment of the Class II Power system must be replaced in the near future with new reliable and maintainable UPS equipment as the existing UPS equipment is starting to reach the end of its service life. It is expected that the new equipment will allow for 20 years of operation after Darlington Refurbishment.

Replacing the UPS equipment of the Class II Power system with new reliable and maintainable UPS equipment is expected to provide the following business results:

- New reliable and maintainable UPS equipment with appropriate warranty period.
- New UPS equipment will meet or exceed reliability requirements listed in the system design requirements.
- Spare parts will be identified and procured.
- UPS equipments will be state of the art technology used in other nuclear facilities.
- OEM will be available to support as required.
- System health rating of the Class II Power system will be maintained.

Preliminary engineering was completed by OPG under the definition releases; the remaining engineering, procurement and construction work will be completed by Extended Services – Master Service Agreement (ES MSA) vendor. The project estimate for design, procurement and construction is based on performance fee quotes received from ES MSA vendor.

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Type 3 Business Case Summary

Project #: 16-31412
Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Deliverables:	Associated Milestones (if any):	Target Date:
This Release (Phase II)		
Unit 4 Channel B (120/208V and 347/600V) AFS	AFS	31Mar2017
Unit 0 Channel C (120/208V and 347/600V) AFS	AFS	15Dec2017
Unit 1 Channel A (120/208V and 347/600V) AFS	AFS	31Mar2018
Unit 2 Channel A (120/208V and 347/600V) AFS	AFS	30Nov2018 (DNRU2)
Unit 2 Channel B (120/208V and 347/600V) AFS	AFS	30Nov2018 (DNRU2)
Unit 2 Channel C (120/208V) AFS	AFS	30Nov2018 (DNRU2)
Future Release BCS (Phase III)		
Unit 0 Channel A (120/208V and 347/600V) AFS	AFS	14Dec2018
Unit 0 Channel B (120/208V and 347/600V) AFS	AFS	13Dec2019
Unit 1 Channel B (120/208V and 347/600V) AFS	AFS	30Jun2022 (DNRU1)
Unit 1 Channel C (120/208V) AFS	AFS	30Jun2022 (DNRU1)
Unit 3 Channel A (120/208V and 347/600V) AFS	AFS	29Jan2021 (DNRU3)
Unit 3 Channel B (120/208V and 347/600V) AFS	AFS	29Jan2021 (DNRU3)
Unit 3 Channel C (120/208V) AFS	AFS	29Jan2021 (DNRU3)
Unit 4 Channel A (120/208V and 347/600V) AFS	AFS	31Jan2020
Unit 4 Channel C (120/208V) AFS	AFS	30Nov2023
Project Complete	PCM	30Jun2025

Part C: Other Alternatives

Alternative 2: Base Case – Do Nothing More

This option is not considered viable as it would not allow Darlington to operate for another 30 years after the Darlington Refurbishment program is complete

Alternative 3: Delay Work

This option is not considered viable as the UPS equipment of the Class II Power system has become obsolete and is reaching the end of its life as per industry standards. The UPS equipment of the Class II Power system should be replaced during the next available planned outage to prevent future UPS equipment failures that could lead to a forced outage.

Alternative 4: Maintenance and 10 to 12 year Refurbishment

This option is not considered viable as the UPS equipment of the Class II Power system has become obsolete and is no longer supported by the OEM. Some spare parts are available but not enough to complete a significant maintenance or refurbishment program to allow the UPS equipment to operate for another 30 years after the Darlington Refurbishment program is complete.

Type 3 Business Case Summary

Project #: 16-31412
Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Part D: Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	3,793	3,734	5,914	1,915	4,771	561			20,688
Requested Now		1,072	570	8,808					10,450
Future Required					263	7,881	7,229	8,553	23,926
Total Project Cost	3,793	4,806	6,484	10,723	5,034	8,442	7,229	8,553	55,064
Ongoing Costs			35						
Grand Total	3,793	4,806	6,519	10,723	5,034	8,442	7,229	8,553	55,099

Estimate Class:	Class 2	**Estimate at Completion:**	[redacted]
NPV:	N/A	**OAR Approval Amount:**	$55,099k

Additional Information on Project Cash Flows (optional):
Financial evaluation was not performed as the project is classified as sustaining. For this release estimate is Class 2, and for the total project is Class 3.

Part E: Financial Evaluation

k$	Preferred Alternative	Base Case	Delay Work	Alternative 4	Alternative 5
Project Cost	55,064	N/A	N/A	N/A	N/A
NPV	N/A	N/A	N/A	N/A	N/A
Other (e.g., IRR)	N/A	N/A	N/A	N/A	N/A

Summary of Financial Model Key Assumptions or Key Findings:
Financial evaluation was not performed as the project is classified as sustaining.

Part F: Qualitative Factors

Staff Relations

Reliable and maintainable UPS equipment for the Class II Power system will allow both Operations and Maintenance to complete their day to day job without dealing with unreliable UPS equipment, which would need a significant amount of their attention to deal with any issue that would arise.

Operational Considerations

If a UPS equipment failure would occur in the Class II Power system Operations and Maintenance would have to respond and operate the Class II Power system in an abnormal state. This may lead to a forced outage, which would be a further burden for Operations and Maintenance to deal with.

Reliability

The current UPS equipment of the Class II Power system is obsolete and no longer supported by the OEM. New reliable and maintainable equipment will prevent future UPS failures from occurring. The new UPS equipment would also be state of the art, used in other Nuclear facilities and supported by the OEM.

Type 3 Business Case Summary

Project #: 16-31412 Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation Probability	Post-Mitigation Impact
Cost	(a) There is a risk that legacy design deficiencies may be discovered as a result of detailed design and Class II power load review	Accept - legacy design deficiencies discovered will need to be resolved as part of the project. This will impact project budget. [redacted] contingency has been included to mitigate cost risk.	Low	Low
	(b) There is a risk that material cost may be higher due to change in exchange rate.			
	(c) There is a risk that OPG oversight cost may be higher than estimated.			
Scope	There is a risk that legacy design deficiencies may be discovered as a result of detailed design and Class II power load review	Accept - legacy design deficiencies discovered will need to be resolved as part of the project. This will cause a delay to the schedule.	Low	Low
Schedule	(a) There is a risk that the project may have to be accelerated if UPS equipment failures occur.	(a) Accept - If UPS equipment failures occurs the schedule will have to be accelerated resulting in increased costs.	Medium	Medium
	(b) There is a risk that inclusion of the UPS replacement scope in forthcoming unit refurbishment outage is not approved.	(b) Mitigate – Projects line management is in close coordination with refurbishment group to approve this project scope and confirm installation window.		
	(c) There is a risk that dates for refurbishment outages for odd and even electrical buses will not be provided in the first year of each unit refurbishment outage as assumed.	(c) Any change will be treated as directed change.		
	(d) There is a risk that the planned outages starting in 2017 will not be in spring as assumed.	(d) Any change will be treated as directed change		
Resources	There is a risk that securing resources from operations to complete a detailed load review of the Class II power system may be a problem.	Mitigate - The need for a detailed load review of the Class II power system will be discussed with senior management and the appropriate resources will be committed.	Low	Low
Quality/ Performance	There is a risk that installed equipment does not meet performance expectation.	Mitigate -Equipment is well proven in other applications & is standard off-the-shelf.	Low	Low
Technical	There is a risk that additional legacy design deficiencies may be discovered during detailed design or load review.	Mitigate - It's resonable to anticipate that additional legacy design deficiencies will be discovered during detail design.	Low	Low

Additional Risk Analysis:

Project Risk Management Guideline (RISK-G-01) has identified under assessments that this project requires extensive risk management. Project scope includes development of an extensive Risk Management Plan found in the Project Management Plan.

Due to staged equipment delivery, it is possible that the OEM may discontinue the selected UPS model in the future. This would result in design rework and impact to scope and schedule. UPS equipment storage requires controlled environments and some of the electronic parts need to be charged after one year; consequently, delivery of the UPS equipment has to be staged close to installation, which introduces the risk of obsolescence before the project is completed. This risk will be mitigated

Type 3 Business Case Summary

Project #: 16-31412 Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Additional Risk Analysis:

through confirming security of supply of the selected model with the OEM.

Reliable operation of the Class II buses and UPS throughout project evolution is essential to maintain nuclear safety and prevent significant production loss. Loss of a single Class II bus will cause a unit shutdown very quickly. If another shutdown system channel is already rejected for maintenance the shutdown will be immediate.

The staged replacement proposed in this release requires work in close proximity to live equipment, and safety, work protection, and technical issues require detailed risk assessments and may place constraints on design details.

Installation sequences and detailed load review will be required as the loads supplied by these systems are large. Agreement between the Project, Operations, Performance Engineering, and Nuclear Safety on what mitigating action, if any, may be required to safely execute the replacement.

Singleton loads are known to exist on Channel A and B 120/208 V Class II buses. It is believed that UPS replacement can be achieved without disruption to a Class II bus, but at any given time during replacement the division undergoing replacement will have one of its two supplies available and no capability to transfer to an alternate.

These replacements will require a turbine window in a unit outage due to unavailability of emergency turbine lube oil and emergency turbine seal oil as a result of battery outages required for the UPS replacements.

Part H: Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Comprehensive PIR	NOV-2023	JUN-2025

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
UPS equipment functional failures	Three functional failures noted in 2014.	Zero functional failure per year.	Number of UPS equipment functional failures reported per quarter in the Class II Power System Health Report.	System Engineer
Spare parts	Limited	Sufficient number of spares parts to perform maintenance or repairs as required.	Spare parts identified in detailed design procured and available prior to AFS.	System Engineer
OEM support	None	OEM available to support the UPS equipment.	Ability to form a contract with the OEM to support the UPS equipment.	System Engineer

Part I: Definitions and Acronyms

AFS: Available for Service
DLC: Darlington Learning Centre
EPC: Engineer, Procure, Construct
EPRI: Electrical Power Research Institute
ES MSA: Extended Services Master Service Agreement
IESO: Independent Electricity System Operator
OEM: Original Equipment Manufacturer
TRF: Tritium Removal Facility
UPS: Uninterruptible Power Supply

Type 3 Business Case Summary

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Type 3 Business Case Summary

Project #: 16-31412
Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

For Internal Project Cost Control

Internal Use Only
OPG-FORM-0076-R005

Type 3 Business Case Summary

Project #: 16-31412
Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Appendix A: Summary of Estimate										
Project Number:	16-31412									
Project Title:	Darlington Class II Uninterruptible Power Supply Replacement									
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Future**	**Total**	**%**
OPG Project Management	854	210	335	340	350	354	372	1,183	3,998	7
OPG Engineering (Design, DO & Performance)	305	180	180	185	160	165	165	550	1,890	3
OPG Procured Materials										
OPG Other (FE, CMO, CM, Operation)	34	15	249	253	255	260	260	835	2,161	4
Design Contract(s)	[redacted]									
Construction Contract(s)										
EPC Contract(s)										
EPC CORE TEAM										
Other Contracts/Costs										
Interest										
Subtotal										
Contingency										
Total	3,793	4,806	6,484	10,723	5,034	8,442	7,229	8,553	55,064	100

Notes			
Project Start Date	MAR-2010	**Total Definition cost** (excludes unspent contingency for Nuclear)	[redacted]
Target In-Service (or AFS) Date	NOV-2023	**Contingency included in this BCS** (Nuclear only)	
Target Completion Date	JUNE-2025	**Total contingency released plus contingency in this BCS** (Nuclear only)	
Escalation Rate	2%	**Total released plus this BCS without contingency** (Nuclear only)	
Interest Rate	5%	**Total released plus this BCS with contingency** (Nuclear only)	$31,138 k
Removal Costs	$75 k	**Estimate at Completion** (includes only spent contingency for Nuclear)	[redacted]

Prepared by:		Approved by:	
Shailesh Shah Project Manager Darlington Projects	Date 2015-07-07	Ricardo Fiorini Section Manager Darlington Projects	Date 2015-07-07

Type 3 Business Case Summary

Project #: 16-31412
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Appendix B: Comparison of Total Project Estimates and Project Variance Analysis

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in k$ (by year including contingency)						Future	Total Project Estimate
			2011	2012	2013	2014	2015	2016		
Definition	Full	OCT 2011	966	417	1,133	2,174	5,135	5,045	4,500	19,370
Execution	Partial	NOV 2013	343	445	272	3,285	4,594	12,000	17,510	38,442
Execution	Partial	APR 2015	343	445	201	2,804	4,806	6,484	39,981	55,064

Project Variance Analysis

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	854	3,877	3,998	121	$800K Field Engineering & Contract Management Officer cost is moved to OPG other.
OPG Engineering (including Design)	305	877	1,890	1,013	Additional OPG oversight cost required for additional scope and for six years extended project schedule.
OPG Procured Materials					
OPG Other (FE, CMO, CM, Operation)	34		2,161	2,161	Additional OPG oversight cost required for additional scope and for six years extended project schedule.
Design Contract(s)	[redacted]				
Construction Contract(s)					
EPC Contract(s)					
EPC CORE TEAM					
Other Contracts/Costs					
Interest					
Subtotal					
Contingency					
Total	3,793	38,442	55,064	16,622	

Type 3 Business Case Summary

Project #: 16-31412 Document #: D-BCS-50320-10003
Project Title: Darlington Class II Uninterruptible Power Supply Replacement, <Partial> <Execution> Release

Note 1:
UPS equipments storage requires controlled environment and some of the electronic parts needs to be energized after one year. Therefore, UPS equipments will be procured in stages as per the increased five years installation schedule.

Note 2:
As per initial assessment Unit 1, 2, 3 and 4 Channel A and B (120/208V and 347/600V) UPS replacement was planned together in station outages and Unit 1, 2, 3 and 4 Channel C (120/208V and 347/600V) UPS replacement was planned online.

After detailed assessment it was concluded that Unit 1, 2, 3 and 4 Channel 'A' & 'B' & 'C' 120/208V UPS replacement will be executed one at a time in unit planned outage or refurbishment and following Channel 'A' & 'B' 347/600V UPS replacement online or during refurbishment. Therefore whole project execution schedule has been extended by 5 years.

Note 3: $67k for Human Factor Engineering Plan.

PCA#	Title	Value
1	Install 347/600V test power supplies	$911k
2	347/600V MCC modification	$506k
3	Change in schedule requirements	$168k
4	Add two dedicated load banks	$28k
5	Perform ETAP study	$17k

Appendix C: Financial Evaluation Assumptions

Key assumptions used in the financial model of the Project are (complete relevant assumptions only):

Project Cost:
(1) Project will be an EPC contract
(2) [redacted] contingency cost is included.

Financial:
Financial evaluation is not required (optional) for sustaining project as per OPG-STD-0076

Project Life:
The expected service life of the new equipment should allow Darlington to operate for another 20 years after the Darlington Refurbishment program is complete.

Energy Production:
This project is to restore the uninterruptible power supply (UPS) equipment of the Class II Power system across the station to a reliable and maintainable state and has no role in energy production.

Operating Cost:
Financial evaluation is optional for sustaining project as per OPG-STD-0076.

Other: None

Appendix D: References

a) Master EC # 108973 (0,1,2,3,4-50320-Master Class II Power UPS Replacement)
b) D-PCH-50320-10001 (Replacement of Class II Uninterruptible Power Supplies)
c) NK38-REP-50320-10008 (Conceptual Design Report for the Class II UPS Replacement)
d) NK38-MDR-50320-10001 (Modification Design Requirements for Class II Power)
e) NK38-TS-50320-10001 (Class II Power Uninterruptible Power Supplies)
f) NK38-REP-50320-10009 (Class II Power UPS Replacement – Reliability Requirement Review)
g) NK38-DR-50300-10001 (System Design Requirements for Class I and II Power Systems)
h) NK38-DM-50320 (Class II Power Design Manual)
i) N-GUID-00120-10003 (Project Risk Management Guideline)
j) EPRI – UPS Maintenance and Application Guide TR-100491 8-16
k) NK38-MAN-09701-10005 Nuclear Refurbishment Planned Outage Management

Type 3 Business Case Summary

To be used for investments/projects meeting Type 3 criteria in OPG-STD-0076.

Executive Summary and Recommendations

Project Information			
Project #:	**Capital** | **MFA** 13-49299 | 13-49300 (P1-4) 13-49158 | 13-49159 (P5-8) 16-31508 | 16-31510 (DNGS)	**Document #:**	N-BCS-09013-10007
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☒ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Regulatory
Phase:	Execution	**Release:**	Partial
Facility:	Pickering Nuclear Generating Station (PNGS) Darlington Nuclear Generating Station (DNGS)	**Target In-Service or Completion Date:**	23-Dec-2017

Project Overview

We recommend the release of $45,393k, including [redacted] contingency to fund the capital part these projects. The Fukushima response projects also require an additional $6,033k in Minor Fixed Asset (MFA) funding release.

This Partial Release Business Case Summary (BCS) will bring the release-to-date to $99,158k including [redacted] contingency (Table 1). This is compared to the previous release of $53,738k, including [redacted] contingency. The MFA funding for the Fukushima response is now $11,695k compared to $5,662k in the previous release ($6,033k increase).

Table 1: Project Release Summary

RELEASE-TO-DATE (k$)				
	Pickering 1-4	**Pickering 5-8**	**Darlington**	**Release Total**
Capital	[redacted]			
MFA				
Subtotal				
Capital Contingency				
MFA Contingency				
Contingency *				
Total Capital	**12,772**	**34,437**	**51,949**	**99,158**
Total Release (including MFA)	**14,804**	**38,646**	**57,403**	**110,853**

AFS for all modifications is planned by December 2017. The project estimate at completion is $110,976k including [redacted] contingency (Table 2) for capital.

Table 2: Overall Project Summary

PROJECT COST (k$)				
k$	**Pickering 1-4**	**Pickering 5-8**	**Darlington**	**Project Total**
Project (Capital)	[redacted]			
MFA				
Subtotal (Base Cost)				
Capital Contingency				
MFA Contingency				
Contingency *				
Total Project Cost (Capital)	**17,051**	**40,988**	**52,937**	**110,976**
Total Project Cost (incl. MFA)	**19,083**	**45,197**	**58,391**	**122,671**

(*) Contingencies noted in Tables 1 and 2 above include both general and specific. See Appendix D for details.

*Associated with OPG-STD-0076, Developing and Documenting Business Cases

OPG Confidential

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Problem Statement/Business Need:

As a result of the event at the Fukushima Daiichi Nuclear Power Plant on March 11, 2011 and at the direction of the Canadian Nuclear Safety Commission (CNSC), Canadian Nuclear Power Plant operators undertook reviews which have confirmed the safety of the OPG Nuclear Fleet for all design basis events.

The bounding scenario for a Beyond Design Basis Event (BDBE) has been defined by OPG and its industry partners as a sustained and total loss of AC power with degraded site access and consequential loss of heat sinks resulting from the coincident failure of the Hydro One electrical system and the loss of existing standby and emergency generators at the nuclear stations. This approach is consistent with what has already been implemented/ planned by other Canadian nuclear utilities and nuclear operators in the United States.

In response to the CNSC Fukushima Action Items (FAI), OPG has undertaken actions to improve the capability to respond to a very low probability BDBE. The business objective of the Fukushima Phase 1 project is to address the station needs for make-up water and power within the first 72 hours following a BDBE in order to mitigate the very low possibility of severe fuel damage. In addition, the project is to provide back-up Emergency Mitigation Equipment (EME) to support a nuclear site in the event that a response to a BDBE is required.

The Fukushima Phase 1 project is fully integrated in providing the comprehensive solution for the BDBE and review level conditions (RLC) that are postulated for PNGS and DNGS. To ensure there is sufficient redundancy to mitigate large release in a BDBE, the EME being purchased is sufficient to ensure N+1 (i.e. one extra unit per site beyond the minimum required) and N+2 (one unit per site stored at alternately at PNGS or DNGS site to provide additional redundancy). Additionally, primary and alternate connection points are employed for the EME equipment.

The Phase I business objective is achieved by:

1. Acquiring new EME – portable diesel-driven make-up water pumps and portable diesel-driven generators,
2. Providing storage facilities for the EME,
3. Providing permanent connections to station equipment,
4. Revising operations and emergency response procedures, and
5. Providing power to maintain monitoring of critical parameters.

The scope and cost of the project has evolved in parallel with the lessons learned from the Fukushima event and the industry response to said event. The initial release scope was primarily an rapid response effort to the emergent issues raised by the Fukushima event. Since that initial release, the scope and cost of the project has evolved to reflect the lessons learned at Fukushima and align with developing industry practices for BDBE response. Areas where this has contributed to additional scope and cost from the original release include:

- Cancellation of the separate $10.6M Regional Response Centre (RERSC) project (13-28458) and replacement with actions at the each sites similar to action taken by the US and Europe, where the sister station will carry the N+2 equipment that would equivalently have been stored at their regional response centres. This sister station concept along with a mutual aid agreement in place with the other Canadian Nuclear facility allows OPG to maintain similar functionality as a regional centre would but for a lower cost. This change has resulted in incremental costs to the site projects of approximately $7M for an overall savings of $3.6M to OPG. [7, 8]
- Expansion of original design activities to include: additional assessment of existing plant equipment for availability and operability in a BDBE response, safe access to equipment under BDBE conditions, additional monitoring parameters, expansion or improvement of alternate connection points and permanent, dedicated connection points to provide for rapid deployment and minimize resource demands in an event.
- Refinement of scope resulting from preliminary engineering.
- Refinement of the approach to addressing review level conditions including augmented seismic, flood and wind assessments.

This evolution in scope is the basis for the overall estimate quality of Class 3. While many items are in service or in the installation phase, design is not yet complete for several items, and the scope arising from the cancellation of the regional response center is at a conceptual stage.

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Project Cash Flows, NPV, and OAR Approval Amount

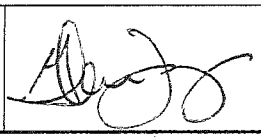
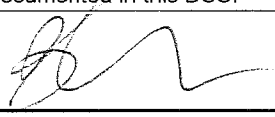
k$	LTD	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	34,752	16,062	2,767	168	16				53,765
Requested Now		13,521	31,674	184	14				45,393
Future Required		-	5,955	5,416	447				11,818
Total Project Cost	**34,752**	**29,583**	**40,396**	**5,768**	**477**				**110,976**
MFA	4,614	934	2,462	3,685	-				11,695
Ongoing Costs		400	817	824	833	841	848	1,692	6,255
Grand Total	**39,366**	**30,917**	**43,675**	**10,277**	**1,310**	**841**	**848**	**1,692**	**128,926**

Estimate Class:	Class 3	**Estimate at Completion:**	**110,976**
NPV:	Not Required	**OAR Approval Amount:**	**128,926**

Additional Information on Project Cash Flows (optional):

- These Project Cash Flows represent the sum of PNGS and DNGS cash flows. In Appendix A, a breakout of PNGS and DNGS Project Cash Flows is shown.
- Ongoing Costs are the incremental OM&A costs to support EME operation, testing and maintenance. Ongoing Costs from 2014 to 2022 are included in the above table, as per financial requirements.
- NPV is not required, as this is a Regulatory project

Approvals

	Signature	Comments	Date
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Glenn Jager Chief Nuclear Officer			7 MAY 2015
I concur with the business decision as documented in this BCS.			
Finance Approval: Beth Summers Chief Financial Officer			11 MAY 2015
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Tom Mitchell President & CEO per OAR 1.1			11 May 2015

ONTARIO POWER GENERATION

Records File Information:
Records SCI/USI Retention
- See Guidance Section

Type 3 Business Case Summary

Project #: 16-31508 | 16-31510
Document #: N-BCS-09013-10007
Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Business Case Summary

Part A: Business Need

As a result of the event at the Fukushima Daiichi Nuclear Power Plant on March 11, 2011 and at the direction of the Canadian Nuclear Safety Commission (CNSC), Canadian Nuclear Power Plant operators undertook reviews which have confirmed the safety of the OPG Nuclear Fleet for all design basis events.

OPG has also undertaken actions which will address conditions for beyond design basis events (BDBE) equivalent to those which occurred at Fukushima, in response to the CNSC Fukushima Action Items (FAIs). OPG and industry partners have developed a "bounding scenario" to assess overall station robustness against BDBE, which has been defined as a sustained and total loss of AC power with degraded site access and consequential loss of heat sinks which could lead to severe fuel damage. This event would require coincident loss of electrical supply from the provincial electrical power grid and the loss of existing standby and emergency generators at the nuclear stations.

OPG's strategic decision to manage this very low probability event is to secure portable EME to provide alternative means of supplying make-up cooling water to steam generators, heat transport systems, moderator systems, and irradiated fuel bays. The EME would also power the secondary control area and shutdown system room panels to maintain monitoring of critical safety parameters. This approach is consistent with what has already been implemented/ planned by other Canadian nuclear utilities and nuclear operators in the United States.

This project, Fukushima Phase 1, will include design changes to address the first 72 hours after a BDBE. The Phase 2 Fukushima project will include design changes for a progression to a more severe BDBE during the first 72 hours, or for a BDBE that lasts longer than 72 hours. A separate project BCS funds the Phase 2 Fukushima Project scope.

Part B: Preferred Alternative: Continue implementation of Phase I Fukushima Response

Description of Preferred Alternative: System modifications and EME procurement to facilitate BDBE Response

1. Provide permanent quick-connections to systems to allow connection to the acquired EME pumps for pumping water from intake ducts, channel, or lake locations into the:
   - Steam Generators (Boilers),
   - Heat Transport System,
   - Moderator System,
   - Irradiated Fuel Bays (IFB-B, IFB-A, and AIFB, DNGS East and West IFBs)
   - Shield Tanks (P5-8, DN).
2. Provide BDBE monitoring instrumentation for the IFB's. (PN, DN)
3. Procure portable EME under MFA funding to support EME reliability as outlined in [1, 4]. (PN, DN)
4. Provide storage facilities for EME equipment, including an alternative to the cancelled regional emergency response support center. (PN, DN)
5. EME upgrades to meet fuelling code requirements. (PN, DN)
6. Provide suction standpipes and modified cover plates to draw water from intake channels.
7. Provide permanent quick-connections to electrical systems for the EME emergency diesel generators and Portable Uninterruptible Power Supply (UPS) devices to power critical monitoring and control instrumentation in secondary control areas and Shut-Down System rooms. (PN, DN)
8. Provide required seismic reinforcing to the passive water system from the De-aerator to the Steam Generators via permanent modifications. (P5-8)
9. Provide required seismic reinforcing to the Class II power supplies that support Steam Relief valve (SRV) opening. (P58)
10. IFB portable Ventilation. (PN)
11. Provide a portable tool to actuate Motorized Valves, including D_2O isolation valves and H_2O injection valves. (PN)
12. Provide a means to measure end shield level in a BDBE. (DN)
13. Provide a means to enable latching of Instrumented Steam Relief Valves (ISRV's) in the absence of normal air and power supplies as a backup to operator action during calculated battery life. (DN)
14. Implement the ability to utilize the dousing water inventory for moderator makeup during a BDBE consisting of removal of NV537 internals and provision of a means to operate 0-72800-V542 without scaffold. (DN)

*Associated with OPG-STD-0076, Developing and Documenting Business Cases

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Part B: Preferred Alternative: Continue implementation of Phase I Fukushima Response
Description of Preferred Alternative: System modifications and EME procurement to facilitate BDBE Response
Note: Initial emergency response capability has already been declared available based on the EME and work completed under the initial partial release.

Part C: Alternative 1 – No Project
This is not an option as Fukushima Phase 1 project actions have been committed to the CNSC as recorded in Regulatory Management actions.
Alternative 2: Delay Work
This is not recommended. Delay of this work will not implement committed actions in support of BDBE response capabilities by year end 2017. These actions were undertaken to support the closure of the Fukushima Action Items.
Alternative 3: Hardened On-Site Power and Water Supply System
This alternative is a fully engineered, hardened on-site facility that would meet review level conditions (RLC) for BDBE, including RLC-tornado, RLC-seismic, and RLC-flood conditions per N-GUID-01130-10000.The cost for this alternative is much higher (potentially over $500M) and the implementation schedule is much longer due to a much higher work volume and the required coordination with station outages for portions of the work. This kind of redundancy is already provided by the design basis. Additional permanent plant equipment would not provide the additional diversity for a severe event that deployable, remotely stored equipment does.
Alternative 4:Not Applicable
N/A
Alternative 5:Not Applicable
N/A

Part D: Project Cash Flows

k$	LTD-2014	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	34,752	16,062	2,767	168	16				53,765
Requested Now		13,521	31,674	184	14				45,393
Future Required		-	5,955	5,416	447				11,818
Total Project Cost	**34,752**	**29,583**	**40,396**	**5,768**	**477**				**110,976**
MFA	4,614	934	2,462	3,685	-				11,695
Ongoing Costs		400	817	824	833	841	848	1,692	6,255
Grand Total	**39,366**	**30,917**	**43,675**	**10,277**	**1,310**	**841**	**848**	**1,692**	**128,926**

Estimate Class:	Class 3	**Estimate at Completion:**	**110,976**
NPV:	N/A	**OAR Approval Amount:**	**128,926**

Additional Information on Project Cash Flows (optional):

- These Project Cash Flows represent the sum of PNGS and DNGS cash flows. In Appendix A, a breakout of PNGS and DNGS Project Cash Flows is shown.
- Ongoing Costs are the incremental OM&A costs to support EME operation, testing and maintenance. Ongoing Costs from 2014 to 2022 are included in the above table, as per financial requirements.
- NPV is not required, as this is a Regulatory project.

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Part E:Financial Evaluation

k$	Preferred Alternative	Base Case	Delay Work	Alternative 3	Alternative 4
Project Cost	117,873	N/A	N/A	> 500,000	N/A
NPV	N/A	N/A	N/A	N/A	

Summary of Financial Model Key Assumptions or Key Findings:

NPV is not applicable as this is a Regulatory project.

Part F:Qualitative Factors

Regulatory: The initial qualitative factor will be to meet OPG actions undertaken as part of the Fukushima Action Items which have been submitted to the regulator proactively by OPG.

Community Relations: Project demonstrates to the public that OPG is applying lessons learned from the Fukushima event in a timely manner.

Part G:Risk Assessment :

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	1. Cost growth due to refinement of industry, regulatory and station approaches to BDBE response. 2. Incomplete design packages at time of estimate may result in cost increase. 3. The Instrumented Steam Relief valve (ISRV) tool is assumed to be a tool as opposed to a permanent modification to the plant. Conceptual design is still under review.	1. Accept – General contingency included to address this. 2. Accept – General contingency included to address this. 3. Accept – Adoption of a concept requiring plant modifications, especially modification or the ISRV's themselves may increase schedule and cost.	Medium	Low
Scope	1. Existing Seismic Margin Assessments (SMA) may not cover all associated Review Level Conditions (RLC) per N-GUID-01130-10000 for all systems, structures and components used in BDBE response. 2. Scopes for some modifications have limited definition which may lead to EPC contract changes. 3. Changes to industry, regulatory and station requirements may result in scope changes.	1. Mitigate – Additional assessments to be added if gaps are found during design activities. An overall review of existing assessments has been included in Phase II. 2. Accept – General contingency included to address this. 3. Accept – General contingency included to address this.	Medium	Low

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Part G:Risk Assessment :

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
Schedule	1. Compliance to online and outage prerequisite milestones for the implementation of the modifications may be challenged in order to satisfy regulatory, industry and public expectations for timely response to the BDBE issue. 2. Modifications affect critical plant systems and assumed installation windows, including access to outage windows, are subject to change. 3. A significant amount of implementation work is planned in 2015 at DNGS. This is a vacuum building outage (VBO) year at DNGS. Resource constraints in the period before during and after the VBO may cause delays in work planning and execution. 4. This BCS reflects a spring 2015 VBO date. A delay to the 2015 VBO was announced on Feb 6, 2015, too late for a full assessment of the impacts on this plan. 5. Several designs require Emergency Power System (EPS) power supplies. Access for tie-ins to these supplies may significantly impact installation schedules where conflicts with other station work or conditions arise. This has already has significant impacts on the EPS Phase I modifications. Completion of EPS quick connects has conflicts with major EPS work at DNGS in 2015. 6. Many of the 2014 designs were issued in a phased release. Delays to the final design release will directly impact installation schedule. 7. Seismic robustness scope for battery room electrical equipment may require an outage for implementation depending on final design solution.(PN) 8. Recently identified additions to the list of critical safety parameters may require unit outages for installation. Current plan assumes that online installation is feasible. This risk applies to the end shield cooling instrumentation at DNGS as well. 9. The site for a second EME storage structure at DNGS is not yet determined.	1. Mitigation – Scope to be identified to work management based on contract schedule, and recovery plans issued early for work that may not meet pre-installation milestones as identified in N-PROC-MA-0013 and N-PROC-MA-0022. 2. Accept – Recovery plans will be formulated where required. 3. Accept – If VBO is delayed or prolonged this could place 2015 completions at risk. Delays due to availability of station support groups may occur. 4. Accept: Once VBO dates are fully defined, impacts on the plan from the new outage dates and alignment with other work programs also affected by VBO will be addressed through recovery plans and the project change process (PCRAF's). 5. Mitigate – Close coordination with the station work management and/or work control to minimize risk. PUPS tie-ins final unit may push to 2016. 6. Mitigate – Increased oversight and close coordination with the EPC vendor and Design to finalize and manage schedule. 7. Mitigate – Close coordination with the EPC vendor and Design during design process to determine if outage will be required to implement Seismic Robustness modification, interface with work management early in process and add work orders to outage scope as appropriate. 8. Mitigate – The need for outage installation will be considered during COMS and Design reviews. 9. Mitigate-: expedite schedule to determine and secure site for building.	High	Medium

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Part G:Risk Assessment :

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
Resources	1. Availability of OPG work group resources to support contractor during Engineering Change Control (ECC) process and contract interface requirements due to large volume of vendor submissions. 2. Station resource conflicts are expected throughout 2015 due to the VBO at DNGS. VBO will be the station's top priority during that period.	1. Mitigate – EPC schedule to incorporate staggered reviews where possible to minimize OPG work group resource requirements. Internal design resources are utilized to support priority modifications. Additional resources may be required to provide additional oversight. 2. Mitigate – reconfigure schedule and resources to avoid conflict with VBO.	High	Medium
Quality/ Performance	1. The large volume of work and compressed schedule may affect the work quality.	1. Mitigate – OPG Oversight Plan will include activities to prevent or reduce quality issues. Work has been planned to reduce the number of concurrent modifications.	Low	Medium
Technical	1. Outcome of Probabilistic Risk Assessment (PRA) reviews may add new requirements for deployment time of EME equipment and impact design (may also impact scope above) 2. No location has been approved for the DNGS N+2 storage facility. Limited potential sites may constrain design or preclude 'duplicate" designs at both sites.	1. Accept – Contingency has been included to address this concern. 2. Accept – Final location may constrain the building design.	Low	Medium

Additional Risk Analysis:

Regulatory

Description: The industry OPEX on required BDBE capabilities is still evolving and it could potentially influence changes in the regulatory requirements resulting in changes in project scope.

Mitigation: CNSC has been kept up to date with all implementation strategies via correspondence by the Fukushima Project group. This project is supported at senior management level.

Part H:Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Comprehensive PIR	2017-12-31	2018-12-14

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
PNGS				
CNSC Regulatory approval/acceptance	Fukushima Actions Items (FAIs)	No related FAIs or FAI follow up actions outstanding.	Action item closure	Regulatory Affairs
• Emergency Response Capability for Steam Generator (SG's) make-up to	No initial capability	Demonstrate deployment and simulated hookup of EME to get water/power to	BDB Drill with EME deployment and simulated connection performed and evaluated	Manager, Emergency Preparedness

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
quick connect • Emergency Response Capability for Heat Transport (HT) make-up to quick connect • Emergency Response Capability for Moderator make-up to quick connect • Emergency Response Capability for P5-8 End Shield Cooling make-up to quick connect • Emergency Response Capability for Drawing Water from Intake Channels via Standpipes and Modified Cover Plates • Emergency Response Capability for Critical Parameter Monitoring • Emergency Response Capability for Irradiated Fuel Bay (IFB) make-up and monitoring • Emergency Response Capability for Motorized Valve Actuation via MV Tool		identified system. Target: 4 hours. Max Time Allowable: 8 hours IFB Target: 15 hours Max Time Allowable: 40 hours		
EME Storage Building(s) in service	No initial facility	Storage for all EME (N, N+1, N+2) equipment	Facility in Service	Manager, Facilities
DNGS				
CNSC Regulatory approval/acceptance	Fukushima Actions Items (FAIs)	No related FAIs or FAI follow up actions outstanding.	Action item closure	Regulatory Affairs
New capabilities: • Emergency Response Capability for Steam Generator	No initial capability	Demonstrate deployment and simulated hookup of EME to get water/power to	BDB Drill with EME deployment and simulated connection performed and evaluated	Manager, Emergency Preparedness

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
(SG's) make-up to quick connect • Emergency Response Capability for Heat Transport (HT) make-up to quick connect • Emergency Response Capability for Moderator make-up to quick connect • Emergency Response Capability for Drawing Water from Intake Channels via Standpipes. • Emergency Response Capability for End Shield Cooling make-up to quick connect • Emergency Response Capability for Critical Parameter Monitoring • Emergency Response Capability for Irradiated Fuel Bay (IFB) make-up and monitoring		identified system. Target: 2 hours Max Time Allowable: 8 hours IFB Target: 15 hours Max Time Allowable: 40 hours		
EME Storage Building(s) in service	No initial facility	Storage for all EME (N, N+1, N+2) equipment	Facility in Service	Manager, Facilities

Notes:
Target result durations based on targets identified in N-CORR-09013-0462534: Fukushima Project Beyond Design Basis Phase 1 - EME Deployment Streamlining Opportunities

Part I:Definitions and Acronyms
BDBE – Beyond Design Basis Event
BDB Drill – Beyond Design Basis Drill
DNGS – Darlington Nuclear Generating Station
EME – Emergency Mitigation Equipment
ECC Engineering Change Control
EPC – Engineering, Procurement and Construction
EPS Emergency Power System
ERT – Emergency Response Team
ESC – End Shield Cooling System

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Part I:Definitions and Acronyms
ESW – Emergency Service Water
FAI – Fukushima Action Item
FMOD – facilities Modification
IOP – Integrated Operational Planning
OPEX – Operating Experience
PNGS – Pickering Nuclear Generating Station
RLC – Review Level Condition
RLE – Review Level Earthquake
SCO – Station Containment Outage
SMA – Seismic Margin Assessment
VBO – Vacuum Building Outage

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

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Type 3 Business Case Summary

Project #:	13-49299, 13-49158 & 16-31508 (Capital) 13-49300 13-49159 & 16-31510 (MFA)
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Document #: N-BCS-09013-10007

For Internal Project Cost Control

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Attachment A: Pickering 1-4 and 5-8 Phase I Deliverables

Previous BCS Deliverables	Status
(1) Procure EME and establish initial response procedures	Initial capability (EME and response procedures) in place for water to boilers, Heat transport, Moderator and power to critical monitoring. Additional EME and for backup (N+1/N+2) and to support additional modifications is ongoing.
(2) Provide Water to Steam Generators	AFS complete for P1-4 and P5-8
(3) Provide Water to Heat Transport System (HTS)	Design complete
(4) Provide Water to the Moderator	Design complete
(5) Provide Water to Irradiated Fuel Bays including temperature, level and radiation monitoring, as well as ventilation.	Design complete for IFB-B temperature and level monitoring
(6) Provide Water to P5-8 End Shield Cooling System	Design complete
(7) Provide Additional Power for Critical Monitoring	Design complete for initial set of critical safety parameters AFS complete for P1471 scope
(8) Provide Seismic reinforcing to the Class II power supplies that support SRV opening, as well as seismic reinforcing to the passive water system from the De-aerator to the Steam Generators via permanent modifications	Design complete for non-outage modifications
(9) Provide storage facilities for EME equipment, including an alternative to the cancelled regional emergency response support center	Initial EME storage building complete
(10) Provide Suction Standpipes and Modified Cover Plates to Draw Water from Intake Channels	Design complete for Standpipes Installation complete for Modified Cover Plates
(11) Addition of Equipment Tie down modifications to the EME building	AFS complete
(12) EME upgrades to meet fuelling code requirements. (PN, DN)	In Progress

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Attachment A: Darlington Phase I Deliverables	
Deliverables	**Status**
(1) Procure EME and establish initial response procedures.	Initial capability (EME and response procedures) in place for water to boilers, Heat transport, Moderator and power to critical monitoring. Additional EME and for backup (N+1/N+2) and to support additional modifications is ongoing.
(2) Provide EME Storage Building	Complete
(3) Provide a second EME storage facility.	New Scope
(4) Addition of Equipment Tie down modifications to the EME building.	Complete
(5) Provide Water to Heat Transport System (HTS).	Design Release I complete. Release II in 2015. Installation planned for 2016.
(6) Provide Water to Boilers.	Design Complete. Installation 50%. Valve 226 connection could not obtain online isolations. Remainder of connection point to be installed in 2015 VBO.
(7) Provide Water to the Moderator.	Design Complete. Installation 50%. Valve 226 connection could not obtain online isolations. Remainder of connection point to be installed in 2015 VBO.
(8) Removal of 0-73000-NV537 to make dousing water inventory available for moderator makeup.	Design complete. Installation planning in progress. New scope identified to provide secure access for required valve line up (See below)
(9) BDBE Access for V542 (Dousing water flow to ESW flow path)	New Scope. Also includes additional analysis to loads others other than moderator.
(10) Provide Additional Power for Critical Monitoring.	Design Complete. Installation in progress.
(11) Provide Suction Standpipes to Draw Water from Intake Channels.	Design Complete. Installation planned for 2016.
(12) Provide Water Addition and Level Monitoring Capability for the End Shield Tank.	Release I design for water addition accepted. Level monitoring scope under review to remove outage requirement and reduce cost.
(13) Provide Water to Irradiated Fuel Bays including temperature, level and radiation monitoring	Detail Design in Progress. Release 1 accepted in Dec 2014.
(14) Provide a means to ensure latching capability for the Instrumented Steam Relief Valves (ISRV's) in the event of Delayed Operator Response or Reduced battery Capacity	Conceptual design in progress. This scope was change from a permanent remote latching system for the ISRV's due to high costs for modifying the existing boiler relief valves.
(15) Provide Seismic reinforcing of each de-aerator storage tank (DST) flow path to ensure boilers can use the approximately 5 hours of passive water inventory.	Design release I complete. Analysis identified an additional support modification required, design in progress. Installation planned for 2015/2016.
(16) Site Restoration work for the EME building site.	Complete
(17) Pump Deployment area improvements.	Planned for 2015.

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Deliverables:	Associated Milestones	Target Date:
P1-4 (Current Release)		
IOP Design Complete MV Tool	Detailed Engineering Complete (ECP)	29-Jan-2016
IOP Design Complete-Additional Injection Point to Moderator	Detailed Engineering Complete (ECP)	28-Jan-2016
IOP Design Complete-IFB-A/AIFB (Anchor/Monitoring/Ventilation)	Detailed Engineering Complete (ECP)	19-Feb-2016
AISC Disposition for Full Release	AISC Disposition for Full Release (ASC)	30-May-2016
OAR Approval for Full Release (Board)	Full Release Funding (FRF)	30-Jun-2016
Power to Critical Monitoring (U1 & U4)	Available for Service (AFS)	P1511 P1641
MV Tool (U1 & U4)	Available for Service (AFS)	
MV Tool UPS (IOP)	Available for Service (AFS)	15-Jun-2017
Water to Moderator	Available for Service (AFS)	17-Sep-2016
Provide Water from Intake Channels (cover plate)	Available for Service (AFS)	2-Apr-2015
P1-4 *Future Release (not covered by this release)*		
PNGS Irradiated Fuel Bays (IFB-A & AIFB) – Anchor, Temp, Level, Gamma monitoring & Ventilation	Available for Service (AFS)	25-Feb-2017
Additional Injection Point to Moderator	Available for Service (AFS)	17-Sep-2016
P5-8 (Current Release)		
EME Building II	Preliminary Design (DES)	Nov 20, 2015
Outage Re-Design Completed-Seismic Robustness Battery Room U5, U6,U 7 & U8	Detailed Engineering Complete (ECP)	30-Nov-2015
IOP Design Completed-IFB-B (Anchor/Monitoring/Ventilation)	Detailed Engineering Complete (ECP)	18-Jun-2016
Power to Critical Monitoring (Outage)	Detailed Engineering Complete (ECP)	30-Nov-2015
MV Tool (U5, U6 & U8)	Available for Service (AFS)	P1551 P1561 P1681
Power to Critical Monitoring (U5, U6, & U8)	Available for Service (AFS)	
Water to Shield Tanks (U5, U6 & U8)	Available for Service (AFS)	
Seismic Robustness Battery Room	Available for Service (AFS)	P1681
Seismic Robustness (IOP)	Available for Service (AFS)	20-Oct-2016
PNGS Irradiated Fuel Bay (IFB-B) – Anchor, Temp, Level, Gamma monitoring & Ventilation	Available for Service (AFS)	25-Feb-2017
Provide Water from Intake Channel (standpipe plate)	Available for Service (AFS)	23-Sep-2016
Water to Heat Transport (V16)	Available for Service (AFS)	21-Aug-2016
Water to Moderator (NV18)	Available for Service (AFS)	22-Sep-2016
P5-8 Future Release (not covered by this release)		
Seismic Robustness Battery Room[2] (U5, U6, U7)	Available for Service (AFS)	P1671 P1751 P1761
Power to Critical Monitoring (U5, U7)	Available for Service (AFS)	P1671 P1751
MV Tool (U7)	Available for Service (AFS)	P1671
Water to Shield Tanks (U7)	Available for Service (AFS)	
IOP Seismic Robustness	Available for Service (AFS)	2-Dec-2016
EME Building II	Available for Service (AFS)	30-May-2017

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Deliverables:	Associated Milestones	Target Date:
DNGS (Current Release)		
End Shield Water Addition [2]	Engineering Complete (ECP)	July 30,2015
DA Seismic[2]	Engineering Complete (ECP)	July 30,2015
IFB Modifications[2]	Engineering Complete (ECP)	May 22, 2016
ESC Modifications (Instrumentation)[2]	Engineering Complete (ECP)	Feb 28,2016
ISRV Tool	Engineering Complete (ECP)	Dec 15, 2015
PHT Tie Ins	Engineering Complete (ECP)	Sept 17,2015
NV537 (Access modifications) [1,2]	Engineering Complete (ECP)	Jul 30, 2016
Standpipes	Start of Installation (SOI)	April 30,2016
ESW	Available for Service (AFS)	Dec 15,2015
EPS Phase I (600V Generator Connections)	Available for Service (AFS)	Jun 30 ,2016
NV537 Internals removal	Available for Service (AFS)	Jul 1,2016
EME Building II	Preliminary Design (DES)	Jul 1, 2016
DNGS Future Release (not covered by this release)		
NV537 – Access[1]	Available for Service (AFS)	Dec 1,2016
PHT Connections	Available for Service (AFS)	Sep 30,2016
End Shield Water Addition[4]	Available for Service (AFS)	Dec 1, 2016
ISRV Tool[5]	Available for Service (AFS)	Dec 1, 2016
DA Seismic	Available for Service (AFS)	Dec 1, 2016
End Shield Instrumentation [3]	Available for Service (AFS)	Dec 1,2016
IFB Monitoring	Available for Service (AFS)	Sep 30,2017
EME Bldg II	Available for Service (AFS)	May 30,2017
Project Closeout (DN)	Project Closeout (PCO)	Jun 30, 2018
Notes to deliverables:		
Note 1: NV removal is planned for 2015.This milestone resolves operator access issues identified in [2]. Note 2: Release 1 of these modifications was completed in 2014. Note 3: (Instrumentation) – Final Unit, assumes outage not required. Note 4: Water Connections, Final Unit. Held to next release pending release II of design. Note 5: ISRV Latching Scope has been cancelled. Tool scope will begin design in 2015. [3]		

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Appendix A: Pickering (A and B) and Darlington Fukushima Phase I Projects Summary									
Project Number:	13-49299 (PNGS A), 13-49158 (PNGS B), 16-31508 (DNGS)								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
OPG Project Management	3,130	952	961	434	124			5,601	5%
OPG Eng. & Support	4,412	1,750	1,175	424	31			7,792	7%
EPC Contract(s)	[redacted]								
Materials (OPG)									
Other Contracts/Costs									
Interest									
Subtotal									
Contingency									
Total	**34,752**	**29,583**	**40,396**	**5,768**	**477**			**110,976**	**100%**

Appendix A: Pickering (A and B) and Darlington Fukushima Phase I MFA Projects Summary									
Project Number:	13-49300 (PNGS A), 13-49159 (PNGS B), and 16-31508 (DNGS)								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
MFA	4,614	934	2,462	3,685				11,695	100%
Subtotal	**4,614**	**934**	**2,462**	**3,685**				**11,695**	**100%**
Contingency	-	-	-	-				-	-
Total	**4,614**	**934**	**2,462**	**3,685**				**11,695**	**100%**
Removal Costs Included	-	-	-	-				-	-

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Appendix A:Summary of Estimate Pickering A									
Project Number:	13-49299								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
OPG Project Management	1475	244	243	132	22			2,116	12%
OPG Eng. & Support	577	488	361	170	16			1,612	9%
EPC Contract(s)	[redacted]								
Materials (OPG)									
Other Contracts/Costs									
Interest									
Subtotal									
Contingency									
Total	**4,054**	**5,059**	**6,159**	**1,733**	**46**			**17,051**	**100%**

Appendix A:Summary of Estimate: Pickering 1-4 (13-49300) MFA									
Project Number:	13-49300								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2,015**	**2,016**	**2,017**	**2,018**	**2,019**	**Future**	**Total**	**%**
MFA	904		174	954				2,032	100%
Subtotal	**904**		**174**	**954**				**2,032**	**100%**
Contingency	-		-	-				-	-
Total	**904**		**174**	**954**				**2,032**	**100%**
Removal Costs Included	-		-	-					

Appendix A:Summary of Estimate Pickering B									
Project Number:	13-49158								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
OPG Project Management	410	263	361	238	102			1,374	3%
OPG Eng. & Support	1,216	776	541	184	15			2,732	7%
EPC Contract(s)	[redacted]								
Materials (OPG)									
Other Contracts/Costs									
Interest									
Subtotal									
Contingency									
Total	**13,663**	**9,986**	**13,861**	**3,047**	**431**			**40,988**	**100%**

Appendix A:Summary of Estimate: Pickering B MFA									
Project Number:	13-49159								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
MFA	1,850	120	692	1,547				4,209	100%
Subtotal	**1,850**	**120**	**692**	**1,547**				**4,209**	**100%**
Contingency	-	-	-	-				-	-
Total	**1,850**	**120**	**692**	**1,547**				**4,209**	**100%**
Removal Costs Included	-	-	-	-				-	-

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Appendix A:Summary of Estimate Darlington									
Project Number:	16-31508								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
OPG Project Management	1,245	445	357	64				2,111	4%
OPG Eng. & Support	2,619	486	273	70				3,448	7%
EPC Contract(s)	[redacted]								
Materials (OPG)									
Other Contracts/Costs									
Interest									
Subtotal									
Contingency									
Total	**17,035**	**14,538**	**20,376**	**988**				**52,937**	**100%**

Appendix A:Summary of Estimate: Darlington MFA									
Project Number:	16-31510								
Project Title:	Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME)								
k$	**LTD**	**2015**	**2016**	**2017**	**2018**	**2019**	**Future**	**Total**	**%**
MFA	1860	814	1596	1184				5454	100%
Subtotal	**1860**	**814**	**1596**	**1184**				**5454**	**100%**
Contingency	-	-	-	-				-	-
Total	**1860**	**814**	**1596**	**1184**				**5454**	**100%**
Removal Costs Included	-	-	-	-					

Appendix A: Release History

Project # Description	Previous Release			Requested Now			Released-to-date		
[$k]	Base Cost	Contingency	Total	Base Cost	Contingency	Total	Base Cost	Contingency	Total
13-49299: Pickering A Capital	[redacted]		10,290	[redacted]		2,482	[redacted]		12,772
13-49158: Pickering B Capital			21,666			12,771			34,437
Pickering Subtotal:			31,956			15,253			47,209
13-49300: Pickering 1-4 MFA			954			1,078			2,032
13-49159: Pickering 5-8 MFA			2,323			1,886			4,209
Pickering Grand Total			35,233			18,217			53,450
16-31508: Darlington Capital			21,809			30,140			51,949
Darlington Subtotal:			21,809			30,140			51,949
16-31510: Darlington MFA			2,385			3,069			5,454
Darlington Grand Total			24,194			33,209			57,403
TOTAL (Capital)			53,765			45,393			99,158
GRAND TOTAL			59,427			51,426			110,853

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Notes			
Project Start Date	2011-09-21	Total Definition cost (excludes unspent contingency for Nuclear)	[redacted]
Target In-Service (or AFS) Date	2017-12-23	Contingency included in this BCS (Nuclear only)	
Target Completion Date	2019-01-30	Total contingency released plus contingency in this BCS (Nuclear only)	
Escalation Rate	3.00%	Total released plus this BCS without contingency (Nuclear only)	
Interest Rate	5.00%	Total released plus this BCS with contingency (Nuclear only)	$99,158k
Removal Costs	$0	Estimate at Completion (includes only spent contingency for Nuclear)	[redacted]

Prepared by:	Approved by:
Ahmed Smaili Section Manager, Projects	Nahil Rahman Director, Pickering Projects
Brian Graham Section Manager, Projects	Ray Balachorek Manager, Design Projects

Appendix B:Comparison of Total Project Estimates and Project Variance Analysis

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in k$ (by year including contingency)						Future	Total Project Estimate
			2012	2013	2014	2015	2016	2017		
Definition	Partial	9/13/2011	16,687	6,787	2,966	2,371	-	-	-	28,811
Definition/ Execution	Partial	7/20/2012	14,348	10,802	5,334	3,850	100	-	-	34,434
Definition/ Execution	Partial	9/18/2013	13,766	9,813	19,583	7,742	124	-	-	51,029
Definition/ Execution	Partial 1	10/18/2013	12,718	13,303	33,380	13,218	3,008	42	-	75,669
Execution	Partial	Requested	-	-	34,752	29,583	40,396	5,768	477	110,976

Note: The 2013-09-18 release was a DNGS only release. Prior PNGS release numbers are added to this release for comparison purposes.

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Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Project Variance Analysis: Pickering A

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	1,475	1,551	2,116	565	Increased OPG Oversight to support schedule recovery
OPG Eng. & Support	577	1,899	1,612	-287	
EPC Contract(s)	[redacted]				
Materials (OPG)					
Other Contracts/Costs					
Interest					
Subtotal					
Specific Contingency					
General Contingency					
Total	**4,054**	**13,452**	**17,051**	**3,599**	
MFA	904	954	2,032	1,078	New EME identified during detailed engineering.
Grand Total	**4,958**	**14,406**	**19,083**	**4,677**	

Project Variance Analysis: Pickering B

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	410	2,867	1,374	-1,493	Increased OPG Oversight to support schedule recovery
OPG Eng. & Support	1,216	2,744	2,732	-12	Increased OPG Oversight to support schedule recovery
EPC Contract(s)	[redacted]				
Materials (OPG)					
Other Contracts/Costs					
Interest					
Subtotal					
Specific Contingency					
General Contingency					
Total	**13,663**	**29,305**	**40,988**	**11,683**	
MFA	1,850	2,323	4,209	1,886	New EME identified during detailed engineering. Also, new scope added for N+1 and N+2 EME (New scope from RERSC)
Grand Total	**15,513**	**31,628**	**45,197**	**13,569**	

Type 3 Business Case Summary

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)

Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Project Variance Analysis: DNGS					
k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	1,245	1,764	2,111	347	Extended schedule and scope. Project oversight costs higher than original assumptions.
OPG Eng. & Support	2,619	2,395	3,448	1,053	Extended schedule and scope. Design oversight costs higher than original assumptions.
EPC Contract(s)	[redacted]				
Materials (OPG)					
Other					
Interest					
Subtotal					
Specific Contingency					
General Contingency					
Total	**17,035**	**27,231**	**52,937**	**25,706**	
MFA	1,877	2,385	5,454	3,069	Pump Reconfiguration including new pumps to address suction and load sharing issues, reconfiguration and addressing fuel review issues $1,500k
Grand Total	**18,912**	**29,616**	**58,391**	**28,775**	

Project #: 13-49299, 13-49158 & 16-31508 (Capital)
13-49300 13-49159 & 16-31510 (MFA)
Document #: N-BCS-09013-10007

Project Title: Fukushima Phase I Beyond Design Basis Event (BDBE) Emergency Mitigation Equipment (EME), <Partial> <Execution> Release

Appendix D:Financial Evaluation Assumptions

Key assumptions used in the financial model of the Project are (complete relevant assumptions only):

Project Cost:

1. Execution estimates are based on current EPC contract information where available.

Financial:

1. 2012 June Ontario CPI (2012-2016) and Canada CPI (2017 and beyond) are used for escalating the incremental ongoing OM&A costs.
2. Retrofit payment for currency exchange may be required for 2014, but projections accounted for a 30% escalation.

Project Life:

1. PNGS: 6 years through 2021
2. DNGS: 40 years through 2055
   Note: A reduced scope of this project will be required for approximately an additional 7 years until remaining fuel is removed from each IFB.

Energy Production:

1. No outage extensions to install modification on outage units

Operating Cost:

1. Ongoing Incremental OM&A Costs: The real (2015$) estimate for future ongoing incremental OM&A costs is approximately $6,255k.

Notes:

1) LTD cost is to the end of Dec. 2014.
2) MFA cost is considered as the cost of EME and thus is capitalized as CCA Class 8h (portable electrical generating equipment).

Appendix E:References

[1] N-REP-09013-0508621: Fukushima N+1/N+2 Conceptual Study and Class 5 Estimate

[2] N-CORR-09013-0521036: Dousing Water Inventory To Moderator System (removal Of Nv537 Internals) Modification At DNGS

[3] N-CORR-09013-0519880: Cancellation Of ISRV Remote Latching Modification At DNGS

[4] N-CORR-01130-0460943: Redundancy Reliability And Operating Time Requirements For OPG Emergency Mitigating Equipment

[5] P-PCH-09013-00001, Beyond Design Basis Fuel Cooling For Pickering

[6] D-PCH-09013-10001, Beyond Design Basis Fuel Cooling For Darlington

[7] N-BCS-03490-10005, Regional Emergency Response Support Center (RERSC) Project

[8] N-REP-09013-0508621, Fukushima N+1/N+2 Conceptual Study And Class 5 Estimate

ONTARIO POWER GENERATION

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Business Case Summary

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A) Full Release Business Case Summary D - BCS - 28270 - 10001 - R000

Name / Title / Phone	Location	Action	Signature	Date
Jack Ballard Manager, Site Infrastructure Projects 701- 2648	P72-1	Review BCS		Jan 31/ 2012
Dwight Zerkee Manager, Investment Management	P82-3A6	Review BCS		1 Feb 12
Jamie Lawrie Director, Nuclear Investment Management	P82-315	Review BCS		1 Feb 2012
Brian Duncan Senior Vice President DNGD	D08-ES3	Review BCS		Feb 3/2012
Randy Leavitt VP Nuclear Finance	TCH07-G27	Review BCS		Feb 16, 2012
Donald Power 2/23 VP Corporate Investment Planning	TCH07-G05	Review BCS		Feb 22/2012
Wayne Robbins Chief Nuclear Officer	P826A-1	Submit BCS		2012-02-17
Donn Hanbidge Senior Vice President & Chief Financial Officer	TCH19-F27	Approve BCS		March 6/12
Tom Mitchell President & Chief Executive Officer Ontario Power Generation	TCH19-A27	Approve BCS		[illegible]
Carolyn Sicard Nuclear Investment Management 702-4082	P82-3B6.2	Return for Distribution		

OFFICE OF THE PRESIDENT & CEO

MAR 6 2012

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
Full Release Business Case Summary D - BCS - 28270 - 10001 - R000

1/ RECOMMENDATION:

We recommend a **Full** Release of an **additional $33.8** Million **Capital** to fund **completion of all modification, commissioning and closeout** for the Maintenance and Computer Development (M&CD) facility at Darlington Generating Station, and **$1.M OM&A** to fund the relocation of the computer development equipment from the existing locations to the new facility. Approval of this request will bring the total to date funding to **44.2** Million including a contingency of **$ 7.1** Million. The total project is estimated to cost **$ 44.2** Million with an estimated completion date of October 31, 2014.

The Business Objectives of this **Sustaining** project are to:

(a) Replace the maintenance work areas that have been or will have to be removed due to nuclear safety and fire code compliance requirements as well as station requirement for the control of transient material.
(b) Provide replacement facilities for those to be removed for implementation of the station Refurbishment Project.
(c) Provide adequate and improved working space for maintenance staff to improve productivity and morale by addressing the following needs:
- increased space requirements because of a change in maintenance strategy to day shift from a shift (24/7) operation
- the implementation of new maintenance management technologies and computerized planning and reporting
- adequate space requirements for Pre/Post Job Briefings to improve Human Performance results, and also for rehearsals and mock-ups for on-line and outage maintenance support.

(d) Replace the existing computer support buildings which are to be demolished as part of the station Campus Plan and provide a home for the Shut-Down Systems computer support facility currently located in leased off-site facility.

For the past few years, the challenges introduced by the shortfalls in maintenance workspace have been met by use of empty spaces in equipment rooms, hallways etc and with various temporary/permanent offices or shops inside and outside of the Powerhouse. Such provisions can no longer be continued due to various drivers for removal of the workstations and facilities. The table below shows the number of maintenance work stations that are affected by various drivers/problems, resulting in the need to relocate maintenance work and staff.

Table 1: Number of Maintenance & Computer Staff Affected

Reason for Relocation of Maintenance Workstations	Number of Affected Maintenance Staff
Health and Safety and code issues (regulatory)	28
Facilities to be dismantled to make room for Refurbishment (sustaining)	50
Life-expired Computer facilities to be demolished as per Campus Plan. Cost saving opportunity (value enhancing)	14
Part of Strategic Consideration and integration for office space and relocating unavailable off site facilities (sustaining)	12
Part of strategic consideration and integration of office space for managing maintenance work. Facilitate Improvements (sustaining)	16
Total	120

In May 2008, the project had recommended a New Maintenance and Computer Development Facility (M&CD) inside the protected area. After further engineering and cost estimations, including the lessons learned from the Darlington Construction Change Room project, it was determined that building the proposed facility inside the

protected area was not cost-effective. The estimate for the M&CD inside the protected area was about $83M including contingency. The decision was made to relocate the facility outside the protected area to reduce costs. A project scope change was approved in the partial release BCS to include replacement of computer support facilities within the M&CD instead of as a stand-alone building. This resulted in cost savings to OPG of $3.0M. The computer development facility was originally part of the station Campus Plan.

A partial release of additional $5.0M was approved in April 2010 to complete preliminary and detailed engineering. Preliminary engineering has been completed and detailed engineering is 40 % complete.

An Engineering/Procurement/Construction (EPC) contractor was retained in November 2011 for design, procurement and construction of the facility on a fixed price basis. The estimates provided in this BCS are based on the contract price and include OPG support and contingency. The M&CD is scheduled to be in service in 2013, just in time to free up space within the protected area required by the station refurbishment project.

The $44.2M estimate for this project includes the cost of the engineering and demolition of the abandoned Powerhouse Annex ($3.4M), estimated cost of computer development portion ($8.3M) and $1.0 M OM&A cost to relocate computer Labs equipment, and overall contingency (~~$6.9M~~ 7.1 NSP).

Table 2: Release Summary and Plan

$000's (Incl contingency)	Funding	Type	LTD Dec 2011	2012	2013	2014	2015	2016	Later	Total
Currently Released	Partial	OM&A								-
		Capital	10,648	2,900	-					13,548
Adjustments to Current Release	Adjustments	OM&A								-
		Capital	(3,727)	(400)						(4,127)
Requested Now	Full	OM&A				1,000				1,000
		Capital	-	17,168	14,650	1,980				33,798
Future Funding Req'd	None	OM&A								-
		Capital								-
Total Project Costs		OM&A	-	-	-	1,000	-	-	-	1,000
Total Project Costs		Capital	6,921	19,668	14,650	1,980	-	-	-	43,219
Total Project Costs		Total	6,921	19,668	14,650	2,980	-	-	-	44,219
Other Costs										-

Investment Type	Class	NPV	IRR	Discounted Payback
Sustaining	Multi Class	11,173	1.9	24.2

Submitted By: (Date)

Wayne Robbins 2012-02-17

Wayne Robbins
CNO

Financial Approval By: (Date)

T D Hanbidge March 6/12

Donn Hanbidge
SVP & CFO

(OAR Element 1.1 Project in Budget)

Line Approval By: (Date)

T Mitchell 6 March 12

Tom Mitchell
President & CEO

2/ BACKGROUND & ISSUES:

The need for additional maintenance space has been in the business plan for years due to removal of office and structures from the station as a result of nuclear and fire assessment reasons, a change in maintenance strategy (day shift vs 24/7), emphasis on human performance and the station Event Free Tools which results in increased frequency of Post and Pre-job briefs as well as life-expired buildings and code compliance.

This project was started in 2001 while the station maintenance management and staff were being continuously challenged by the shortage or inadequacy of the space for conducting day to day maintenance work resulting in management and worker frustrations. Building this facility will demonstrate management's commitment for making adequate provisions for the station maintenance activities.

In May of 2008 a partial release BCS was approved for a new maintenance facility to undertake the following activities:

- Removal and de-commissioning of the building on the selected site within the protected area,
- Design for the tie-ins and/or relocation of the tie-ins,
- Contract procurement process for the building and approval of a full release BCS.

Upon further engineering and cost estimation, including incorporation of lessons-learned in the Construction Change Room project, we are now recommending a facility outside the protected area that will be better value for money and will meet the stations needs and include a computer development facility. The following are some of the activities that were undertaken to arrive at the recommended approach:

(a) Completed an initial Value Engineering (VE) workshop to evaluate alternatives using commercial standards with modified layouts, reduced footprint, and a self sustained stand alone Maintenance Facility inside the protected area. The cost of the alternatives ranged from $51M to $90M.

(b) Conducted a benchmarking exercise with other North American Nuclear utilities to obtain cost information for similar buildings inside the protected area and compare with OPG cost estimates. Although other buildings for security purposes were constructed by other utilities, no building comparable to a maintenance facility building had been built inside the protected areas since the events of September 11, 2001.

(c) The cost of the 19000 sq ft Construction Change Room (CCR) inside the protected area in Darlington amounted to approximately $24M, or about $1.3k/sq ft. The CCR did not include some major equipment or features such as overhead crane, overhead doors, loading bays, offices or IT and LAN services therefore, allowances were included in the estimate for the maintenance facility which resulted in a total estimate of some $83M which included 30% contingency.

In May 2009 a Project Charter was approved for considering a maintenance facility outside the protected area that could house adequate workspace for station maintenance and the computer development facilities which were earmarked for relocation by the Darlington Campus Plan due to aging of the existing computer buildings.

In April of 2010 a Partial Release BCS was approved for continuing the project activities with preliminary engineering, retention of an Engineering/Procurement/Construction (EPC) contractor, completing the detail design and procurement of long lead material and equipment.

Preliminary engineering has been completed, the contract for an EPC contractor has been awarded, and detailed engineering is 40 % complete and planned for completion in June 2012.

Strategic Considerations:

The plan for building a new maintenance facility outside the protected area expanded the project considerations to some other OPG initiatives and long terms plans such as **Campus Plan, Darlington Refurbishment and Operations Support Building Retrofit.** The summary of such considerations are discussed in the following sections:

Computer Development Facility:
Several projects have recently been approved to replace or upgrade the existing computerized systems of the station Shut Down Systems (SDS), Fuel Handling (FH) and Digital Control Computers (DCC) . The computer development and laboratories supporting these computerized stations systems are currently located in three locations (two on site and one off-site). The on-site facilities are life expired and targeted for demolition as part of Campus Plan and the off-site facility needs to be vacated. These facilities are now integrated into the Maintenance Facility Project with a cost savings to OPG of approximately $3M.

Campus Plan
The Darlington Campus Plan was approved in May 2009. The Darlington Campus Plan – funded by refurbishment project – will replace all the life-expired facilities at Darlington and build new facilities strategically located around the station on OPG land for long term support of DNGD. At the same time that the Campus Plan was being approved, the decision was made to relocate the M&CD outside the protected area and to incorporate the Computer Development Facility into this project (within funding limit of $50M) as an opportunity for cost saving.

All other proposed facilities in the Campus Plan are proposed for specific usage at various locations on site and on nearby OPG land. Additional integration with the M&CD will not result in further cost savings to OPG. For example, a Facility Services Building is planned for 2016 at a location north of the station. Consolidation of this building into the proposed M&CD will not be possible or cost effective due the space limitation and the impact of such a large complex on the available parking space near the plant.

Darlington Refurbishment
This project was also reviewed in the light of the Refurbishment project and facility needs. The facilities planned for the Refurbishment varied from the M&CD facility in terms of functionality and use. In order to consolidate these facilities with the proposed M&CD facility, a hybrid complex would need to be designed and constructed and would not become available to the station until 2024, after Refurbishment, which is too late to meet the station maintenance challenges.

The start date for infrastructure construction within the protected area (outside the powerhouse) for the Refurbishment program is late 2013. This will require some of the current Darlington maintenance facilities in the area targeted to be replaced by Refurbishment facilities to be vacated and ready for demolition by 2013. As such, the M&CD project completion is required in 2013 to satisfy the needs for Refurbishment infrastructure Projects.

Operations Support Building (OSB) Retrofit Project
This project was also reviewed against the Operating Support Building (OSB) retrofit project. The driver for OSB retrofit is the deteriorating condition of the building and will not result in additional space. The swing space for OSB refurbishment is being planned separately by the Nuclear Facilities organization.

The M&CD facility is being proposed to support the day to day station maintenance needs and its objectives. Its scope is limited to certain specific maintenance functions and includes a minimum number of offices. The OSB occupants are made up of station planning and operations staff and management that need to have ready and immediate access to the plant. During OSB refurbishment, some of the staff can be relocated temporarily but

permanent relocation of the staff and de-commissioning of the OSB has been determined not to be feasible due to cost to relocate essential services presently housed in the OSB and would have major impact on scope, cost and schedule of this project with no overall cost benefit to OPG.

Business Case Justification:

Economic benefits

A detailed assessment was made of the economic benefits of this facility based on extensive communications and interviews with the maintenance staff, supervisory and management personnel. Several challenge meetings were held between the project team and maintenance supervisory staff to ensure that their inputs were consistent with the financial assumptions and arguments.

Economic benefits were categorized into the areas of productivity savings and the risk mitigation of forced and planned outages. Estimates were obtained in terms of loss productivity for each function for normal day to day work, planned and forced outage campaigns, unconditional transfer permits savings, and rental facility savings. Considerations included (i) the list of the work spaces and offices that have been removed and will have to be removed due to life expiry and code compliance, (ii) the more recent need to make room for the station Refurbishment project, (iii) an aging station, (iv) the change in maintenance strategies and (v) more rigorous procedures for managing the station day to day maintenance activities. The economic contributions of each of the work shops have been summarized in the table below.

Employee morale

This project was first initiated in 2001 and later deferred in 2002 due to other priorities. The project was initiated again in 2005 while station maintenance management and staff were being continuously challenged by the shortage or inadequacy of the facilities for carrying out maintenance work. Building the M&CD demonstrates OPG's commitment to making adequate provisions for the station maintenance activities and creating an environment where staff can perform their duties more efficiently. This will have a positive effect on employee morale.

Table-3: Breakdown of NPV per each assumption:

Benefits	%	NPV (000$)
Productivity Saving (1)	**17%**	**1,874**
Control Maintenance Valve Shop	2%	204
Mechanical Maintenance Relief Valve shop	2%	183
Mechanical Maintenance Supervisors offices	3%	382
Reactor Maintenance	5%	555
Control Maintenance Breaker and Relay Shop	3%	379
Welding shop	1%	94
Electronics shop	1%	76
Mitigation of Planned Outage Extension (2)	**67%**	**7,455**
Control Maintenance Valve Shop	16%	1,797
Reactor Maintenance	36%	3,993
Control Maintenance Breaker and Relay Shop	15%	1,664
Mitigation of Forced Outage Extension (3)	**15%**	**1,666**
Mechanical Maintenance Relief Valve shop	0%	22
Reactor Maintenance	9%	960
Control Maintenance Breaker and Relay Shop	6%	684
UTP Saving (4)	**1%**	**58**
Rental Facility Saving (5)	**1%**	**121**
Total	**100%**	**11,173**

Facility Layout and Requirements:

In October 2009, continuing with the project and plan to build a maintenance and computer development facility outside the protected area was endorsed by the station senior management.

A Value Engineering (VE) session was held in January of 2010 with strong representation from Maintenance Department, Computer Engineering, Facilities, Radiation Protection, Field Engineering, Contract Management Office and Projects & Modification. The objectives of this workshop were to:

- analyze the current challenges to maintenance production and find ways to optimize the concept that would eliminate/minimize these challenges,
- identify the maintenance functions and activities that could be located outside the protected area,
- identify the computer development facility functions that could be located in the new building,
- identify the work groups that would be residing, using or maintaining the building,
- identify any logistical issues that may arise as the result of relocations to the extent possible,
- Estimate incremental security support and include the cost in the financial analysis,
- outline the functional requirements for the building to support the objectives, and
- estimate footprints

The building layout developed during preliminary design and validated during detailed design is summarized in the Table-4 below.

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
Full Release Business Case Summary D - BCS - 28270 - 10001 - R000

Table-4: Building Layout/Use Concept – DNGS Maintenance & Computer Development Facility

Work Area	Facility Component	Number of Staff	Approximate Area (sq. ft.)
Mechanical Maintenance	RV Shop, HP Compressor Room and Workstations	4	1,800 + 80 for HP Compressor Room
	Welding Shop and FLMA Offices	12	3,500
	Reactor Mock-up Rehearsal and Training Shop, FLMA Offices	13	6,000
	Machine Shop		
Civil Maintenance	Insulation and Sheet Metal Shop, FLMA Offices	20	5,000
	Carpentry Shop		
	Paint Shop		
	Lamacoid Shop		
Control Maintenance	Multi Function Valve Shop, Breaker & Relay Shop, FLMA Offices	24	5,000
	Electronics, Cards and Boards Repair Shop	4	
Workshop Offices	Mechanical, Control and Reactor Maintenance Shops	17	1790
Predictive Maintenance	Assessing and Planning	8	1,000
Computer Development Labs	OH-180 Lab	10	1,330
	SD Computer Lab & Monitoring Room		1,480
	Computer Development Lab & Monitoring Room		1,750
	F/H Computer Lab & Monitoring Room	4	1,180
	X-Y Development Room	4	533
	Boards Repair Room		621
General Offices	SE Managers Offices		2,750
	Admin Room		120
	Computers Area Offices		1,390
Conference Rooms and Pre-job/ Coaching Rooms	Second Floor Conference Rooms		2,906
	Pre-job Briefing and Coaching Rooms		360
Office Services	Printer and Photocopying Rooms First, Second Floors and Computer Labs Area. Mail Room on First Floor		408
Building Services	Main Mechanical Room Second Floor		4,000
	Mechanical Room First Floor		275
	Electrical Rooms First and Second Floors		455
	Computer Labs Fire Suppression Cylinder Room		780
	Communication/ IT Rooms First and Second Floors		153
	Second Floor Building Automation Room		100
	Second Floor Facility Maintenance Shop		216
	Facility Maintenance Storage Rooms First and Second Floors		416
	Elevator and Elevator Machine Room		160
	First Aid Room		134
	General Loading Room		540
	Recycling / Garbage Storage Room		175
	Computer area Receiving, Storage & Layout Area		470
	Janitorial Room First and Second Floors		127
Corridors, Lobbies, Vestibules	Corridors First Floor		2,741
	Corridors Second Floor		1,315
	Lobbies North (Main) and South		1,655
	Vestibules – Main entrance, South Entrance, South-East Entrance, Shop Entrances, RV Shop Entrance		775

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Work Area	Facility Component	Number of Staff	Approximate Area (sq. ft.)
Amenities	Coffee Rooms & Lunch Storage in Shop Area, Computer Labs Area and SE Offices		335
	Second Floor Lunch Room, Kitchenette and Vending Machine Area		2,150
Washrooms and Change Rooms	Men's Change Room and Lockers		1,293
	Women's Change Room and Lockers		466
	Second Floor Men's & Women's Washrooms		610
Stairs and Exits	Emergency Exit Stairs First and Second Floors – N, S, SE		857
Exterior	Green Roof/ Terrace /Patio Landscaping Pathways/ Walkways Parking		
	TOTAL	**120**	**59,196**

The proposed M&CD facility will be built south east of the Auxiliary Security Building (ASB) (in place of existing temporary building No. 119). The relative proximity of this new building to the ASB will provide ease of movement between the plant and the new facility. The building will be occupied by about 102 Maintenance personnel on day shifts who will report to work in the building, execute the majority of the day shift activities in the building and leave work from the building. The computer development facility would be occupied by up to 18 personnel on days shift.

Building #119 will be vacated by Nuclear East Facilities organization and will be dismantled by this project for site preparation.

The new M&CD facility located outside the Protected Area will meet the primary objective to improve maintenance productivity and provide adequate space for a new computer development facility for Fuel Handling, Shutdown Systems, Digital Control and Programmable Logic Controllers computer support services. Improvements or replacement of such computer systems inside the plant have been approved. The new computer support facility will be providing testing, repair and development capabilities to the live systems in the plant. The current computer support facilities are in permanent and temporary buildings nearing the end of life, not suitable for computer environment, and are planned for removal as part of the Darlington Campus Plan.

Project Status:
Under the previous releases the following activities were completed or in progress. Some of the clean-up activities in the list below were completed as part of the plan for constructing the facility inside the protected area:

- De-commissioning and removal of Powerhouse Annex and adjacent buildings complete
- Partial engineering on the relocation of services and tie-ins complete
- Preliminary engineering for the new M&CD facility complete
- Engineering/Procurement/Construction (EPC) Contract award complete
- Detailed design of the facility in progress about 40 % complete

Current approved release is $ 13,548 K and actual cost to date (Dec 2011) is $ 6,921 K. Another $2.3 M under a contract is also committed to complete detailed engineering, ordering of long lead material items and site preparation by June 2012. The under expenditure of current partial release is due to cost savings in the l preliminary engineering contract, lower OPG of effort support cost, and delay to the award of the Engineering/Procurement/Construction Contract.

3/ ALTERNATIVES & ECONOMIC ANALYSIS:

Table 5: ALTERNATIVES AND ECONOMIC ANALYSIS

$000's	Base Case	Alt 1 (Recommended)		Alt 2	Alt 3	Alt 4	Alt 5
		Full Cost	Incremental Cost				
Total Revenue	0	275,306	275,306	0	0	0	0
Base OM&A	0	(45,340)	(45,340)	0	0	0	0
Project OM&A	0	(1,000)	(1,000)	0	0	0	0
Total OM&A	0	(46,340)	(46,340)	0	0	0	0
Capital Expenditures	0	(40,911)	(33,990)	0	0	0	0
Present Value (PV)	0	4,879	11,173	0	0	0	0
Net Present Value (NPV)	N/A	4,879	11,173	0	0	0	0
IRR%	N/A	0.7%	1.9%	N/A	N/A	N/A	N/A
Discounted Payback (Yrs)	N/A	31.66	24.24	N/A	N/A	N/A	N/A

Base Case: × *Not Recommended* - **Status Quo**
This option is not recommended. The need for upgraded maintenance facilities at Darlington has been escalating for many years resulting in an increased risk to employee health and safety and increasing potential outage extensions and loss of productivity.

Several maintenance areas and shops are neither intended nor suitable for maintenance space or are in life-expired buildings such as Bldg 29 and 31 planned to be demolished by the refurbishment project. Other maintenance functions are in temporary structures that do not meet codes and are planned for removal. Computer Development facilities are in permanent building such as Bldg 115 and temporary buildings that are nearing end of life and are planned for removal by the Campus Plan, and some are in off site locations.
Therefore new maintenance and computer development facilities are needed.

Alternative 1: ✓ *Recommended* - **Build New Maintenance and Computer Development Facility outside the Protected Area for Non-radioactive Functions**
This alternative will provide the needed space for conducting the station non-radioactive maintenance activities, and will replace and consolidate the existing aging and deteriorating computer development laboratories currently at various on site and off site locations. The new M&CD facility will be a two storey high with about 59,000 square feet of Maintenance shops, computer labs and offices and amenities to accommodate 120 maintenance and computer development staff.

The following alternatives were evaluated as part of the partial release BCS but their economic analysis has not been updated for this full release BCS.

Alternative 2: × ***Not Recommended*** **- Delay 2 years**

Delay the project. This alternative is not recommended since it will further delay the project for at least 2 years while the station will continue to be challenged with lack of adequate space for maintenance work. Delay of two years will also create a major threat to Maintenance since several buildings (listed under base case) housing the current maintenance shops and computer labs will be beyond their life span and would be in the demolition stage. The refurbishment project is planning to demolish some existing maintenance buildings and replace with refurbishment support buildings by 2013.

Alternative 3: × ***Not Recommended*** **- Build New Maintenance Facility inside the Operating Island**

This is not recommended due to the high capital cost of over $83 M for a new Maintenance facility alone inside the protected area based on lessons learned from the Construction Change Room Project. The $33M cost increase can be attributed to full ECC process, additional codes and standards, regulatory, fire and security requirements, complications related to the tie-ins to the Emergency Service Water (ESW) and Class III power supply, requirement for the building blow-out panels, the potential for discovery issues associated with the adjacent Powerhouse structures and external contractor logistic within the protected area and associated delays.

Alternative 4: × ***Not Recommended*** **- Securing Facilities away from the Site**

A number of options for off-site facilities were reviewed and estimated by Corporate Real Estate as follows:

- Lease existing facility
- Buy existing facility
- Have designed/built and own
- Have designed/build and lease

Facility costs were comparable (within the same estimating range) to the recommended option, but additional overheads of logistics and functionality decreased the benefits of this alternative

The proposed M&CD facility is for the day to day station maintenance activities. The proximity of this facility to the plant systems and the need for the presence of key staff in or around the plant is paramount for its usefulness in terms of the intended objectives. An off-site M&CD facility would require a major shift in the station philosophy in approach to the day to day management of the plant with no appreciable cost savings to OPG. Therefore this alternative is not recommended.

Alternative 5: × ***Not Recommended*** **- Use Refurbishment Facilities Post Refurbishment**

This project was also reviewed in the light of the Refurbishment project and facility needs. The facilities planned for the Refurbishment are too varied from a maintenance facility in terms of functionality and use. In order to consolidate these facilities with the proposed maintenance facility, they need to be designed and constructed as a hybrid complex which will, firstly, result in much higher cost and secondly, will not become available to the station until 2024 which is too late to meet the station present maintenance challenges.

4/ THE PROPOSAL

The funds requested in this release are needed to allow timely completion of the remaining detailed engineering, obtaining all necessary permits to start construction, site preparation, material procurement, construction, commissioning, turn over a new M&CD facility ready for occupancy, and close-out of the project as well as relocation of the computer development equipment from the existing locations to the new facility.

5/ QUALITATIVE FACTORS

The successful completion of this project will improve the following:

Employee Engagement:

- New maintenance facility shops and offices will relieve overcrowding and congestion, provides better pre-job and post-job briefing facilities and result in improved staff morale and productivity

Health and Safety

- New maintenance facility shall be compliant with latest codes and standards which will provide adequate ergonomic work environment, relieve overcrowding and congestion, thus addressing health and safety concerns.

Productivity and Efficiency

- New Maintenance Facility with mock-up, rehearsal, fabrication, repair and refurbishment capabilities will enable the station to implement new and improved maintenance strategies, improve readiness for Outage and Online work.
- Reduction in personnel traffic through security systems and cross-zonal monitoring systems during peak station hours.

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6/ RISKS ANALYSIS (See Attachment D for details)

Low 1 to 3	Medium 4 to 9	High 10 to 25

Probability \ Impact	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Risk Description	Mitigating Activities	Mitigation	Specific Cont'ncy $000's	Probability X Impact: Finance	Schedule	Quality	Corporate Reputation	Regulatory	Health & Safety	Environmental	Nuclear Safety	Risk Rating (1 to 25)
Discovery work from poor configuration management could Increase scope of work such as re-route buried services in building (footprint). Additional engineering work and rework in the field	Perform configuration management assessment during detailed eng. Conduct additional underground surveys to locate underground services, finalize geotechnical reports and freeze the scope before Full Release BCS. Continue liaison with Campus Plan. Scope and cost for relocation of buried services is included in the EPC Fixed price contract	Before		3	12	6	0	0	0	0	0	12
		After		2	6	2	0	0	0	0	0	6
Scope creep from geotechnical analysis of soil indicating soil conditions different from original contract assumptions. Causing major foundation design rework and more expensive foundation	Completed geotechnical analysis. Perform additional soil analysis. Detailed Foundation design will be based on the Geotechnical report results. Cost allowance is included in EPC Fixed Price contract and in the Full Release BCS for implementing alternate foundation design.	Before		4	20	4	0	0	0	0	0	20
		After		2	6	0	0	0	0	0	0	6
Schedule delays due to late Design deliverables and longer design reviews.	Design will be implemented and accepted in stages to allow phased permits and construction to maintain overall schedule. Regular design progress review meetings with EPC contractor and OPG reviewing	Before		4	16	4	0	0	0	0	0	16
		After		3	9	0	0	0	0	0	0	9

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Poor configuration management on Tie-ins "Legacy issues on design (tie-in services)." and later during final tie-ins of the services	Conducted detailed surveys during preliminary engineering. Detailed engineering will be based on the surveys. Establish early ownership of tie-in points.	Before		3	6	6	0	0	0	0	0	6
		After		2	2	2	0	0	0	0	0	2
Exact locations of tie-ins to water and sewer have not been designed. This may introduce a risk of having to install longer lines. Connection to existing Fire Protection Services, PA, LAN, and Tel) may require additional technical assessments beyond what has been provided for.	The facility will not increase overall station loading for these services. Modification Design Requirements are approved. Detailed engineering will meet design requirements and address any gaps. Continue liaison with Domestic/Sewage water upgrades Project and other campus plan projects. 200 K allowed for risk response	Before		4	12	8	0	0	0	0	0	12
		After		2	4	2	0	0	0	0	0	4
Lack of adequate supply of current electrical Power supply would add Technical difficulties, additional activities , and potential re-work	Risk Response of $ 500k has been allowed for potential new scope to upgrade existing or procure new transformers and switchgears.	Before		10	20	15	0	0	0	0	0	20
		After		3	9	3	0	0	0	0	0	9
Presence of Asbestos, Mold, and other hazardous material in Building 119 that is planned to be demolished would pose Health and safety issues to personnel involved with the demolition activities.	Identify all hazards. Prepare and implement Site Specific Health and Safety, environmental, demolition and waste disposal plans for this project	Before		3	6	3	0	0	9	9	0	9
		After		2	2	0	0	0	2	2	0	2
Environmental issue from conventional contamination of waste from Excavation, construction, and demolition activities waste which may not be suitable for shipment to a clean landfill site	Complete Soil sampling and analysis, allowed 200 K for potential decontamination, material handling and transporting of potential contaminated soil to approved disposal sites according to approved environmental and waste management plans.	Before		3	9	0	0	3	3	6	0	9
		After		2	4	0	0	2	2	2	0	4
Insufficient OPG resources. Resources could be supporting other major projects being executed at the same time in preparation for refurbishment.	Secured commitment on required resources. Establish an agreed upon resource plan with Nuclear Refurbishment, CMO, Facilities and Station Maintenance and Computer Development	Before		3	12	0	0	0	0	0	0	12
		After		2	6	0	0	0	0	0	0	6
Proximity of the building to the security fence and meeting security requirements	Get Security involved in the detailed design reviews and COMS to address Security requirements	Before		2	4	0	0	0	0	0	0	4
		After		1	1	0	0	0	0	0	0	1

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Construction of the building would reduce current adjacent Parking space and add more Parking requirements for people relocated to using the new building	The impact on parking will be communicated during the various stages of detailed engineering with the Site Parking Committee. The project will make every reasonable effort to minimize the impact on parking especially during Outages.	Before		5	15	0	0	0	0	0	0	15
		After		3	6	0	0	0	0	0	0	6
Impact of delayed AFS on the start of NR Projects and additional cost and schedule delays to this project	Work with Contractors, Maintenance, Computer Labs, Campus Plan and NR to minimize impact of potential delay to AFS. Agreed with contractor on the schedule. A partial AFS for occupancy of the building would be considered. This is to align with the NR plans to demolish other buildings currently occupied by Maintenance and Computer labs and personnel planned to move into the new Facility, and to save potential additional interest and Project support costs	Before		10	25	0	0	0	0	0	0	25
		After		3	12	0	0	0	0	0	0	12
Impact of unexpected or unusual weather conditions on construction.	Work with the Contractor to continuously monitor and assess the impact of weather on construction activities and its impact on project schedule and cost. Take corrective measures as necessary. $300 k allocated to cover the cost to recover schedule.	Before		2	6	0	0	0	0	0	0	6
		After		1	2	0	0	0	0	0	0	2
Impact of late delivery of long lead items on construction schedule	Long lead items have been identified and have a maximum of 6 months delivery. The items will be ordered during detailed engineering phase of the EPC contract under current partial release to ensure on time delivery.	Before		3	9	0	0	0	0	0	0	9
		After		2	4	0	0	0	0	0	0	4
Delayed award of EPC contract by about 5 months causing a straight delay in the critical path	Worked with EPC contractor on a schedule that meets the Full Release BCS Milestones. General contingency applied to cover the costs to maintain or advance the schedule where possible	Before		10	25	0	0	0	0	0	0	25
		After		3	9	0	0	0	0	0	0	9

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Accuracy of the costs for Furniture, OPG costs, and Construction support costs, and potential additions of optional take out prices items to the EPC contract	Project will work with stakeholders during detailed engineering phase to improve the quality of this estimate for furniture and equipment, and finalize the need for the optional take out items and add it to the EPC contract. General contingency is applied	Before		6	9	0	0	0	0	0	0	9
		After		2	4	0	0	0	0	0	0	4

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7/ POST IMPLEMENTATION REVIEW

Type of PIR:	Targeted Final AFS Date:	Targeted PIR Approval Date	PIR Responsibility (Sponsor Title)
Simplified	30-Oct-13	18-Dec-14	Sponsor's Title

	Measurable Parameter	Current Baseline	Targeted Result	How will it be measured?	Who will measure Person / Group?
1.	Replacement of removed facilities	Buildings # 29, 31 and temporary trailers used by Maintenance, and Bldg. # 115 for computer Labs to be removed by 2013	Replacement Facilities will be provided within the new Maintenance Building complex	The replacement facilities will be ready for occupancy as part of the New Maintenance Facility AFS in Oct 2013.	DOM/DNGD Operations and Maintenance
2.	Productivity Savings	Overtime hours by affected work groups	Reduction of OT as per values indicated in Table 2 Appendix C.	Monitor OT costs for affected staff using time reporting systems	DOM/DNGD Operations and Maintenance
3.	Mitigation of Planned Outage Extension	Potential risk of Planned Outage Extension can be as high as 2.6d/year.	Reduction of 2.24 days/year has been estimated as per Table 2 Appendix C due to ready and available workspace.	Monitor each Planned Outage Extension and do appropriate analysis & comparison.	DOM and Outage Manager/DNGD
4.	Mitigation of Forced Outage Extension	Potential risk of Forced Outage Extension can be as high as 0.95d/year .	Reduction of 0.63 days/year estimated as per Table-2 Appendix C due to adequate and ready workspace.	Monitor each Forced Outage Extension and do appropriate analysis & comparison.	DOM and Outage Manager/DNGD
5.	Rental Facility Saving	Computer Lab space for Shutdown system is available at no cost off-site but needs to be vacated. Potential cost for a rental facility to house the lab can be about $51K/yr in 2013 dollar value	Replacement lab will be provided in the M&CD. Reduce potential Rental Facility cost by $51K/yr	No additional rental facility cost of $51k will be required.	DOM/DNGD Operations and Maintenance
6.	Unconditional Transfer Permits (UTP) Savings	UTP costs on Feeder Replacement equipment stored in the Protected Area by Vendor is about $18k/Planned Outage in 2009 dollar value or $20K/year in 2013 dollar value	Reduce yearly UTP expenditures by $25k post AFS until Refurbishment.	Monitor UTP costs on affected work using cost reporting systems	DOM/DNGD Operations and Maintenance
7.	Employee Morale and Engagement	Employee concerns related to (pre-job and post job briefing), health and safety, lack of adequate space, poor facilities conditions, logistics for doing work	Provide adequate space and safe working environment for employees. Provide improved pre-job and post job briefing.	Conduct surveys, meetings, and interviews with relocated personnel to document satisfaction levels and improvements in morale and engagement.	DOM/DNGD Operations and Maintenance

APPENDIX "A' GLOSSARY (acronyms, codes, technical terms)

AFI - Area for Improvement
AFS - Available for Service
ASB - Auxiliary Security Building
BCS - Business Case Summary
BOD - Board Of Directors
BP- Business Plan
B&W – Babcock and Wilcox
CCR – Construction Change Room
CDF – Computer Development Facility
CM - Control Maintenance
CMO - Contract Management Office
COMS - Constructability, Operability, Maintainability, and Safety
DA - Design Authority
DCC - Digital Controllers Computers
DOM - Director, Operations and Maintenance
DNGS - Darlington Nuclear Generating Station
ECC - Engineering Change Control
EM - Elective Maintenance
EPC - Engineering, Procurement, Construction
EOI - Expression of Interest
EOL - End Of Life
ER - Event reset
ESA - Engineering Services Agreement
ESW - Emergency Service Water
FFAA - Fueling Facility Auxiliary Area
FH - Fuel Handling
FLM - First Line Manager
FLM (A) - First Line Manager (Acting)
FLR – Forced Loss Rate
FMOD - Facilities Modifications
FTE - Full Time Equivalent
H&S - Health and Safety
IPG - Integrated Planning Group
IRR - Internal Rate of Return
LTA - Lost Time accident
MM - Mechanical Maintenance
MS - Civil Maintenance
MSA - Master Services Agreement
NIMS - Nuclear Information Management System
M&CD - New Maintenance Facility
NPV - Net Present Value
OM&A - Operating, Maintenance and Administration
OEM - Online Elective Maintenance
OEMB - Online Elective Maintenance Backlog
OPEX - Operating Experience
OPG - Ontario Power Generation
OSB – Operations Support Building
OT - Overtime
PV - Present Value
PCRAF - Project Change Request Authorization Form
PEP - Project Execution Plan
PIR - Post Implementation Review
PLC - Programmable Logic Controllers
PO - Planned Outage
PJB/PJB - Pre Job Briefing/Post Job Briefing
RFP - Request for Proposal
RM - Reactor Maintenance
RP - Radiation Protection
RV - Relief Valve
SAM - Small Articles Monitor
SATM - Space Allocation and Transient Material
SAVH - Sickness and Accident Vacation Holiday
SDS - Shut Down System
SOW - Scope Of work
TBD – To be Determined
UTP - Unconditional Transfer Permit
VE - Value Engineering
WANO - World Association of Nuclear Operators
WO – Work Order

APPENDIX "B"

Comparison of Total Project Estimates

BCS Type	Class	Mth	Yr	2007	2008	2009	2010	2011	2012	2013	Later	Est
Developmental	Capital	Jul	2007	1,369	2,781	18,679	19,701	15,023				57,553
Partial	Capital	May	2008	508	4,194	18,932	19,985	13,599	521			57,739
Partial	Capital	Apr	2010	508	2,560	1,660	1,640	4,280	29,728	9,438		49,814
Full	Capital	Mar	2012	508	2,560	1,660	703	1,490	19,668	14,650	1,980	43,219
Full	OM&A	Mar	2012								1,000	1,000
												0

LTD Spent	Capital	Dec	2011	508	2,560	1,660	703	1,490				6,921
LTD Spent	OM&A	Jan	2012						0			0

Comments:

APPENDIX "C" TABLE 1: FINANCIAL MODEL – ASSUMPTIONS

Financial Assumptions:

Discount Rate:	7%	Cost Escalation (Yr)	2%	SR&D Opportunity	No
Progress Payments	Yes	Foreign Currency	No	Retainer Fee	No
Depreciation Rate (Capital)	Blgs Oth Structures 4%	PST	No	Interest Rate (Capital)	6%
Revenue Rate	Corp SEV	Leasing	No	Indexed Priced Contract	No

Comments:

Depreciation Rate: For New Non-residential buildings 6%.

ASSUMPTIONS AND METHODOLOGY of NPV Calculations

The model tries to quantify the following benefits of the New Maintenance Facility over the existing facility:

Productivity

Assumption:
Overcrowded location, lack of PJB areas, lack of suitable equipment, extra material/ equipment shuffling, & lack of Mock up/Rehearsal area result in OT to recover productivity loss for the existing facility.

Method:
1. Input from Maintenance on the OT equivalent to FTE to maintain productivity under current facility and the expected improvement with the new facility
2. Use appropriate labor rate to determine the FTE saving

For Reactor Maintenance Shop, also consider saving from training delivery to a bigger group, Radiation Protection saving on UTP due to allowing only one set of tools in the plant instead of two, and UTP saving associated with fabrication in the Machine Shop. For Welding Shop, also consider saving from UTP and travelling to Fabrication Shop.

Impact on Planned & Forced Outage Extension

Assumption:
Expect the new facility will improve response time on Valve/ RV/ Breaker preparation and minimize rework as the Mock up/Rehearsal facility and crane are always in place.

Method:
1. Input from Maintenance/Engineering on the expected critical path push and the probability of the current facility on Planned/Forced Outage Extension.
2. Input from Maintenance/Engineering on the expected critical path push and the probability of the new facility on Planned/Forced Outage Extension.
3. Determine the risk of the critical path push and the incremental benefit of the new facility.

Unconditional Transfer Permit Saving

Assumption:
Current practice for Feeder Replacement is to send both sets of replacement tools to Bldg 29. With the New Maintenance Facility, only one set will be sent to the plant. The other set can stay in the M&CD.

Method:

1. Input from Maintenance on the expected saving from not cleaning & categorizing a trailer of tools by B&W.

Rental Facility Saving

Assumption:
Existing off-site facility is no longer available for our SDS Lab. The equipment is critical to DN and renting an industrial complex will be required.

Method:
1. Input from Engineering on the expected rent & utility cost.

Incremental Benefit/Cost

Table-2: Basis, Assumptions and Estimates for Calculating NPV

Incremental Benefit/ Cost	Assumptions	Control Mtce Valve Shop	MM RV Test /Repair	MM Suprvrs. Offices	Reactor Mtce	MC Breaker & Relay Shop	Civil Mtce	Insulators / Building Mechanics Shop	Welding Shop	CDF/ FH/ SDS Lab	Electronics Shop	Predictive Mtce Shop
Productivity	** OT to maintain productivity (FTE/yr)	2-3-4	1-1.5-2	4-5-6	0.5-1-1.5	1-2-2.5					1	
	** Communication loss (min/FTE)											
	** UTP Coordination (FTE/yr)								1 FTE 1.5d per week			
	M&CD improvement for ** (%)	20-30-40	40	10-20-20	50	50			60-65-70		20	
	Training Saving with bigger group				1 FTE 1 month per PO							
	Feeder Repl RP UTP saving (FTE hr/PO)				180 (no impact after Retube)							
	Machine Shop RM UTP saving (FTE/yr)				0.5							
	Machine Shop RP UTP saving (FTE/yr)				0.25							
	% of crew in the Fab Shop (%)								15			
	Travelling loss for Fab Shop FTE (hr/d)								0.75			
Planned Outage Critical Path	Current PO Push (d/PO)				1-1.5-2	0-1.5-2						
	Current probability for PO Push				80	50						

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	(%/PO)											
	M&CD PO Push (d/PO)	8-9-10d in 10 years from rework			1-1.5-2	0-1.5-2						
	M&CD Probability for PO Push (%/PO)				20 (benefit of rehearsal to avoid rework)	25 (less rework)						
Forced Outage Critical Path	Current FO Push (d/FO)		0-1.5-2h/FO loss due to occupation of RV stand		1-7-14 (delay due to Mock up not in place & availability of turbine crane)	0-1.5-3						
	Current probability for FO Push (%/FO)		0-5-10		1.75	1.75-10-20						
	M&CD FO Push (d/FO)		0		0.5-1-2	0-1.5-3						
	M&CD Probability for FO Push (%/FO)		0-5-10		1.75	0.88-5-10 (less rework)						
UTP Saving	B&W saving on tools ($k/PO)				15-17.5-20 (no impact after Retube)							
Rental Facility Saving	Rent ($k/month)					0 (Whitby Facility is part of the Whitby Central Warehouse, pay no rent, no utility, housekeeping)				3 (relocate from AECL to an industrial complex)		
	Utility (k$/month)									1		
	Housekeeping ($k/month)									0		
Effectiveness	Factor due to % function & location(%)	0-60-60	50-80-80	100	100	100	100	100	100	100	100	100
UTP Cost	IPG Work	5-5-6 valves/wk (no work during Intensive Outage Valve Program)	26-28-30 RV/wk			Med Volt bkr - o/h every 12yr, PM every 6yr. Only do 600V bkr PM every 6yr. 347 Med Volt bkr & 658 600V bkr in total		Consider very min UTP for BM. Consider 10% insulators stay in the M&CD all the time & save 40min				

	Outage Work	10 valves/d	120-125-130 RV/PO					travelling time/d & 90% insulators in the field will lose 25% of time on UTP.				
	Function of Shop in M&CD (%)	60	80			Do 10% Med Volt bkr o/h & 100% PM at DN						
	Factor by using SAM or bundling (%)		20									
	Mtce UTP Handling Time (FTE hr/comp)	4	4			24 for Med Volt bkr & 16 for 600V						
	RP UTP Handling Time (FTE hr/comp)	2	2			2		0 (MS to cover RP)				

TABLE 3: Project Cost Estimate:

Design Complete:	Zero to Minimal	Fixed Price Contract	Yes	3rd Party Estimate	Yes
Quality of Estimate	Release +15% to -10%	OPEX used	Yes	Lessons Learned	Yes
Similar Projects	Yes	Budgetary Quote	Yes	First Unit Actual Used	N/A
Firm Vendor Proposal	Yes	Cost Sharing	No	Competitive Bid	Yes
Reviewed by Sponsor	Yes	Fee for Service	No	Contracts in place	Yes

Comments:

Project Estimate Assumptions:

- Procurement of new or relocation of existing maintenance equipment and tools are not included in the scope of this project but have been accounted for in the economics analysis (NPV).
- The project will plan and execute the de-commissioning, relocation and commissioning of the computer development equipment from the existing locations to the new facility in 2014. The OM&A costs of this work have been included in this BCS.
- Project Construction estimates are based on a fixed price EPC contract November 29, 2011.
- Project estimates are based on an AFS in October 2013.
- Project will be implemented under an owner only EPC type contract using F-MOD commercial process for the new facility
- The existing security protocols for the movement of the equipment between the station and the proposed building will be followed. The building will also be equipped with security access controls and other security features as required.
- New Building will be owned and maintained by Facilities.
- Location of new building is south of ASB in the current building 119 and adjacent parking lot.
- Overall cost for the New Maintenance facility and tie-ins is about $25.2 M including contingencies, and the new computer development facility is about $8.3 M, plus $1.0 M for relocation of equipment. Removal and write down costs are $ 2.915 M. Life to date cost as of Dec 2011 is 6.921. M.
- General contingency of $5.4 M is based on an extensive risk management plan with qualitative and quantitative analysis including Monte Carlo simulations.
- Specific contingency of $1.5 M is to mitigate potential power supply shortage, potential delays due to extreme weather conditions.

Rationale for Capital Cost Classification:

Capital – new construction.

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
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TABLE 4: Generation Plan Assumptions:

Station	Unit	EOL or Refurb	MW	Planned Outages for Project Work						
Pickering A	1	Jun-20	515							
	4	Jun-20	515							
Pickering B	5	Nov-18	516							
	6	Nov-18	516							
	7	Jun-20	516							
	8	Jun-20	516							
Darlington	1	Sep-16	878							
	2	Feb-18	878							
	3	Sep-19	878							
	4	Jan-21	878							

Comments:

The analysis was based on the above Darlington End Of Life EOL with a 30 years extension after the Refurbishment. For simplicity, benefits of the New M&CDF Facility during Refurbishment period (2016 to 2023) or final EOL (2046-2050) have not been scaled back. Notice that NPV of future years (2016-2023) and (2046-2050) should be relatively small.

**Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
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APPENDIX "E" ***PROJECT DELIVERABLES***

Release Deliverable	Description	Item	Cost ($000's)
Detailed Design remaining work	Design documents approved and issued Remaining Design work funded by this release.	1	1600
Project Management	Project Coordination and reporting	2	900
Procurement	Furniture and office computers for new Facility	3	2600
Construction	New Maintenance and Computer Development Facilty	4	18000
Installation Support	Contract administration	5	600
Commissioning	Commissioning of New facility	6	1000
Interest	Interest	7	2198
Contingency	General Contingency	8	5400
Contingency	Specific Contingency	9	1500
Relocate Computer Labs Equipmnt.	Relocate three computer labs equipment (OM&A)	10	1000
Total			**34,798**

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Business Case Summary

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
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ATTACHMENT "A-1" PROJECT COST SUMMARY 31717 (Capital)

	$ 000's Capital	LTD Dec 2011	2012	2013	2014	2015	2016	2017	Later	Total
Accounting Basis	Project Mgmnt & Support	2,237	450	400	150					3,237
	Engineering	526	250	250	100					1,126
	Procurement	81	1,000	1,500	100					2,681
	Construction	598	12,000	8,000	1,402					22,000
	Other	2,502	-	-	-					2,502
	OPG Installation Support	170	350	250	50					820
	SAVH	50	168	150	40					408
	CMO Support	15	250	200	30					495
	Interest (Capital Project)	742	1,200	1,000	108					3,050
	Project Costs	**6,921**	**15,668**	**11,750**	**1,980**	**-**	**-**	**-**	**-**	**36,319**
	General Contingency		3,000	2,400						5,400
	Specific Contingency		1,000	500						1,500
	Project Costs	**6,921**	**19,668**	**14,650**	**1,980**	**-**	**-**	**-**	**-**	**43,219**

	$ 000's Capital		LTD Dec 2011	2012	2013	2014	2015	2016	2017	Later	Total
Funding Basis	Current Release	Project Costs	9,876	2,500							12,376
		Contingency	772	400							1,172
		Total	**10,648**	**2,900**	**-**	**-**	**-**	**-**	**-**	**-**	**13,548**
	Adj to Current Release	Project Costs	(2,955)								(2,955)
		Contingency	(772)	(400)							(1,172)
		Total	(3,727)	(400)	-	-	-	-	-	-	**(4,127)**
	This Release	Project Costs		13,168	11,750	1,980					26,898
		Contingency		4,000	2,900						6,900
		Total	-	17,168	14,650	1,980	-	-	-	-	**33,798**
	TTD Released	Project Costs	6,921	15,668	11,750	1,980	-	-	-	-	36,319
		Contingency	-	4,000	2,900	-	-	-	-	-	6,900
		Total	**6,921**	**19,668**	**14,650**	**1,980**	**-**	**-**	**-**	**-**	**43,219**
	Future Releases	Project Costs								-	-
		Contingency								-	-
		Total	-	-	-	-	-	-	-	-	-
	Project Funding		**6,921**	**15,668**	**11,750**	**1,980**	**-**	**-**	**-**	**-**	**36,319**
	Contingency Funding		**-**	**4,000**	**2,900**	**-**	**-**	**-**	**-**	**-**	**6,900**
	Total Funding		**6,921**	**19,668**	**14,650**	**1,980**	**-**	**-**	**-**	**-**	**43,219**

Budget	**2012 - 2016 Business Plan**	18,255	21,714	7,183	0					**47,152**
	Variance to Budget	**(11,334)**	**(6,046)**	**4,567**	**1,980**	**0**	**0**	**0**	**0**	**(10,833)**

Other	**Removal Costs (above)**	1862								**1,862**
	Inventory W / O	1053								**1,053**
	Spare Parts in Invent									**-**

Reviewed by:	(Date)	Approved by:	(Date)
Name of Reviewer Project Manager	Jan 31, 2012	Name of Approver Strat IV Manager	Jan 31 - 2012

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Business Case Summary

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
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ATTACHMENT "A-2" PROJECT COST SUMMARY 38945 (OM&A)

	$ 000's OM&A	LTD Dec 2011	2012	2013	2014	2015	2016	2017	Later	Total
Accounting Basis	Project Mgmnt & Support				50					50
	Engineering				50					50
	Procurement				50					50
	Construction				650					650
	Other									-
										-
										-
										-
	Interest (Capital Project)									-
	Project Costs	-	-	-	**800**	-	-	-	-	**800**
	General Contingency				200					200
	Specific Contingency									-
	Project Costs	-	-	-	**1,000**	-	-	-	-	**1,000**

	$ 000's OM&A		LTD Dec 2011	2012	2013	2014	2015	2016	2017	Later	Total
Funding Basis	**Current Release**	Project Costs									-
		Contingency									-
		Total	-	-	-	-	-	-	-	-	-
	Adj to Current Release	Project Costs									-
		Contingency									-
		Total	-	-	-	-	-	-	-	-	-
	This Release	Project Costs				800					800
		Contingency				200					200
		Total	-	-	-	1,000	-	-	-	-	**1,000**
	TTD Released	Project Costs	-	-	-	800	-	-	-	-	800
		Contingency	-	-	-	200	-	-	-	-	200
		Total	-	-	-	**1,000**	-	-	-	-	**1,000**
	Future Releases	Project Costs								-	-
		Contingency								-	-
		Total	-	-	-	-	-	-	-	-	-
	Project Funding		-	-	-	**800**	-	-	-	-	**800**
	Contingency Funding		-	-	-	**200**	-	-	-	-	**200**
	Total Funding		-	-	-	**1,000**	-	-	-	-	**1,000**

Budget	**2011 - 2015 Business Plan**									-
	Variance to Budget	0	0	0	800	0	0	0	0	800
Other	**Removal Costs (above)**									-
	Inventory W / O									-
	Spare Parts in Invent									-

Reviewed by:	(Date)	Approved by:	(Date)
Morad Solaimani	Jan 31, 2012	Carm Agosta	Jan 31-2012
Name of Reviewer Project Manager		Name of Approver Strat IV Manager	

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
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ATTACHMENT "B" PROJECT VARIANCE ANALYSIS

	$ 000's Cap + OM&A	LTD Dec 2011	Total Project Last BCS Apr 2011	Total Project This BCS Mar 2012	Variance	Comments
Scores Basis	Project Mgmnt & Support	2,237	2,947	3,237	290	To cover 5 months extension
	Engineering	526	1,034	1,126	92	More work by OPG eng (NR) and Passport
	Procurement	81	2,381	2,681	300	For furniture and special security access
	Construction	598	24,055	22,000	(2,055)	Based on Fixed price EPC contract
	Other	2,502	3,602	2,502	(1,100)	Tie-ins will be done by EPC contract
	OPG Installation Support	170	686	820	134	To cover 5 months extension
	SAVH @ 17.25% OPG Labor	50	420	408	(12)	minor calculation variance
	CMO Support @ 1.25%	15	598	495	(103)	recalculation Based on LTD
	OM&A - New - Relocate CD equipment			1,000	1,000	Relocation of Computer Development Facilities equipment classified as OM&A.
	Interest (Capital Project Only)	742	3,050	3,050	-	recalculation Based on AFS in Oct 2013
	Project Costs (Scores Basis)	**6,921**	**38,773**	**37,319**	**(1,454)**	
	General Contingency		**9,441**	**5,400**	(4,041)	
	Specific Contingency		1,600	1,500	(100)	
	Project Costs (Scores Basis)	**6,921**	**49,814**	**44,219**	**(5,595)**	

Other	**Removal Costs included above**	**1,862**	**1,862**	**1,862**	-	
	Inventory to be written off	**1,053**	**1,053**	**1,053**	-	
	Spare Parts in Inventory				-	

Comments:

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
Full Release Business Case Summary D - BCS - 28270 - 10001 - R000

ATTACHMENT "C" **SCHEDULE**

Key Milestones

Completion Date	Description
28-Mar-12	FRF: : Full Funding Release Approved
26-Apr-12	PEP: Project Execution Plan for Full Release Approved
15-May-12	ICA: Release Phase 2 fro EPC for procurement and construction
28-May-12	SOI: Start of Installation of M&CDF
08-Aug-12	ECP: All Design Documents Approved. Detailed Design Completed
14-Aug-13	CMS: Start of Commissioning of M&CDF
30-Oct-13	AFS: New M&CDF available for service (Ready for occupancy)
27-Nov-14	PCO: Project closeout

A Project Execution Plan (PEP) will be approved by 26-Apr-12

In Service Declarations: (Capital only)

Date	Description	$000's	% In Service (= 100%)
28-Nov-13	AVAILABLE FOR SERVICE DECLARATION FORM APPROVED and REIS approved. Ready for Occupancy of the M&CD facility	31,424	94 %
30-May-14	REIS approved for outstanding work after ready for occupancy	1,980	6 %

Comments:

Darlington Maintenance and Computer Development Facility 16-31717(Capital)16-38945(OM&A)
Full Release Business Case Summary D - BCS - 28270 - 10001 - R000

Attachment "D" **Risk Probabilities Chart**

Likelihood	Improbable	Unlikely	Possible	Likely	Probable
Probability	<= 1 in 100	About 1 in 100	About 1 in 10	About 1 in 5	>= 3 in 4
Rank	1	2	3	4	5

Risk Impact Chart

Impact Rating	Financial	Project Schedule 12 month	Quality	Corporate Reputation	Regulatory / Legal	Health & Safety	Environment	Nuclear Safety
5	>80% of Total Project $	> 90 day delay	Significant, unacceptable non-conformance requiring extensive rework	National and international adverse coverage or impacts	Non-compliance with potential for significant implications for personnel, potentially large damages or Criminal Charges OR Potential loss of operating licenses	Potential for fatality(s)	Spill or release causing immediate and extended impact with off-site impacts, e.g.:Clean-up costs > $15MCat. A spill (>55 pts)	Loss or serious degradation of a safety system
4	30% - 80% of Total Project $	30 - 90 day delay	Unacceptable non-conformance requiring some rework, but not major	Long-term local or national impact	Legislative non-compliance with potential for fines, charges, and damages ORMajor degradation of reputation with regulatory bodies	Potential for life-threatening critical injury or permanent total disability, including occupational disease	Exceedances resulting in charges or Director's OrderCat. A spill (45 - 55 pts)Public complaints with OPG implications Explosion and/or major fire	Reduced effectiveness of a safety system
3	15% - 30% of Total Project $	10 - 30 day delay	Non-conformance bordering design tolerances, potential to require rework	Major local impact or minor national impact.Minor local damage	Systematic non-compliance with potential for finesORPotential to cause strained relationship with regulator, increased surveillance and/or regulations	Potential for less serious critical injuries (e.g. fractures), permanent partial disabilities and temporary total disabilities of a significant nature	Cat. B spillsEmission in exceedance of regulatory or legal limitsField orders or AMP'sPublic complaints with OPG implicationsDanger to health, life, or property	Reduced effectiveness of redundant safety system components
2	5% - 15% of Total Project $	3 - 10 day delay	Acceptable non-conformance, within design tolerances, no rework required	Complaints from local officials / politicians	Systematic non-compliance with impacts to project scheduleORPossibility of regulatory / legal implications	Potential for less serious temporary disabilities and injuries requiring off-site medical attention other than first-aid. Complete recovery by worker.	Cat. C spills - reportableAdministrative infractionsPublic Complaints with plant level implications	Impact on a safety support or safety related system
1	<5% of Total Project $	< 3 day delay	Minimal impact on qualityRoutine non-conformance, can be easily dispositioned	Complaints from local public	Isolated non-complianceORRoutine approval / notification	No medical attention beyond first aid, no impairment to worker or complete recovery of worker	Administrative, non-reportable eventsCat. C spills non-reportable and spills resulting from Acts of God	

ONTARIO POWER GENERATION

Records File Information:
Records SCI/USI Retention
- See Guidance Section

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OPG-FORM-0076-R005*

Type 3 Business Case Summary

To be used for investments/projects meeting Type 3 criteria in OPG-STD-0076.

Executive Summary and Recommendations

Project Information			
Project #:	16-33621	**Document #:**	D-BCS-73980-10004 R000
Project Title:	DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Sustaining
Phase:	Execution	**Release:**	Superseding
Facility:	Darlington	**Target In-Service or Completion Date:**	Apr 2017 (All AFS)

Project Overview

We recommend a superseding release of $11,983 k ([redacted] base costs plus [redacted] contingency).
This will bring the total-to-date release to $25,772k, including [redacted] of contingency, compared to the previous release of $13,789 k, including [redacted] contingency.
The estimated total project cost is $28,299 k, including [redacted] of contingency, compared to the previous estimate of $19,316 k including [redacted] of contingency.

The quality of the estimate for this release and the project is Class 3

This release will fund the following scope of work:

- Installation, Commissioning and Available for Service (AFS) of 4 Secondary Control Area (SCA) ACUs of the remaining 6 ACUs.
- The completion of all Detailed Design including ESW pipe replacement and Technical Operability Evaluation (TOE) Control upgrades.
- Installation, Commissioning and AFS for the ESW pipe replacements on all 4 Units.
- NEW SCOPE: Installation, Commissioning and AFS for all SCA ACU TOE upgrades (ref #5).
- Procurement of material.
- Closeout activities for Design ECs which are AFS'd.
- Preparation of the Final Execution Business Case Summary (BCS).

The future release will fund the following scope of work:

- Installation, Commissioning and Available for Service (AFS) of the last 2 Secondary Control Area (SCA) Air Conditioning Units (ACUs).
- ESW Temporary Modification (TMOD) removal for all 4 units.
- Closeout of all Design EC's.
- Project Closeout.

Problem Statement/Business Need:

The Secondary Control Area air conditioning system comprises 10 air conditioning units, two per SCA. The purpose of the air conditioning system is to provide a suitable environment for the reliable operation and long service life of the electrical and electronic equipment, comfortable working conditions for operating personnel, and emergency smoke removal.

These ACUs are at end of life and are experiencing high functional failures. In addition there are 4 independent manufacturers across the station without interchangeable parts. Three of the 4 manufacturers are no longer in business and a complete set of spare parts cannot be procured. The decreasing reliability of these ACUs , increasing complexity to obtain spare parts and increasing maintenance workload all contribute to the risk to unit operation and could result in a complete station shutdown.

New scope added to the original project includes two Technical Operability Evaluations. The replacement of the Emergency Service Water piping from the header to the SCA ACUs due to inadequate ESW flow (Ref #4), and revisions to the ACU control

*Associated with OPG-STD-0076, Developing And Documenting Business Cases

Type 3 Business Case Summary

Project #: 16-33621 Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Project Overview

logic to correct legacy issues (Ref #5).

The business driver for this project is the loss of generation due to the possibility of a forced Unit/Station shutdown. The proposed improvement to the ACU System will bring the system back to design conditions, significantly reduce the length of time the system is without redundancy due to failed components and diminish the risk of a forced Unit or Station shutdown.

Summary of Preferred Alternative:

Replacement of the 10 SCA ACUs with reliable units. These units will be supplied by one manufacturer (to simplify spare parts inventory). Replacement of the ESW supply and return lines with larger lines to ensure there is adequate supply of water for the ACUs to function properly. Further to this the ACU control logic (including legacy units) is required to ensure the ACUs function as designed following restoration of ESW pressure and 600V power. This will bring the system back to design conditions and significantly reduce the risk of a forced outage due to elevated SCA temperatures.

The project team is working towards completing the TOE-73980-00001 TAB 271 Revision 02 within the assigned milestone.

Current Status & Project Cost Estimate

This project was awarded with separate Engineering and Construction contracts following a competitive bidding process.

The Detailed Design activities, OPG project execution and Construction activities have exceeded the cost estimate in the last BCS. Additionally new scope has been added to this project to resolve issues identified under TOE (Ref #5). The cost underestimate and new scope has added [redacted] to the total project completion cost. A breakdown of the significant cost variances follows:

(i) **OPG Project Management and support organization costs increased by** [redacted]

- Project Management and Modification Execution costs have increased due to project schedule delay and compression of work activities to meet tight installation windows and retaining the current OPG lead project execution contracting strategy.
- Field engineering support costs have increased, due to new project scope, and reassessing of installation work packages and quality assurance activities by OPG. New estimates are based on field executed work.
- ACU and TOE installations are first of a kind installations, OPG maintenance commissioning support was higher than estimated. New estimates are based on field executed work.

(ii) **OPG Design cost increased by** [redacted]

- OPG design and Design Team Lead (DTL) support costs have increased, due to schedule extension and new TOE design scope.

(iii) **Material cost increased by** [redacted]

- Cost increase is due to underestimate of ESW material cost and new TOE scope.

(iv) **Construction and other contracts increased by** [redacted]

- Construction vendor costs have increased based on new scope for TOE and higher than expected costs for ACU installations. The quality assurance activities have been moved from the construction contractor to OPG.
- Engineering vendor costs have increased based on final contract negotiations for ESW line replacements and new scope for TOE.

(v) **Interest increased by** [redacted]

- Interest has added an additional [redacted] to the total project completion cost.

(vi) **Contingency**

Contingency funding increased by [redacted] compared to the last BCS's estimate. Refer to appendix B for a detailed explanation of the cost variance.

History of BCS releases and project cost estimates:

The project scope remains largely unchanged from the previous BCS. However, new scope to resolve the TOE (Ref #5) has been added to the project. ACU installations were placed on hold until the detailed design for this TOE was completed.

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Type 3 Business Case Summary

Project #: 16-33621 Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Project Overview

This effort, combined with the limited installation window for these ACUs, have added approximately 2 years delay to the installation schedule. The final AFS for this project has slipped from March 27, 2015 to April 12, 2017.

Partial Release BCS Scope:

- Detailed design for the replacement of the 10 ACUs - Completed
- Replacement of 3 ACUs (U0-ACU2, U1-ACU2, U3-ACU1) - Completed

Superseding BCS Scope:

- Design of the temporary ESW supply - Completed
- Installation of the temporary ESW supply - Completed
- Installation of 3 ACUs (U0-ACU1, U1-ACU1, U3-ACU2) – AFS 30-Mar-2014 – Not completed due to new TOE
- Detailed design of the new ESW lines – milestone 30-Jul-2014 – Only preliminary design completed
- Material procurement for the new ESW lines – Not completed

Second Superseding BCS Scope (this BCS):

- Installation of 4 ACUs, new replacement sequence to meet DNGS needs following TOE (U0-ACU1, U2-ACU2, U4-ACU1, U2-ACU1)
- Detailed design and installation of the new permanent ESW lines in 4 units
- Material procurement for the new permanent ESW lines
- Design and installation for ACU Control Revisions due to TOE (Ref # 5)

Key Assumptions and Risks:

Assume installation schedule follows the integrated on-line installation schedule and that resources will be available for scheduled work.

ACU installations can occur between November and March, when the outside air temperature will not exceed 13 degrees Celsius.

Work on Unit 1 ACU2 TOE, Unit 2 ACU2 replacement/TOE, U3 ACU1 TOE and U4 ACU1 replacement/TOE will have to be injected in the schedule. Station resources are currently not available during the Vacuum Building Outage (VBO). Projects team is working with the Station to resolve resource issue.

Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD 2014	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	11,905	1,884	0	0	0				13,789
Requested Now		4,447	7,274	262	0				11,983
Future Required		0	844	1,568	115	0			2,527
Total Project Cost	11,905	6,331	8,118	1,830	115	0	0	0	28,299
Ongoing Costs		0	0	0	0				0
Inventory (spares)		144	144	0	0				288
Grand Total	11,905	6,475	8,262	1,830	115	0	0	0	28,587

Estimate Class:	Class 3	**Estimate at Completion:**	[redacted]
NPV:	N/A	OAR Approval Amount:	$ 28,587 k

Additional Information on Project Cash Flows (optional):

Project Contingency is estimated at [redacted] total with the following annual cash flow ($k):

- 2015: [redacted] 2016: [redacted] 2017: [redacted] 2018: [redacted]
- Spare parts inventory for new installed ACUs is estimated at $144k for 2015 and an additional $144 k for 2016

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Type 3 Business Case Summary

Project #: 16-33621
Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

- Spare parts inventory to be written off is estimated at $116 k for the old ACU spares. Refer to Appendix E for the complete list of spare parts inventory.

Approvals			
	Signature	**Comments**	**Date**
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meat the validated business need.			
Recommended by (Project Sponsor): G. Jager President OPG Nuclear and CNO			27 JUL 2015
I concur with the business decision as documented in this BCS.			
Finance Approval: B. Summers SVP and CFO			Aug 12/15
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: T. Mitchell J. Lyash President and CEO per OAR 1.1			Aug 31, 2015

ONTARIO POWER GENERATION

Records File Information:
Records SCI/USI Retention
- See Guidance Section

OPG Confidential

OPG-FORM-0076-R005*

Type 3 Business Case Summary

Project #: 16-33621
Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Business Case Summary

Part A: Business Need

The Secondary Control Area air conditioning system comprises 10 air conditioning units, two per SCA. The purpose of the ACU system is to provide a suitable environment for the reliable operation and long service life of the electrical and electronic equipment, comfortable working conditions for operating personnel, and emergency smoke removal.

These ACUs are seismically-qualified, safety related equipment. They are not performing properly as required by design requirements, and functional failures are excessive. In addition there are 4 independent manufacturers across the station without interchangeable parts between the ACUs. Three of the 4 manufacturers are no longer in business and a complete set of spare parts cannot be procured. The decreasing reliability of these ACUs , increasing complexity to obtain spare parts and increasing maintenance workload all contribute to the risk to unit operation and could result in a complete station shutdown.

The ACU reliability has deteriorated to the point that it represents a significant risk to unit operation and/or complete station shutdown. Per Abnormal Incidents Manual Part A (Ref #6), if the temperature in the Unit SCA or Common SCA becomes greater than 32°C and repairs to the ACU system cannot bring the temperature below 32°C within 4 hours (8 hours for Common SCA) and then control the temperature, a controlled shutdown of the affected unit (or entire station for Common SCA) must be commenced within 2 hours (4 hours for common SCA).

New scope added to the original project includes two Technical Operability Evaluations. The replacement of the Emergency Service Water piping from the header to the SCA ACUs due to inadequate ESW flow (Ref #4), and revisions to the ACU control logic to correct legacy issues (Ref #5).

The business driver for this project is the loss of generation due to the possibility of a forced Unit/Station shutdown. The proposed improvement to the ACU System will bring the system back to design conditions, significantly reduce the length of time the system is without redundancy due to failed components and diminish the risk of a forced Unit or Station shutdown.

Part B: Preferred Alternative: Replacement of SCA ACUs, Upgrade of ESW Supply & ACU Control Revisions

Description of Preferred Alternative

Replacement of the 10 SCA ACUs with reliable seismically qualified units. These units will be supplied by one manufacturer (to simplify spare parts inventory). Replacement of the ESW supply and return lines with larger lines to ensure there is adequate supply of water for the ACUs to function properly. Further to this, new scope to revise the ACU control logic (including legacy units) is required to ensure the ACUs function as designed following restoration of ESW pressure and 600V power. This will bring the system back to design conditions and significantly reduce the risk of a forced outage due to elevated SCA temperatures.

Deliverables:	Associated Milestones (if any):	Target Date:
Available For Service U0-ACU1	Available For Service U0-ACU1	24-Apr-2015
Available For Service U2-ACU2	Available For Service U2-ACU2	29-Jan-2016
Available For Service U4-ACU1	Available For Service U4-ACU1	26-Feb-2016
Available For Service U2-ACU1	Available For Service U2-ACU1	31-Mar-2016
Available For Service U3-ACU2	Available For Service U3-ACU2	16-Dec-2016
Detail Design Complete Permanent ESW Supply / Return Line	Detail Design Complete Permanent ESW Supply / Return Line	29-Jan-2016
Available For Service ESW PMOD Unit 1	Available For Service ESW PMOD Unit 1	03-Jun-2016
Available For Service ESW PMOD Unit 2	Available For Service ESW PMOD Unit 2	15-Jul-2016
Available For Service ESW PMOD Unit 3	Available For Service ESW PMOD Unit 3	02-Sep-2016
Available For Service ESW PMOD Unit 4	Available For Service ESW PMOD Unit 4	15-Nov-2016
New U0-ACU2 TOE AFS New U1-ACU2 TOE AFS Legacy U1-ACU1 TOE AFS	Available For Service ACU Control Revisions (TOE)	30-Jun-2016 (All units)

*Associated with OPG-STD-0076, Developing and Documenting Business Cases

Type 3 Business Case Summary

Project #: 16-33621 Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Deliverables:	Associated Milestones (if any):	Target Date:
Legacy U2-ACU1 TOE AFS		
Legacy U2-ACU2 TOE AFS		
Legacy U3-ACU2 TOE AFS		
New U3-ACU1 TOE AFS		
Legacy U4-ACU1 TOE AFS		
Legacy U4-ACU2 TOE AFS		
Execution Business Case Summary Full Approved	Execution Business Case Summary Full Approved	30-Sep-2016

Part C: Other Alternatives

Summarize all viable alternatives considered, including pros and cons, and associated risks. Other alternatives may include different means to meet the same business need, and a reduced or increased scope of work, etc.

Alternative 2: Base Case – No Project

This alternative is not recommended because the SCA ACUs are at their end of life and failure to improve their reliability will increase the risk of a Unit or Station shutdown due to the SCA temperature exceeding prescribed temperature limits.

Alternative 3: Delay Work

Delaying the project is not recommended as it will leave the station exposed to an elevated risk of a forced shutdown due to the inability to maintain the Units SCAs / Central SCA temperatures below the prescribed limits. In the past the station has been forced to operate without redundancy while searching, qualifying, reverse engineering and procuring spare parts.

Alternative 4: Replace Five (5) of Ten (10) Existing ACUs

This alternative is not recommended. This alternative is to replace one of two ACUs on each reactor unit and salvage the parts of the removed ACU. It is not recommend since the majority of the cost involved is leading up to the first installation and the risk is only reduced by half, as there is still one unreliable ACU on each operating unit. Also, since there are four (4) independent manufacturers, parts are not interchangeable between units and, as a result, will not provide us with enough spare parts to maintain these units operable for the life of the station. Overall, this option does not provide a sufficient inventory supply of spare parts. The station will remain at a high risk of a forced shutdown, due to the increasing unreliability of the existing units.

Alternative 5: Spare Parts Only

This alternative is not recommended. Electing to maintain these ACUs operable through sourcing, qualifying and procuring equivalent parts for use is not feasible as it has been confirmed that a complete set of equivalent spares cannot be found.

This option is not recommended since these units are at the end of their life and component failures are increasing. Due to the fact that the original equipment manufacturers (OEMs) are out of business and these units being seismically qualified, identical replacement parts cannot be found and an extensive time and money effort is required to located, procure, qualify or reverse engineer a part for use. In summary, this alterative does not rectify the problem (a complete set of critical spares parts are not available) and has not been evaluated further.

Type 3 Business Case Summary

Project #: 16-33621 Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Part D: Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD 2014	2015	2016	2017	2018	2019	2020	Future	Total
Currently Released	11,905	1,884	0	0	0				13,789
Requested Now		4,447	7,274	262	0				11,983
Future Required		0	844	1,568	115	0			2,527
Total Project Cost	11,905	6,331	8,118	1,830	115	0	0	0	28,299
Ongoing Costs		0	0	0	0				0
Inventory (spares)		144	144	0	0				288
Grand Total	11,905	6,475	8,262	1,830	115	0	0	0	28,587

Estimate Class:	Class 3	**Estimate at Completion:**	[redacted]
NPV:	N/A	**OAR Approval Amount:**	$ 28,587 k

Additional Information on Project Cash Flows (optional):

Project Contingency is estimated at [redacted] total with the following annual cash flow ($k):

- 2015: [redacted] 2016: [redacted] 2017: [redacted] 2018: [redacted]
- Spare parts inventory for new installed ACUs is estimated at $144k for 2015 and an additional $144 k for 2016
- Spare parts inventory to be written off is estimated at $116 k for the old ACU spares. Refer to Appendix E for the complete list of spare parts inventory.

k$	Preferred Alternative	Base Case	Delay Work
Project Cost	28,299	N/A	N/A
NPV	N/A	N/A	N/A
Other (e.g., IRR)			

Summary of Financial Model Key Assumptions or Key Findings:

As per OPG-STD-0076, a financial evaluation is not required for sustaining investment type projects.

Part F: Qualitative Factors

None.

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Quality	There is a risk that the installed design will not meet design intent of the modification due to integration errors. There are multiple vendors interfacing through OPG and the design is complex, includes multiple systems and is addressing legacy design issues.	The project has assigned a dedicated OPG Design Team Leader and has assigned other design support in various disciplines. Lessons learned from the installed portion of this project is being tracked and used to update any design revisions for future work.	Medium	Medium
Resources	There is a risk that station resources may not be able to support installation and commissioning activities, further extending the project schedule. ACU installations occur in the winter months between November and March. This is	The lack of resources has been officially noted at the Senior Information Meeting (SIM) dated November 3, 2014. The maintenance manager took an action to determine which work can be supported and will keep projects informed.	Medium	Medium

Type 3 Business Case Summary

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Part G: Risk Assessment				
Risk Class	**Description of Risk**	**Risk Management Strategy**	**Post-Mitigation**	
	also the time when critical station resources are required to perform regulatory required predefined maintenance activities on all station air conditioning systems. Further compounding the 2015/2016 winter installation resources, is the fall vacuum building outage.	The project will work closely with work control and mechanical maintenance to schedule work according to the integrated online planning procedure and will escalate conflicts to Darlington senior management as conflicts arise.		
Schedule	Materials for these modifications are supplied in kits, and require assembly on site and field customization. Some of the assemblies have been pulled and returned to store without verification. The risk is that these assemblies may not be complete.	Project will assess the status of the material in accordance with the IPG timeline and will ensure through diligence to have holds removed. A field team leader will be added to the project team and will investigate the material status of the project. Contingency is added in case material requires to be purchased or expedited.	Low	Low
Schedule	There is a risk that TMOD Removal Extension Request for Master EC # 121654 target completion date of September 2016 requires extension.	The project will closely monitor the progress of the permanent ESW design and installation planning. The ESW TMOD constructor will be involved in early design phase for constructability input.	Medium	Low
Cost	There is a risk that new discovery work adds scope to the project. The project has been delayed 2 years due to continuous discovery work. Two TOEs (Ref # 4 & 5) have been issued and the project absorbed legacy issues. There is a possibility of more discovery work during implementation of TOE solutions and replacement of new ACUs.	The project charter has been revised to include the new scope. No further legacy scope will be added to this project. Contingency is added in case new scope is discovered during commissioning the TOE solutions, which includes software revision 12. . Lessons learned from the installed portion of this project is being tracked and used to update any design revisions for future work.	Low	Medium

Part H: Post Implementation Review (PIR) Plan		
Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Simplified PIR	Apr 2017 (All AFS)	Dec 2017

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
Reliable ACUs. No functional failures.	ACUs are unreliable, functional failures occur within 2 year period.	No functional failures of ACUs prior to PIR approval. ACUs will have an operational period ranging from 3 years (first install) to 6 months (last install).	Station Condition Records will be reviewed	System Responsible Engineer
Cooling, heating, humidification, and pressurization must be maintained per design and operating manual.	No humidity control.	Cooling, heating, humidity, and pressurization within design and operating manual specification.	Available for Service and will be measured against specifications. Station Condition Records will be reviewed	System Responsible Engineer
ACU control meets operational	The ACUs do not automatically restart following restoration of	ACUs will automatically restart, without need for	Available for Service Declaration	System Responsible Engineer

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Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
requirements.	ESW pressure or 600V power & 120V control power.	operator manual reset, following restoration of ESW pressure or 600V power & 120V control power.		
Emergency Service Water Flow meets ACU requirements.	Insufficient ESW flow to USCA ACUs (Temporary fix installed under MEC # 121654)	Permanent fix to allow ESW flow to USCA ACUs at minimum rate of 4,165 L/s.	Available for Service and will be measured against specifications. Station Condition Records will be reviewed	System Responsible Engineer

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Type 3 Business Case Summary

Project #: 16-33621 Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

For Internal Project Cost Control

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Type 3 Business Case Summary

Project #: 16-33621
Document #: D-BCS-73980-10004 R000
Project Title: DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement, <Superseding> <Execution> Release

Appendix A: Summary of Estimate										
Project Number:	16-33621									
Project Title:	DN Secondary Control Area (SCA) Air Conditioning Unit (ACU) Replacement									
k$	LTD 2014	2015	2016	2017	2018	2019	2020	Future	Total	%
OPG Project Management	3,635	1,130	1,088	362	90	-	-	-	6,305	23
OPG Engineering	1,034	343	197	174	-	-	-	-	1,748	6
OPG Procured Materials	1,349	443	566	192	-	-	-	-	2,550	9
Design and Construction Contract(s)	[redacted]									
Other Contracts/Costs										
Interest										
Subtotal										
Specific Contingency										
General Contingency										
Total	11,905	6,331	8,118	1,630	115	-	-	-	28,299	100
Removal Cost	60	20	100	20	-	-	-	-	200	

Notes			
Project Start Date	2009-02-11	Total Definition cost (excludes unspent contingency for Nuclear)	[redacted]
Target In-Service (or AFS) Date	Apr 2017	Contingency Included in this BCS (Nuclear only)	
Target Completion Date	Apr 2018	Total contingency released plus contingency in this BCS (Nuclear only)	
Escalation Rate	2%	Total released plus this BCS without contingency (Nuclear only)	
Interest Rate	5%	Total released plus this BCS with contingency (Nuclear only)	$25,772 k
Removal Costs	$200 k	Estimate at Completion (Includes only spent contingency for Nuclear)	[redacted]

Prepared by:		Approved by:	
A Abdalla	2015-07-27		2015-07-27
Ayman Abdalla Project Leader Design Projects, P&M	Date YYYY-MM-DD	Scott Ritzie Section Manager Design Projects, Projects & Mods	Date YYYY-MM-DD

Type 3 Business Case Summary

Project #: 16-33621
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Appendix B: Comparison of Total Project Estimates and Project Variance Analysis

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in k$ (by year including contingency)						Future	Total Project Estimate
			LTD 2014	2015	2016	2017	2018	2019		
Definition	Full	2009-02-11	8,448	0						8,448
Execution	Partial	2010-05-11	12,018	273	0					12,291
Execution	Super	2013-06-20	16,942	2,309	65					19,316
Execution	Super		11,905	6,331	8,118	1,830	115			28,299

Project Variance Analysis

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	3,635	2,131	6,305	4,174	There was an underestimate of OPG resources required to support this project. Project engineers, field engineering, contract administrators, maintenance and operations support required to support 2013 & 2015 installations were higher than estimated. Future estimate was re-calculated based on latest project history information.
OPG Engineering	1,034	943	1,748	805	Increase due to delays and new scope.
OPG Procured Materials	1,349	1,939	2,550	611	Increase due to new TOE scope.
Design and Construction Contract(s)	[redacted]				
Other Contracts/Costs					
Interest					
Subtotal					
Contingency					
Total	11,905	19,316	28,299	8,983	

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Project #: 16-33621 Document #: D-BCS-73980-10004 R000
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Appendix C: Financial Evaluation Assumptions
Key assumptions used in the financial model of the Project are (complete relevant assumptions only):
Project Cost: 1. Design cost estimates are based on existing contracts with vendors. 2. Future ACU construction replacement costs are estimated based on executed ACU replacements and existing contracts with vendor. 3. Future ESW permanent pipe replacement execution costs are based on the installed temporary ESW hosing. **Financial:** 1. Eleven AFS are assumed for interest calculation. 1 AFS per ACU replacement. 1 AFS per ESW permanent modification (PMOD). 1 AFS for control TOE solution implementation. **Project Life:** 1. All work will be executed by April 2017.

Appendix D: References
1. D-BCS-73980-10002 – DN Secondary Control Area ACU Replacement Partial Release BCS 2. D-BCS-73980-10003 - DN Secondary Control Area ACU Replacement Superseding Partial Release BCS 3. D-PCH-73980-10001 – Project Charter 4. NK38-TOE-72800-00001 TAB 259, Potential ESW flow degradation to USCA ACUs 5. NK38-TOE-73980-00001 TAB 271, Potential unavailability of SCA ACUs during harsh environment accident conditions 6. NK38-OM-09013A, Operating Memo AIM Part A – Impairment of Special Safety Systems and Elected Safety Related Systems

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Appendix E: Spare Parts Inventory (to be written off) for OLD ACUs

Unit 1 ACU1 Equipment - Manufacturer EDPAC - MODEL- WB 8033					
CATID	Description	Unit Price	Status	On Hand	Total Spares
632865	RELAY, CONTACTOR, CONTACT RATING 25A, 3PST, COIL VOLTAGE 24VAC	$37.26	READY	5	$186.30
611730	PLUG, FUSIBLE PRESSURE, -, 3/8" MNPT, REFRIGERANT,168 DEG F	$54.65	READY	3	$163.95
194113	CONTACTOR, ., -, 24V, 25/30A	$75.38	READY	2	$150.77
194112	BOARD, PRINTED CIRCUIT, -, PROCESSOR	$1,108.76	READY	5	$5,543.78
195324	BOARD, PRINTED CIRCUIT, TEMPERATURE,HUMIDTY SENSOR	$273.77	READY	2	$547.54
195152	DISPLAY, LIQUID CRYSTAL, -	$86.58	READY	4	$346.30
195151	BOARD, PRINTED CIRCUIT, -, BAR LED	$230.69	READY	4	$922.75
195150	PAD, ., -	$214.66	READY	4	$858.64
195149	SWITCH, FILTER, -	$70.42	READY	4	$281.66
195148	BUZZER, ., -, 24V	$28.46	READY	4	$113.84
195147	BOARD, PRINTED CIRCUIT, INTERFACE,P/N 65007	$1,356.34	READY	2	$2,712.68
192121	BOARD, PRINTED CIRCUIT, -, HI WATER SENSOR	$84.50	READY	1	$84.50
192122	BOARD, PRINTED CIRCUIT, -, MAIN CONTROL	$337.39	READY	1	$337.39
192116	PLUG, ., LINE, 600VAC, FOR CONDAIR HUMIDIFIER	$58.59	READY	1	$58.59
192117	PLUG, ELECTRICAL, HUMIDIFIER, 600VAC	$26.76	READY	1	$26.76
195499	PLUG, ., -, WHITE SENSOR CYLINDER FOR NHMC150 HUMIDIFIER	$47.86	READY	2	$95.72
194885	VALVE, ., -, DRAIN, PLUG FOR NORTEC AIR CONDITION 1326126 HUMIDIFIER MODEL OES400	$171.67	READY	3	$515.00
473072	CONTACTOR, CONTROL, 24VAC, SECONDARY LINE VOLTAGE, CONTROL FOR ACU1, 3 POLE	$128.00	READY	10	$1,280.00
473075	SWITCH, AUXILIARY, 24 VAC, CONTROL, 3-POLE	$80.00	READY	2	$160.00
543091	HEATER, ELECTRIC, ., 12.5KW, FOR EDPAC ACU MODEL WB8033	$409.22	READY	1	$409.22
603666	VARISTOR, ., 30V, DISC FOR 0-73980-ACU1...MODEL WB 8033	$7.11	READY	8	$56.86
					$14,852.27

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Unit 2 ACU1 Equipment - Manufacturer: HIROSSCAN - Model: U56W04					
CATID	Description	Unit Price	Status	On Hand	Total Spares
194328	COMPRESSOR, REFRIGERATION, HERMETIC, SOLDER CONNECTIONS, 575V, 60HZ, 3P, FOR HIROSS EC OS AIR CONDITIONER U56W04	$4,916.67	Ready	1	$4,916.67
195584	CONDENSER, ., -, SHELL AND TUBE, WATER COOLED, 10 TONS CAPACITY, HORIZONTAL, APPROXIMATE OVERALL DIMENSIONS ARE 39" LONG X 7-1/2" DIA;	$3,535.00	Ready	2	$7,070.00
190670	FILTER, DRYER, -, 5/8" LINE SIZE, REFRIGERANT	$39.99	Ready	2	$79.98
481580	FILTER, DRIER, -, 1-1/8" ODF SOLDER ENDS, SUCTION LINE SEALED TYPE	$90.02	Ready	1	$90.02
193914	INDICATOR, MOISTURE, -, 5/8" ODF, SOLDER ENDS, FOR REFRIGERANTS WITH FULL VIEW SIGHT GLASS	$20.13	Ready	1	$20.13
194333	SWITCH, PRESSURE, -, AIR CONDITIONER	$72.09	NOPURCH	2	$144.18
288011	LIGHT, INDICATING, INCANDESCENT, 28V, AMBER, PANEL, TWO 0.25 INCH QUICK CONNECT	35.002	Ready	6	$36.00
192446	LAMP, INDICATING, -, 28VDC, RED LENS, (TYPICAL FOR HIROSS U36W03 OR U56W04 AIR CONDITIONER)	$10.69	Ready	4	$42.75
194332	SWITCH, PRESSURE, -, LOW	$63.18	NOPURCH	1	$126.36
194335	VALVE, SOLENOID, -, -, 24V AC, 5/8" INLET/OUTLET SOLDERED, TWO-WAY PILOT OPERATED, CONTINOUS DUTY, REFRIGERANT LIQUID LINE	$292.00	Ready	3	$876.00
190384	FILTER, ., -, -, 29-1/2" X 27" X 4"	$24.50	NOPURCH	1	$73.50
195053	VALVE, SOLENOID, -, 7/8", SOLDER, LESS COIL	$157.43	Ready	1	$157.43
154738	VALVE, ., -, DISCHARGE BYPASS, A3 ELEMENT, 5/8", SET PRESSURE 0 TO 80 PSI	$268.64	Ready	2	$537.28
194052	BOARD, PRINTED CIRCUIT, -, ALARM	$1,231.17	Ready	1	$1,231.17

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698875	VALVE, RELIEF, -, 1/2", 425 PSIG, MUELLER BRASS	$270.00	Ready	4	$1,080.00
					$16,481.46

Unit 2 ACU2 Equipment - Manufacturer: HIROSSCAN - Model: U56W04

CATID	Description	Unit Price	Status	On Hand	Total Spares
192118	GASKET, SPECIAL PURPOSE, DRAIN CANAL, FOR CONDAIR HUMIDIFER	$27.48	Ready	4	$109.9
192119	DRAIN, CANAL, -, -, PLASTIC, ROUND, PLASTIC CAP WITH DRAIN PORT AND RAISED HOLE IN CEN TRE OF BOTTOM	$45.29	Ready	3	$135.9
					$245.80

Unit 3 ACU2 Equipment - Manufacturer: ENVIROTEMP - Model: CEMW2036

CATID	Description	Unit Price	Status	On Hand	Total Spares
89983	BEARING, BLOWER, -, 1" ID, 2-17/32"(C/W RUBBER CARTRIDGE) OD, EXTENDED INNER RING TYPE, WITH RUBBER CARTRIDGE(CUP)	$25.27	Ready	8	$202.1446
357109	VALVE, ., -, CONTOL, EXPANSION THERMAL ELECTRIC STYLE FOR AIR CONDITIONER	$401.00	Ready	2	$802
357362	THERMISTOR, ., ., 50 OHM RANGE	$255.00	Ready	2	$510
490650	VALVE, ., -, HOT GAS BYPASS, 0/80PSIG, 1/2" SAE FLARE CONNECTIONS, BRASS BODY, ADJUSTABLE INTERNAL EQUALIZER	$308.55	Ready	2	$617.1
667368	CONDENSER, ., -, CO-AXIAL	$12,797.66	Ready	1	$12797.6589
9546	INSERT, COUPLING, -, .	$5.65	Ready	1	$5.650834
620280	SEAL, ., -, ROTALOCK VALVE 3/4", TEFLON, DIA OF GASKET 9/16"	$1.60	Ready	2	$3.2
503966	GASKET, ., 1", ROTALOCK	$6.06	Ready	4	$6.05625
					$14,944

Unit 4 ACU1 Equipment - Manufacturer: LIEBERT - Model: UH267W800

CATID	Description	Unit Price	Status	On Hand	Total Spares
601175	VALVE, SOLENOID, -, CONNECTION SIZE 7/8 ODF, 24V COIL, 50-60 HZ AMS 12 W	240.42375	Ready	2	$480.85
677672	COMPRESSOR, REFRIGERATION, FOR AIR CONDITIONER, 24 CFM @ 1750 RPM, 575V, 3PH, 60HZ, C/W SUCTION AND DISCHARGE VALVES, GASKETS, DBE C	$20,900.00	Ready	2	$41,800.00

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697326	VALVE, RELIEF, -, 1/4" MPT INLET, 3/8" FL OUTLET, 400 PSIG SET, BRASS, FOR ACU CONDENSER, SQ	$8,950.00	Ready	2	$17,900.00
195300	BOARD, PRINTED CIRCUIT, -, CONTROL	$464.50	Ready	2	$929.00
192228	BOARD, PRINTED CIRCUIT, -, LEVEL 0 ELECTRONICS	$2,214.00	Ready	1	$2,214.00
195194	BOARD, PRINTED CIRCUIT, -, AIR CONDITIONER, FOR CU069/WBOO AIR CONDITIONER	$1,412.77	Ready	1	$1,412.77
196513	BREAKER, CIRCUIT, OVERCURRENT	$25.53	Ready	1	$25.53
194030	CUTOUT, THERMAL, HUMIDIFIER SAFETY, OPN-RISE 225F	$9.28	Ready	2	$18.56
190211	FILTER, ., -, -, 16" X 20" X 4"	$7.94	Ready	3	$23.81
190210	FILTER, ., -, -, 20" X 25" X 4"	$40.46	Ready	3	$121.37
195196	LAMP, QUARTZ, 3800 WATTS, 575V, LEAD, T3, LIEBERT, P/N H-0030S	$200.87	Ready	6	$1,205.20
192281	MOTOR, FAN, -, -	$569.67	Ready	1	$569.67
196515	RELAY, MONITOR, 24V, SPDT	$18.72	Ready	1	$18.72
196514	RELAY, LOCK OUT, -	$25.53	Ready	1	$25.53
195188	RELAY, TIME DELAY, -, 24V	$22.12	Ready	1	$22.12
272437	RELAY, ., -	$27.57	Ready	1	$27.57
230325	SENSOR, HUMIDITY, -, 40 TO 60%, REMOTE	$197.23	Ready	2	$394.47
196516	TRANSFORMER, AIR CONDITIONER, -, 208V	$71.48	Ready	1	$71.48
196487	VALVE, SOLENOID, -, 1/8" NPT, FOR FOR AI R CONDITIONER SIZE CU47W CHALLANGER 2 C OMPUTER MTCE ROOM	$63.40	Ready	2	$126.80
192286	VALVE, SOLENOID, -, -, FOR AIR CONDITIONER MODEL CU47W	$133.78	Ready	2	$267.56
195186	VALVE, ., -, REGULATING, 1/4", FPT	$22.12	Ready	1	$22.12
192283	VALVE, SOLENOID, -, 1/2", 24 VDC COIL, AIR CONDITIONER LIQUID LINE	$110.73	Ready	3	$332.18
546468	VALVE, ., -, HOT GAS BYPASS, O-80 PSI, 7/8" SOLDERED CONNECTIONS	$223.97	Ready	3	$671.91
546473	ELEMENT, VALVE, -, ., ADJUSTABLE, FOR SPORLAN MODEL ADRHE6-78 HOT GAS BYPASS VALVE	$68.10	Ready	4	$272.40
546474	KIT, ., -, INTERNAL VALVE PARTS, FOR SPORLAN MODEL ADRHE-6-78-0/80 HOT BYPASS VALVE	$48.06	Ready	2	$96.12
196485	SWITCH, SAFETY, 25A@600VAC NON-INDUCTIVE LOAD, THERMOSTATIC, 120 DEG F TRIP, DPST	$230.00	Ready	1	$230.00
					$69,279.74
Total estimated $ for Spare Parts Inventory					**$ 116k**

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Business Case Summary

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
Full Release Business Case Summary D - BCS - 73910 - 10003 - R000

Name / Title / Phone	Location	Action	Signature	Date
M. Clemente Technical Engineer, Design Projects 703-1191	D08-ES1	Prepare BCS		July 16/2010
P. Monize Project Leader, Design Projects 703-1136	D08-ES1	Review BCS		July 16/2010
V. Tzambazis Project Manager, Design Projects 703-1180	D08-ES1	Review BCS		July 16, 2010
O. Wynia Section Manager, Project Mgmt Office 703-3563	BW7-02	Review BCS	FOR	19 JUL 10
T. Cvitkovic Manager, Design Projects 703-3571	BW7-02	Review BCS		16 July 2010
R. Bauer Manager, Performance Engineering 703-7325	D08-ES2	Review BCS		21 July 2010
J. Shemilt Manager, Projects Design 701-2748	P72-03	Review BCS		2 Aug 2010
D. Zerkee Manager, Nuclear Investment Mgmt 702-5058	P82-03	Review BCS		27 Jul 10
M. Peckham V.P., Projects & Modifications 701-6063	P72-01	Review BCS		
S. Seedhouse Senior Vice President, Darlington 703-7499	D08-ES3	Submit BCS		10 Aug 2010
R. Leavitt V.P. Nuclear Finance 702-5177	P82-03	Review BCS		Aug 12, 2010
W. Robbins Executive Vice President & CNO 702-5294	P82-6A	Review BCS		2010-08-16
D. Power VP, Corporate Investment Planning 400-7172	TCH07-D06	Review BCS		Aug 2/2010
D. Hanbidge Chief Financial Officer 400-2395	TCH19-F27	Approve BCS		Sept 2/2010
T. Mitchell President & CEO 400-2121	P82-6A	Approve BCS		Sept 3/2010
Sue MacKinnon Nuclear Investment Management 702-4082	P82-3B6.2	Return for Distribution		

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Business Case Summary

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
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V Tzambazis Project Manager, Design Projects 703-1180	D08-ES1	Review BCS		July 16, 2010
O Wynia Section Manager, Project Mgmt Office 703-3563	BW7-02	Review BCS		19 July 10
T Cvitkovic Manager, Design Projects 703-3571	BW7-02	Review BCS		16 July 2010
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M Peckham V P., Projects & Modifications 701-6063	P72-01	Review BCS		6 Aug 2010
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R Leavitt V.P. Nuclear Finance 702-5177	P82-03	Review BCS		
W Robbins Executive Vice President & CNO 702-5294	P82-6A	Approve BCS		
D Power VP, Corporate Investment Planning 400-7172	TCH07 D06	Review		
D Hanbidge Chief Financial Officer 400-2395	TCH19 F27	Approve BCS		
T Mitchell President & CEO 400-2121	P82-6A	Approve BCS		
Sue MacKinnon Nuclear Investment Management 702-4082	P82-3B6 2	Return for Distribution		

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
Full Release Business Case Summary D - BCS - 73910 - 10003 - R000

1/ RECOMMENDATION:

Approval of an additional $19.535 Million for a total project Full Release of $29.975 Million (capital, including contingency) is requested to complete the following:

- The installation/commissioning of one Tritium Removal Facility (TRF) Chiller
- The installation/commissioning of two Central Services Area (CSA) Chillers
- The installation/commissioning of six Reactor Auxiliary Bay (RAB) Chillers
- Closeout of the project.

The business objectives of this Regulatory project are:

- To comply with Environment Canada's 2003 Halocarbon Regulations by replacing the 10 chlorofluorocarbon (CFC) based water-cooled chillers at Darlington with units that use an approved refrigerant, by the January 1st 2015 Federal Regulation deadline, and one chiller at the Tritium Removal Facility by the January 1st 2012 Provincial Regulation deadline.
- To improve the performance of Darlington chiller system at low load conditions.

A Partial Release of $10.4 Million was approved in May 2007 to complete detailed engineering for all units, procure eleven chillers and install three units (two RAB and one TRF chiller). The Partial Release also identified potential savings to reduce the total project cost estimate from $23.2 Million to $14.9 Million. However, the final release quality estimate for this Full Release has demonstrated the total project cost will be significantly higher than previous projections. The total project cost estimate has increased due to schedule delays, experience gained from installations and a change in installation strategy for the CSA chillers.

To date, two RAB chillers have been installed and commissioned, with the TRF chiller planned to be installed and commissioned in the fall of 2010. All eleven chillers have been purchased and received, effectively mitigating the materials risk going forward. Detailed design is near completion for all eleven chillers. Included in the design will be the lessons learned from the first two installations by August 2010. For this Full Release, an independent third party estimating firm used the final details of these designs and the experience gained through the first two chiller installations to improve the accuracy of cost estimates. Life to date costs (as of Apr 28, 2010) are $9.2 Million, with all contingency requested to allow expenditure to the currently approved $10.4 Million.

The requested amount includes a specific contingency of $1.0 Million and a general contingency of $1.1 Million for issues as identified in the project risk register.

$000's (incl contingency)	Type	LTD 2009	2010	2011	2012	2013	2014	2015	Later	Total
Currently Released	Full - Phase 1	8,540	1,200	700						10,440
Requested Now	Full	(498)	4,766	8,134	6,764	369				19,535
Future Funding Req'd	N/A									-
Total Project Costs		8,042	5,966	8,834	6,764	369	-	-	-	29,975
Non Project Costs										-
Grand Total		8,042	5,966	8,834	6,764	369	-	-	-	29,975
Investment Type: Regulatory		Class: Capital		NPV: -17.2 M$			IRR: n/a		Discounted Payback: n/a	

Submitted By: (Date)

10-Aug 2010

S. Seedhouse
Senior Vice President Darlington

(OAR Element 1.1 Project in Budget)

Financial Approval By: (Date)

Sept 2/2010

D Hanbridge
Chief Financial Officer

Line Approval By: (Date)

3 Sept 2010

T. Mitchell
President & Chief Executive Officer

2/ BACKGROUND & ISSUES

Regulation Requirement

Halocarbons are chemical substances that include, among other components, elements in the halogen group of the periodical table (bromine, chlorine and/or fluorine) and carbon. They are used as refrigerants in air-conditioning and refrigeration systems, fire extinguishing agents in fire extinguishing systems and blowing agents in the manufacture of foams, and as solvents. Halocarbons pose a double-edged environmental problem. Firstly, most of them contribute to the depletion of the stratospheric ozone layer. Secondly, they are greenhouse gases which contribute to climate change. R-11 is the most common refrigerant in use.

Environment Canada's 2003 Federal Halocarbon Regulations mandated the phase-out of equipment containing CFCs: "Effective January 1, 2015 no person shall operate or permit the operation of any chiller [containing CFCs]" (Section 20). The federal regulation applies to the eight RAB Chillers and the two CSA Chillers at Darlington.

The Ontario Government is seeking to phase-out CFC refrigerant by January 1, 2012, three years earlier than the federal regulation. This impacts the TRF chiller which is under Ontario Provincial Regulation. The RAB and CSA chillers are required for safe operation of the nuclear reactors so they are only governed by the Federal Halocarbon Regulations. The TRF chiller is not required to operate the reactors, so it falls under the Provincial Halocarbon Regulations.

In addition, the poor performance of the existing 3-way control valve is identified as impacting the chiller operating at the low load conditions. Darlington requested to replace the 3-way valve controller in order to improve performance of the chiller system.

Project Scope

Darlington has twelve (12) chillers inside the operating island. One of the TRF chillers was replaced with a chiller using refrigerant R-134a in 2002 under a previous project. This project will replace Darlington's eleven R-11 water-cooled chillers with R-134a water-cooled chillers:

- 2 chillers in CSA provide cooling to CSA and Main Control Room (MCR). CSA chiller is in-service year-around and has no off-season.
- 8 chillers in RAB provide cooling to RAB and the instruments for shutdown system. RAB chiller off season is from the months of October to April.
- 1 chiller in the TRF provides cooling to Heavy Water Management Building (HWMB) and for its operational process needs.

The chiller installation includes the removal of the existing chillers, at a total value of approximately $330k. There is no significant salvage value to be realized from the existing/old chillers due to the age of the equipment and the phase-out of R-11 refrigerant.

Work to Date

As part of the previous scope, two chillers have been replaced. Both are located in the RAB, one in Unit 1 and one in Unit 2. The unit 1 chiller was declared in service in Dec 2009 and the unit 2 chiller was declared in service in July 2010. The TRF chiller was originally planned to be replaced in November 2008, the installation was delayed and it is now scheduled to be replaced in Sept 2010.

All remaining chillers have been purchased and are being stored in the OPG Whitby warehouse.

Detailed design work is progressing and is planned to be completed by August 2010. The remaining detailed design work is to apply all lessons learned from the first two installations into all remaining chiller replacements. The design agency contract has been completed and any installation support or further changes required to the design engineering change packages will be performed by OPG Project Design.

Issues

The project has experienced a number of delays which have resulted in schedule delays and costs over expenditures. Originally installation work was targeted to begin in Feb 2008, but the first installation did not begin until Oct 2009. This delay resulted in a number of additional costs and schedule delays.

The main reasons for the schedule delays during the current phase of the project are:

1) A vendor name change which delayed issuing of the purchase order for the chillers

- Purchase order could not be issued due to legal reasons; Credit Auditors and Lawyers from both OPG and Vendor were involved. The name change was a result of a new entity being created without an amendment of the existing company, requiring different supporting paperwork. See SCR# D-2007-07986.
- Schedule Delay of 6 months

2) Incorporating the results of the low load study into the design engineering change packages and the issuance of a purchase order for the new 3 way valve controller
   - The chillers could not be replaced with out a new 3 way valve controller, all detailed engineering could not be completed until a PO was issued and vendor's engineering documents were received.
   - Schedule delay 12 Months.

The main reasons for the cost over-expenditures during to the current partial release are:

1) Additional costs for Design Projects, Project Design and the contract for the design agency due to schedule delays above
   - Cost increase = $1,189k
2) Installation delays resulting in additional costs to the project. First installation was planned to take three weeks but actually took 11 weeks due to discovery issues and interferences
   - There were many lessons learned and subsequent design changes during the first installation. The lessons learned have been incorporated into all future design engineering change packages. The second installation faced similar issues but as they were known ahead of time the problems were anticipated and addressed. Installation costs on the second chiller were reduced by more then 50%. Cost increase = $695k
3) Rework due to lessons learned and design quality issues, resulting in more effort from OPG Design, Projects and Field Engineering
   - All detailed engineering was contracted to a Design Agency and all design packages were nearly complete prior to the first installation. The lessons learned from the first installation are being incorporated into all other design Engineering change packages. This required additional effort and coordination from Projects Design, Design Projects and Field Engineering as nearly all design engineering change packages needed to be revised. Cost increase = $586k
4) Additional carrying costs for interest due to delays above
   - Due to the schedule delays and increased costs, interest charges have been substantially more then anticipated. Cost increase = $580k

There has been a change in installation strategy for the CSA chillers. It was originally anticipated that as a contingency during the CSA chiller replacements, free air cooling would be used. Reactor Safety evaluated this strategy and determined that it is unacceptable. Additional costs have been allocated for contingency planning. The new strategy will be to tie in the Unit 3 chillers to the fans that feed the Main Control Area in the CSA. This strategy provides 100 % redundancy during the replacement of the CSA chillers. Since the Unit 3 chillers have a lower capacity than the CSA chillers, this is only a viable option if the chillers are replaced during the winter months. The additional cost to the project is $485k.

Installation Schedule

The RAB chillers will be replaced during the chiller off-season from October to April. As there is no off season for the CSA chillers, the 2 CSA chillers will be replaced during January and February when the cooling demand is minimized, and as a contingency, a temporary tie in will be made with the unit 3 chillers to provide redundancy during the CSA chiller replacement. The TRF is scheduled to be replaced during the fall 2010 TRF outage. The installation schedule will be as follows:

Fall 2010	Winter 2011	Fall 2011	Winter 2012	Fall 2012
1 TRF Chiller	1 CSA Chiller 1 RAB Chiller	2 RAB Chillers	1 CSA Chiller 1 RAB Chiller	2 RAB Chillers

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
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ALTERNATIVES & ECONOMIC ANALYSIS

$000's	Base Case	Alt 1 (Recommended) Full Cost	Alt 1 (Recommended) Incremental Cost	Alt 2 Delay 2 yrs	Alt 3	Alt 4	Alt 5
Revenue							
Base OM&A							
Outage OM&A							
Project OM&A							
Total OM&A	0	0	0	0	0	0	0
Capital	N/A	(28,315)	(23,421)	(36,625)			
Present Value (PV)	N/A	(22,580)	(17,218)	(25,554)			
Net Present Value (NPV)	**N/A**	**(22,580)**	**(17,218)**	**(25,554)**			
Internal Rate of Return (IRR) %	N/A	N/A	N/A	N/A			
Discounted Payback (Yrs)	N/A	N/A	N/A	N/A			

Base Case: Not Recommended - Stop the Project

With two chillers installed and commissioned, a third to be done this September, design near completion, all chillers purchased, and the regulatory requirement for Provincial 2012 / Federal 2015 compliance, it is not recommended to stop this project.

Alternative 1: Recommended - Replace all remaining 9 Chillers

Continuing with this project as planned is the only option due to regulatory requirements. All design work is nearly complete and chillers are already on site.

Alternative 2: Not Recommended - Delay Project

We do not recommend delaying this project, as there would be a risk of not completing the TRF installation before the Provincial 2012 regulation and the other installations by the Federal regulation of 2015.

4/ THE PROPOSAL

- The major project deliverables for this Full Release are:
- Installation and commissioning of the remaining two CSA chillers, six RAB chillers and one TRF chiller.
- Declaration of the above chillers as Available for Service
- Post Implementation activities
- Project close-out.

5/ QUALITATIVE FACTORS

- The addition of refrigerant leak detection and an alarm system will provide an automated early warning system. These additions have a positive benefit to worker and environment health and safety and also on equipment health monitoring.
- Improvement of equipment reliability due to new technology with commensurate reduction in ongoing maintenance and spare parts.

6/ RISKS ANALYSIS (See Attachment D for details)

Low 1 to 3	Medium 4 to 9	High 10 to 25

Probability \ Impact	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Risk Description	Mitigating Activities	Mitigation	Finance	Schedule	Quality	Corporate Reputation	Regulatory	Health & Safety	Environmental	Nuclear Safety	Risk Rating (1 to 25)
			Probability X Impact								
Potential schedule delays and cost increases due to discovery issues during CSA and TRF installations. There is a greater risk of discovery work during these installations as specific OPEX has not been gained	Perform a thorough walk down with contractor and field engineering to ensure where applicable lessons learned from the RAB installations are incorporated & interferences are identified	Before	8	16	16					8	16
		After	3	6	6					4	6
Potential schedule delays and cost increases due to discovery issues during RAB installations	Lessons learned from first 2 installations have been incorporated into Design Engineering change packages. This is an acceptable risk.	Before	2	4	2						4
		After	2	4	2						4
Risk of missing regulatory deadlines, TRF chiller is required to be replaced according to the Provincial Halocarbon regulation by Jan 1, 2012. All remaining CSA and RAB chillers have to be replaced according to the Federal Halocarbon Regulation by Jan 1, 2015.	TRF chiller is scheduled to be replaced in Sept 2010. All other installations are planned to be completed by Jan 2013.	Before				9	9			6	9
		After				0	0			0	0
Free air cooling is not available as a contingency in the CSA. During the CSA chiller replacements there will be no redundancy in the event of the operating CSA chiller failure.	A temporary tie in will be made to the Unit 3 Chillers to supply cooling to the MCA fans in the event of the operating chiller failing during the CSA replacements. The CSA chillers will only be replaced in the winter when cooling demand is at its lowest.	Before	2	4		6				6	6
		After	1	0		0				0	1
In the event of a failure of an existing chiller that contains R-11 refrigerant and it can not be operated again the installation schedule would need to be revised to accommodate the station's immediate need for a replacement.	SRE and maintenance to keep project informed of any potential developing issues. This is an acceptable risk	Before	3	3							3

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		After	3	3							3
Quality of design packages / design turnover. Design Agency performed original design. OPG to address any design issues going forward.	Ensure all electronic files and drawings have been turned over. Perform a walk down with Field Engineering to identify potential issues	Before	3	9	9						9
		After	3	6	6						6
The new condenser water 3 way valve controllers have only operated for a brief time frame during commissioning. There is some uncertainty of how it will perform over varying chiller loads.	Performance to be re-evaluated after chiller has been in operation. Vendor representative will assist as required.	Before	3	6	9						9
		After	3	4	4						4
If there is a failure of a new chiller and the confidence in its reliability questioned, there is a potential that it prevents further replacements.	Chillers have already been test run at the factory. Installations of redundant chillers are scheduled at least 1 year apart to allow for OPEX. This is an acceptable risk.	Before	1	4	4						4
		After	1	4	4						4
If the current code effective date that is incorporated into all Design ECs and the subsequent reconciliation statement issued December 2009 is not applicable after 2010, design rework will be required.	Receive clarification on code effective date requirements and determine how it impacts the installation schedule and if rework is required	Before	9	9							9
		After	3	2							3
Resource limitations during outages (i.e. Field Engineering, maintenance)	Plan the installation schedules with Stakeholders involvement and get their buy in. Schedule Installation with Work Control to get commitment on maintenance resources.	Before	3	9							9
		After	2	4							4
		Before									
		After									
		Before									
		After									
		Before									
		After									
		Before									
		After									

7/ POST IMPLEMENATION REVIEW

Type of PIR:	Targeted Final AFS Date:	Targeted PIR Approval Date	PIR Responsibility (Sponsor Title)
Comprehensive	14-Jan-13	31-Dec-13	Manager Performance Engineering

	Measurable Parameter	Current Baseline	Targeted Result	How will it be measured?	Who will measure Person / Group?
1.	Environment Canada's 2003 Federal Halocarbon Regulations	Will not be in compliance with the regulations by Jan 1, 2015.	Comply with the regulations	The new RAB and CSA chillers with approved refrigerant in service	All AFS signatories sign-off "Declaration of Available for Service" N-FORM-10091 on all chillers.
2.	Environment Canada's 2003 Provincial Halocarbon Regulations	Will not be in compliance with the regulations by Jan 1, 2012.	Comply with the regulations	The new TRF chiller with approved refrigerant in service	All AFS signatories sign-off "Declaration of Available for Service" N-FORM-10091 for TRF Chiller.
3.	System Health		System health is not negatively impacted by new chiller installations.	System health report	System Responsible Engineer (SRE)
4.	Chiller outlet glycol temperature	Existing chillers maintain constant evaporator outlet temperature.	New chillers maintain constant Evaporator outlet temperature as per design manual / set point.	Monitor evaporator outlet temperature over a 24 hour period during a time of high load (i.e. July) and low load (i.e. Oct)	System Responsible Engineer (SRE)
5.	Condenser water inlet temperature	N/A – Currently does not maintain temperature, it is designed to control the refrigerant pressure	New 3 way valve controller maintains a constant condenser inlet temperature as per design manual / set point.	Monitor condenser inlet temperature over a 24 hour period during a time of high load (i.e. July) and low load (i.e. Oct)	System Responsible Engineer (SRE)

APPENDIX "A' GLOSSARY (acronyms, codes, technical terms)

- CFC – Chlorofluorocarbon
- CRN – Canadian Registration Number
- PEO – Professional Engineer of Ontario
- CSA – Canadian Standard Association
- PB -- Pressure Boundary
- CSA – Central Service Area
- RAB – Reactor Auxiliary Building
- TRF – Tritium Removal Facility
- COMS -- Constructability Operability Maintainability and Safety
- PB code (CSA B51) – Governing requirement for Pressure Boundary system
- Refrigeration Code (CSA B52) – Governing requirement for refrigeration system
- Evaporator – Heat exchanger, in which refrigerant cools down chilled water
- Condenser – Heat exchanger, in which refrigerant is cooled by water or air
- Water-cooled chiller – Refrigerant is cooled by water
- Refrigerant loop – A closed refrigerant loop inside chiller, including compressor, refrigerant sides of evaporator and condenser, etc.
- Chiller Package –Chiller mechanical package, including refrigerant loop, evaporator and of condenser, etc.
- R-11 – CFC based refrigerant
- R-134a – Approved non-ozone depleting refrigerant without phase-out time
- Federal Halocarbon Regulation – Phase-out CFC based refrigerant equipment on January 1, 2015.
- One-year grace period – Overhauled/recharged chiller can only be allowed to operate for one year from date of charging effective from January 1, 2005 to December 31, 2009.

APPENDIX "B" Comparison of Total Project Estimates

$ 000's		This Appendix compares the Total Project Estimate for each BCS Existing and Planned BCS's Total Project Estimate by Year (incl Contingency)									Total Project
BCS Type	Month	Year	2006	2007	2008	2009	2010	2011	2012	Later	Est
Developmental	Apr	2004	5,600	2,000							7,600
Interim	Feb	2005	6,220	13,780							20,000
Interim	Jan	2006	6,520	14,480							21,000
Partial	May	2006	4,747	1,756	3,853	4,969	3,776	4,144			23,245
Full (Phase 1)	May	2007	2,889	1,405	3,046	3,000	2,860	1,700			14,900
Full	Aug	2010	2,889	771	1,012	3,370	5,966	8,834	6,764	369	29,975
											0
											0
LTD Spent	Apr	2010	2,889	771	1,012	3,370	1,184				9,226

Comments:

- Costs shown for 2006 are a total cost for 2004, 2005 and 2006.
- Interim BCS releases show all future spending to occur in 2007, at the time total project cost was estimated but cash flows were not included.

APPENDIX "C" FINANCIAL MODEL – ASSUMPTIONS

Financial Assumptions:

Discount Rate:	7%	Cost Escalation (Yr)	2%	SR&D Opportunity	No
Progress Payments	No	Foreign Currency	No	Retainer Fee	No
Depreciation Rate (Capital)	Generating Equip 8%	PST	No	Interest Rate (Capital)	6%
Revenue Rate	N/A	Leasing	No	Indexed Priced Contract	Yes

Comments:

Project Cost Estimate:

Design Complete:	100%	Fixed Price Contract	No	3rd Party Estimate	Yes
Quality of Estimate	Release +15% to -10%	OPEX used	Yes	Lessons Learned	Yes
Similar Projects	Yes	Budgetary Quote	No	First Unit Actual Used	Yes
Firm Vendor Proposal	Yes	Cost Sharing	No	Competitive Bid	Yes
Reviewed by Sponsor	Yes	Fee for Service	No	Contracts in place	No

Comments:

Rationale for Capital Cost Classification:

Replacement of obsolete equipment.

Generation Plan Assumptions:

Station	Unit	EOL or Refurb	MW	Capacity	Planned Outages for Project Work					
Pickering A	1	Jun-20	515	85%	N/A					
	4	Jun-20	515	85%	N/A					
Pickering B	5	Nov-18	516	88%	N/A					
	6	Nov-18	516	88%	N/A					
	7	Jun-20	516	88%	N/A					
	8	Jun-20	516	88%	N/A					
Darlington	1	Sep-16	878	92%	N/A					
	2	Jul-18	878	92%	N/A					
	3	Apr-20	878	92%	N/A					
	4	Dec-21	878	92%	N/A					

Comments:
Chillers will not be replaced during outages, except for the TRF chiller which will be replaced during the fall 2010 TRF outage (Not a generating Unit outage)

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
Full Release Business Case Summary D - BCS - 73910 - 10003 - R000

ATTACHMENT "A" PROJECT COST SUMMARY

	$ 000's OM&A	LTD 2009	2010	2011	2012	2013	2014	2015	Later	Total
Accounting Basis	Project Mgmnt & Support	1,792	766	817	589	43				4,007
	Engineering	1,265	558	516	402	173				2,914
	Procurement	713	1,058	1,558	1,071					4,400
	Construction	497	886	1,053	773	9				3,218
	Contract - Design	2,326	113							2,439
	Contract - Construction	509	1,683	3,110	2,566					7,868
	Contract - Other	64	41	44	42					191
	SAVH (17.2% of OPG Labo		234	389	284	36				943
	CMO (1.25% of total cost)		67	94	71	3				235
	Interest (Capital Project)	876	360	253	166	5				1,660
	Project Costs	**8,042**	**5,766**	**7,834**	**5,964**	**269**	**-**	**-**	**-**	**27,875**
	General Contingency		100	500	400	100				1,100
	Specific Contingency		100	500	400					1,000
	Project Costs	**8,042**	**5,966**	**8,834**	**6,764**	**369**	**-**	**-**	**-**	**29,975**

	$ 000's OM&A		LTD 2009	2010	2011	2012	2013	2014	2015	Later	Total
Funding Basis	Current Release	Project Costs	7,790	1,200	700						9,690
		Contingency	750								750
		Total	**8,540**	**1,200**	**700**	**-**	**-**	**-**	**-**	**-**	**10,440**
	This Release	Project Costs	(498)	4,566	7,134	5,964	269				17,435
		Contingency		200	1,000	800	100				2,100
		Total	(498)	4,766	8,134	6,764	369	-	-	-	**19,535**
	TTD Released	Project Costs	7,292	5,766	7,834	5,964	269	-	-	-	**27,125**
		Contingency	750	200	1,000	800	100	-	-	-	**2,850**
		Total	**8,042**	**5,966**	**8,834**	**6,764**	**369**	**-**	**-**	**-**	**29,975**
	Future Releases	Project Costs									
		Contingency									
		Total	-	-	-	-	-	-	-	-	-
	Project Funding		**7,292**	**5,766**	**7,834**	**5,964**	**269**	**-**	**-**	**-**	**27,125**
	Contingency Funding		**750**	**200**	**1,000**	**800**	**100**	**-**	**-**	**-**	**2,850**
	Total Funding		**8,042**	**5,966**	**8,834**	**6,764**	**369**	**-**	**-**	**-**	**29,975**

Budget	2010 - 2014 Business Plan	10,149	4,008	1,910						16,067
	Variance to Budget	(2,857)	1,758	5,924	5,964	269	-	-	-	11,058
Other	Removal Costs (above)	30	60	120	120					330
	Inventory W / O									-
	Spare Parts in Invent									-

Reviewed by: (Date)
Vince Tzambazis
Project Manager
July 16, 2010

Approved by: (Date)
Tom Cvitkovic
Strat IV Manager
16-July-2010

ATTACHMENT "C" PROJECT VARIANCE ANALYSIS

	Capital	LTD Apr 2010	Total Project Last BCS Apr 2007	Total Project This BCS Aug 2010	Variance	Comments
Scores Basis	Project Mgmnt & Support	2,052	1,110	4,007	2,897	See Note 1
	Engineering	1,439	1,143	2,914	1,771	See Note 2
	Procurement	759	4,537	4,400	(137)	See Note 3
	Construction	776	760	3,218	2,458	See Note 4
	Contract - Design	2,369	2,415	2,439	24	See Note 5
	Contract - Construction	745	2,582	7,868	5,286	See Note 6
	Contract Other	68	40	191	151	See Note 7
	SAVH (17.2% of OPG Labour)			943	943	New Requirement
	CMO (1.25% of Total Project)			235	235	New Requirement
	Interest (Capital Project Only)	1,018	713	1,660	947	Increased total cost and project delays
	Project Costs (Scores Basis)	**9,226**	**13,300**	**27,875**	**14,575**	
	General Contingency		**1,600**	**1,000**	(600)	
	Specific Contingency			1,100	1,100	
	Project Costs (Scores Basis)	**9,226**	**14,900**	**29,975**	**15,075**	

Other	**Removal Costs included above**	**60**	**330**	**330**	-	
	Inventory to be written off				-	
	Spare Parts in Inventory				-	

Comments:

Note 1: Increased effort required due to installation / design issues /schedule delays ($1,040k), and revised cost estimates for remaining chillers ($1,857k)

Note 2: Increase to address design quality and delays – Projects Design ($676k), additional scope for over pressure protection in RAB –Project Design ($30k), supporting installation and close out – Projects Design ($295k) and revised cost estimates ($770k)

Note 3: Decrease in material costs are based on adjustments from budgetary estimates for miscellaneous materials ($-137k)

Note 4: Internal Construction costs for Field Engineering, CMO and station resources, CSA chiller redundancy requirements ($165k), and revised cost estimates based on lessons learned from first installations ($2,293)

Note 5: Increase in the design contract costs were due to: delays in design deliverables – Design Agency- (291k) and additional scope – Design Agency (28k), and a reduction in costs from the design agency not performing installation support – Design Agency (-295k).

Note 6: Contract – Construction includes external trades labour. Revised cost estimates based on lessons learned from the first 2 RAB installations ($4,986K) and additional cost for CSA chiller redundancy requirements ($300k)

Note 7: Increase is due to contract for software qualification report from third party (23k), third party estimate for full release (33k) and additional commissioning support from chiller manufacturer (95k).

ATTACHMENT "C" **SCHEDULE**

Key Milestones

Completion Date	Description
25-Aug-10	FR2 – Full Release Approved
15-Oct-10	ICA – Installation Labour Contract Awarded
9-Sep-10	SOI – Start of Installation TRF-RFU2
3-Jan-11	SOI – Start of Installation CSA RFU1
7-Mar-11	SOI – Start of Installation Unit 2 RFU2
3-Oct-11	SOI – Start of Installation Unit 3 RFU1
10-Oct-11	SOI – Start of Installation Unit 4 RFU1
2-Jan-12	SOI – Start of Installation CSA RFU2
5-Mar-12	SOI – Start of Installation Unit 1 RFU2
1-Oct-12	SOI – Start of Installation Unit 3 RFU2
8-Oct-12	SOI – Start of Installation Unit 4 RFU2
16-Aug-13	PCM – Project Complete Milestone

A Project Execution Plan (PEP) will be approved by 25-Aug-10

In Service Declarations: (Capital only)

Date	Description	$000's	% In Service
28-Dec-09	*AFS – Available for Service Unit 1 RFU1	3,496	12
30-Jun-10	**AFS – Available for Service Unit 2 RFU1	2,394	8
2-Dec-10	AFS – Available for Service TRF-RFU2	3,283	11
28-Mar-11	AFS – Available for Service CSA - RFU1	4,166	14
30-May-11	AFS – Available for Service Unit 2- RFU2	2,068	7
23-Dec-11	AFS – Available for Service Unit 3 - RFU1	2,368	8
13-Feb-12	AFS – Available for Service Unit 4 - RFU1	2,368	8
26-Mar-12	AFS – Available for Service CSA – RFU2	3,298	11
28-May-12	AFS – Available for Service Unit 1 – RFU2	2,068	7
14-Jan-13	AFS – Available for Service Unit 3 – RFU2	2,068	7
14-Jan-13	AFS – Available for Service Unit 4 – RFU2	2,068	7

Comments:

* In Service declaration was performed for Unit 1 RFU1 in partial release

** In Service declaration is pending for Unit 2 RFU1 and is part of partial release

DNGD: Chiller Replacement to Reduce CFC Emissions 16 - 33631 (Capital)
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Risk Probabilities Chart

Likelihood	Improbable	Unlikely	Possible	Likely	Probable
Probability	<= 1 in 100	About 1 in 100	About 1 in 10	About 1 in 5	>= 3 in 4
Rank	1	2	3	4	5

Risk Impact Chart

Impact Rating	Financial	Project Schedule 12 month	Quality	Corporate Reputation	Regulatory / Legal	Health & Safety	Environment	Nuclear Safety
5	>80% of Total Project $	> 90 day delay	Significant, unacceptable non-conformance requiring extensive rework	National and international adverse coverage or impacts	Non-compliance with potential for significant implications for personnel, potentially large damages or Criminal Charges OR Potential loss of operating licenses	Potential for fatality(s)	Spill or release causing immediate and extended impact with off-site impacts, e.g.:Clean-up costs > $15MCat. A spill (>55 pts)	Loss or serious degradation of a safety system
4	30% - 80% of Total Project $	30 - 90 day delay	Unacceptable non-conformance requiring some rework, but not major	Long-term local or national impact	Legislative non-compliance with potential for fines, charges, and damages ORMajor degradation of reputation with regulatory bodies	Potential for life-threatening critical injury or permanent total disability, including occupational disease	Exceedances resulting in charges or Director's OrderCat. A spill (45 - 55 pts)Public complaints with OPG implications Explosion and/or major fire	Reduced effectiveness of a safety system
3	15% - 30% of Total Project $	10 - 30 day delay	Non-conformance bordering design tolerances, potential to require rework	Major local impact or minor national impact.Minor local damage	Systematic non-compliance with potential for finesORPotential to cause strained relationship with regulator, increased surveillance and/or regulations	Potential for less serious critical injuries (e.g. fractures), permanent partial disabilities and temporary total disabilities of a significant nature	Cat. B spillsEmission in exceedance of regulatory or legal limitsField orders or AMP'sPublic complaints with OPG implicationsDanger to health, life, or property	Reduced effectiveness of redundant safety system components
2	5% - 15% of Total Project $	3 - 10 day delay	Acceptable non-conformance, within design tolerances, no rework required	Complaints from local officials / politicians	Systematic non-compliance with impacts to project scheduleORPossibility of regulatory / legal implications	Potential for less serious temporary disabilities and injuries requiring off-site medical attention other than first-aid. Complete recovery by worker.	Cat. C spills - reportableAdministrative infractionsPublic Complaints with plant level implications	Impact on a safety support or safety related system
1	<5% of Total Project $	< 3 day delay	Minimal impact on qualityRoutine non-conformance, can be easily dispositioned	Complaints from local public	Isolated non-complianceORRoutine approval / notification	No medical attention beyond first aid, no impairment to worker or complete recovery of worker	Administrative, non-reportable eventsCat. C spills non-reportable and spills resulting from Acts of God	