ONTARIO POWER GENERATION

Records File Information:
See Guidance Section

OPG-FORM-0076-R003*

Type 3 Business Case Summary

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

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

Executive Summary and Recommendations					
Project #:	16-31555	**Title:**	D2O Storage and Drum Handling Project		
Phase:	Execution		**Release:**	Partial	
Facility:	Darlington		**Records File:**	N-BCS-00120.3-10018-R000	
Class:	Capital		**Investment Type:**	Value Enhancing	

Project Overview

We recommend the release of $11,641 k ([redacted] base costs plus [redacted] contingency).

The work to be completed under this release includes ordering of long lead materials, such as Nuclear Class III tanks and pumps, and the start of site preparation activities upon approval of the Darlington Refurbishment Environmental Assessment.

The project scope is to build a facility for the storage of 2,100 m^3 of D_2O in tanks, including a drum cleaning, testing and handling area and consolidated office space for the Tritium Removal Facility (TRF) staff. The planned in service date is October 15, 2015. Of the 2,100 m^3 of D_2O storage to be provided, 1,700 m^3 is mandatory support of core scope for Darlington Refurbishment (a value enhancing project). The appropriate alternative for this scope is the lowest cost feasible alternative. The remaining project scope provides needed D_2O management operational improvements and is also value enhancing scope. The need for D_2O management operational improvements had been approved earlier but was deferred in June 2009 to be consolidated with Refurbishment's need for D_2O storage to achieve economies of scale.

This project is currently executing a full definition release of $15,689 k to complete scope definition, modification planning, and detailed engineering. This work will be completed by July 15, 2013 and includes Phase I of a three phase engineer, procure and construct (EPC) contract. OPG previously negotiated a performance target price for Phase I of the EPC contract, and a performance target price for the entire EPC contract. Shortly after approval of the full definition release, OPG successfully re-negotiated a fixed price for Phase I of the EPC contract. This reduces OPG's overall cost risk, while maintaining the same overall EPC performance target price. However, the contract change requires the Phase I price, previously approved under the full definition phase release, to be increased by $400k while the future Phase III target price, to be released later, will be reduced by $400k. This change is reflected in the cash flows for this project and approval for this change to the cash flows from the previously released full definition phase is being requested as part of this partial execution phase release business case.

This partial execution release is required in parallel to the full definition release to issue Phase II of the EPC contract in order to mitigate schedule completion risk. Total released for this project after approval of this BCS will be $30,930k, which includes LTD, currently released, requested now, and contingency. Contingency is broken out in Part G of this BCS.

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

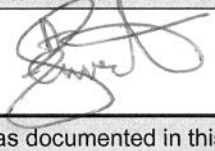
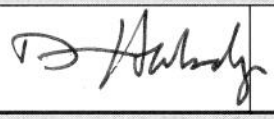
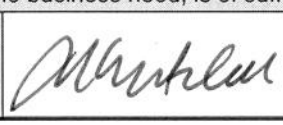
Type 3 Business Case Summary

Project Cash Flows									
k$	LTD	2012	2013	2014	2015	2016	2017	Future	Total
Currently Released	3,034	7,413	8,842						19,289
Requested Now	-	3,275	8,366						11,641
Future Required	-		21,574	40,880	14,667				77,121
Total Project Cost	3,034	10,688	38,782	40,880	14,667				108,051
Ongoing Costs	-				348	638	663	on-going OM&A	
Grand Total	3,034	10,688	38,782	40,880	14,667				108,051

Estimate Class:	Class 2	**Estimate at Completion:**	$84,128 k
NPV:	$67,100 k	**OAR Approval Amount:**	$108,051 k

Additional Information on Project Cash Flows (optional):

Grand Total does not include on-going costs (OM&A).

Approvals			
	Signature	**Comments**	**Date**
This BCS represents the best option to meet the validated business need in a cost effective manner.			
Recommended by: Albert Sweetnam Project Sponsor			2 August 12
I concur with the business decision as documented in this BCS.			
Finance Approval: Donn Hanbidge Position per OPG-STD-0076			Aug 2/12
I confirm this project will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Tom Mitchell Position per OAR, per OAR 1.1			Aug 2/12

Type 3 Business Case Summary

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

Business Case Summary

Part A: Business Need

Business Need:

The scope of this project is to build a heavy water (D_2O) storage and drum handling facility to meet two mandates. The first mandate is for Refurbishment, and the second mandate is to implement operational improvements for heavy water management at Darlington and OPG's Tritium Removal Facility (TRF). This will be accomplished by increasing operational storage at DNGS, adding D_2O drum handling, cleaning, testing, and storage capability, and consolidating offices for TRF staff. Executing this work together saves cost through economies of scale.

Additional D_2O storage capacity is needed to support refurbishment of Darlington. The first unit refurbishment outage is scheduled to begin October 2016. To meet refurbishment needs, the new D_2O Storage Facility at Darlington must be completed and fully operational at least six months before the earliest potential start of refurbishment. The in-service date for this facility of October 15, 2015 is one year before the planned start of the first unit refurbishment outage to mitigate the risk of an earlier start of refurbishment, and to perform refurbishment preparation activities.

During refurbishment, storage capacity is needed at the Darlington site for the heavy water from two reactors, or 1,500 m^3, because of overlapping unit outages. In addition, refurbishment requires 200 m^3 of storage to facilitate flushing and other support operations associated with the preparation of the Darlington units for refurbishment work. This 200 m^3 storage need must be met through additional capacity as the existing Darlington operational storage is required to support the operations of the units across the OPG fleet that remain in service during refurbishment. Therefore, the total additional D_2O storage capacity required to support refurbishment is 1,700 m^3.

The second mandate to improve heavy water management in support of all OPG nuclear units is the result of a previously approved Operational Improvement project which was deferred to be merged with the refurbishment D20 storage project in order to achieve cost efficiencies. The three main components of the second mandate are as follows:

1. Additional 400 m^3 of permanent storage required to improve utilization of the Darlington TRF and mitigate threats to the achievement of OPG detritiation objectives (before, during and after Darlington refurbishment) due to current storage constraints. The increased storage will address the TRF feed and product storage bottleneck that is a significant challenge to the efficiency of the overall tritium removal process. As documented in internal reports, eliminating this bottleneck is required to maintain the units within the Operating Policies and Principles limits for tritium.

2. A new Drum Handling, Cleaning, Testing, and Storage Facility providing services to both Pickering and Darlington stations will centralize drum storage, and provide a means of long term cleaning and disposal of the current inventory of drums. Incident reports indicate that the current large backlog of drums has caused radiological and conventional safety concerns, injuries, and significant operational burden due to storing drums throughout the Heavy Water Management Building. The facility will also provide the ability to support any refurbishment activities requiring drum cleaning/disposal, and expedite commercial shipments.

3. New consolidated office space for TRF staff. Construction of the new D_2O Storage Facility will require demolition of existing permanent office trailers, and new replacement office space for these operations staff is required. As well, there are currently numerous staff located in nonstandard offices throughout the TRF/HWMB. In addition, Strat III and IV managers will be relocated to the central offices, improving communication, oversight, and time in the field. There will also be increased efficiencies associated with consolidating the TRF operations, maintenance, and management team. The office requirements are for 9 staff, including 1 conference room.

The increased operational storage (400 m^3) is a key element and supports implementation of the TRF Life Extension Strategy because it allows the existing facility to operate more efficiently and effectively and therefore maintain adequate quantities of detritiated D_2O to support the operating units. This support is required to maintain Darlington's operating units within the established regulatory limits for tritium for the extended life of Darlington station.

The improvements to the TRF and Darlington operations are summarized below:

- Improve tritium removal capability within OPG by providing scheduling flexibility and reducing detritiation management dependency on TRF availability
- Improve utilization efficiency of available TRF capacity by providing storage for high Curie input feed, thereby maximizing tritium removal
- Improve operational flexibility and ability to segregate different D_2O streams to support Darlington operation and outage scenarios, such as unit, station containment, and vacuum building outages
- Eliminate the backlog of D_2O in drums that needs to be processed through the D_2O Cleanup System
- Allow OPG to pursue new business opportunities for heavy water upgrading/detritiation and isotope sales
- Rectify long standing problem of unconsolidated and nonstandard work locations with new offices
- Support life extension of the TRF until 2055, mitigating risk of a costly TRF refurbishment or new TRF construction

Part B: Preferred Alternative

Description of Preferred Alternative: Build 2100 m3 of D2O Storage and a Drum Handling Facilty

Construction of a new 2,100 m^3 D_2O storage and drum handling facility is recommended because it is the lowest cost option that meets both the mandate to support Darlington Refurbishment and the need for OPG heavy water management operational improvements.

The major components of this option are as follows:

(a) Refurbishment: 1700 m^3 of storage

(b) Heavy Water Management Operational Improvements:
- 400 m^3 of storage for improved TRF operations
- Drum Handling, Cleaning and Testing Facility
- TRF Staff Offices for 9 staff, including 1 conference room

For refurbishment to be successful, the new facility must provide sufficient heavy water storage at the Darlington site for the heavy water from two units prior to start of refurbishment, a requirement of the Darlington refurbishment project. This option meets this requirement. In addition, by increasing the operational storage, this option would enable more efficient utilization of the Darlington TRF and mitigate threats to the achievement of OPG detritiation objectives (before, during and after Darlington refurbishment) due to current D_2O storage constraints. Lastly, this option facilitates the current TRF/Heavy Water Management Life Cycle Management plan to 2055, thus reducing the risk of requiring a costly refurbishment of the existing TRF, or construction of a new TRF facility.

An economic analysis was completed for this alternative showing an NPV of $67,100 k for the D_2O operational improvements scope of work. The tank storage option for Refurbishment D_2O storage was found to be the lowest cost feasible alternative.

The execution of this work will be divided into 3 Phases:

Phase I, June 2012 – July 2013

Detailed Design. This work is underway under the previously approved Full Definition Release.

Phase II, September 2012 – September 2013

Site Preparation and procurement of Long Lead materials. This work will be executed under a Partial Execution Release (this BCS). Site preparation includes activities such as demolition of existing truck dock and TRF trailers, relocation of existing and buried services, start of excavation, and miscellaneous civil substructures. The Darlington Refurbishment Environmental Assessment is a prerequisite for the Site Preparation work and is required to be completed by December 2012 in order to preserve the project schedule.

Phase III September 2013 – April 2016

Construction of facility and tie-in to existing station. This work will be executed under a Full Execution Release.

The project has negotiated a performance based target price for an engineer, procure, and construct (EPC) contract to complete this work. A portion of the performance target price for the whole project is a fixed price contract to complete Phase I, Detailed Engineering. The fixed price portion and the overall target price are the basis of the design and construction costs. The OPG costs are associated with the required nuclear oversight to mitigate schedule and quality risks to ensure timely completion of this prerequisite project for Darlington Refurbishment. A significant constraint on the project is that the project cannot start Phase II Site Preparation and Phase III construction until the Darlington Refurbishment Environmental Assessment has been approved.

The following are milestones that will be confirmed during execution of the Partial Execution Release BCS.

EPC Phase III Installation Contract Awarded	23-Sep-13
Start of Installation	16-Oct-13
Final In-service Declaration Complete	15-Oct-15
Project Close-out Complete	15-Apr-16

Deliverables:	Associated Milestones (if any):	Target Date:
The following are deliverables committed to under both the Full Definition Release and Partial Execution Release.		
Partial Execution BCS (Under previous release)	Partial Execution BCS Approved	14-Sep-12
Preliminary Design Complete (Under previous release)	Preliminary Design Complete	29-Oct-12
Award Phase II of EPC Contract (Under this BCS)	EPC Phase II Installation Contract Awarded	15-Jan-13
Award Long Lead Material Contracts (Under this BCS)	All Long Lead Time Materials Contracts Awarded	28-Mar-13
Detailed Design Packages (Under previous release)	Design Documents Approved and Issued	15-Jul-13
Full Execution BCS (Under this BCS)	Full Execution Release Approved	16-Sep-13

Part C: Other Alternatives

Base Case: Status Quo – No Project

The do nothing option is not viable and therefore has not been assessed because this option does not meet the Darlington Refurbishment mandate. Work must be undertaken to address the 1700 m^3 storage requirements to support refurbishment.

Alternative 2: Build "drum warehouse" inside the Protected Area to store 1700 m3 of D2O for Refurbishment in drums, and build a smaller D2O Facility for the Operational Improvements

This option for the Refurbishment D_2O storage is not viable because of the impact to the refurbishment outage critical path. It has been determined that 2 months of round the clock drumming would be required to drain the primary heat transport (PHT) system and moderator in this fashion. As well, it would require 2 months of round the clock drum purging to re-fill the PHT system and moderator post-refurbishment. This would be required for each refurbished unit, with estimated total lost generation revenue of approximately $290,000 k (2012$ PV).

An estimated 7200 drums at a cost of $1000/drum would also be required to implement this option. This solution would still require a building with similar requirements of the proposed solution, and therefore would still result in the need to design, procure, and construct a new D_2O facility. Thus this option does not avoid much of the cost associated with the preferred option. The station would also be required to address an increased environmental risk of D_2O spills. Current incident reports indicate that the existing backlog of drums have caused radiological and conventional safety concerns, injuries, and significant operational burden.

An economic analysis was completed for the D_2O operational improvements scope of work with an NPV of $59,900k.

Alternative 3: Delay Work- Building 1700 m3 for Refurbishment now, and Operational Improvement portion 3 years later

This option does not meet the operational improvement requirements in the short term and it will increase risk to the TRF Life Extension Strategy.

The Operational Improvement portion of this work was previously approved in 2006. However, it was deferred to be merged with the refurbishment D20 scope in order to achieve cost savings, estimated at $20 M to $30 M, by realising efficiencies of completing the two mandates together as one project. Completing two different projects and time periods eliminates any cost savings even after factoring in the time value of money. There is high demand for detritiation services particulary in the period 2016 – 2020 as a result of the need to detritiate Pickering units prior to shutdown and to detritiate the heavy water drained from the Darlington units during refurbishment.

An economic analysis was completed for the D_2O operational improvements scope of work with an NPV of $64,200k.

Alternative 4: Do Less – Build 1700 m3 of Storage for Refurbishment needs only

This option does not meet the operational improvement requirements and it will jeopardize the TRF Life Extension Strategy, and increase OPG's risk of having to complete a costly refurbishment of the existing TRF or the construction of a new TRF to meet ongoing regulatory detritiation requirements for the Darlington moderator and primary heat transport system. There is high demand for detritiation services particulary in the period 2016 – 2020 as a result of the need to detritiate Pickering units prior to shutdown and to detritiate the heavy water drained from the Darlington units during refurbishment.

The 400 m^3 of incremental storage is required to improve the efficiency and effectiveness of the TRF operation. Optimization of the TRF is required to improve its overall ability to manage its D_2O inventories to support continuous station operations before, during and after the refurbishment period.

During the refurbishment period the 1700 m^3 will be utilized to drain the units, and will have limited capability of increasing the TRF's reliability. It is currently anticipated that the 1500 m^3 of reactor grade storage, which will be surplus storage after Darlington refurbishment, will be available for the long term storage of D_2O from OPG units. Therefore, the operational improvements are still required to improve the efficiency and effectiveness of the TRF operation and minimize threats to OPG's detritiation objectives from 2015 to 2055.

Alternative 5: Build 2100 m^3 of D_2O Storage outside the Protected Area

This option is not recommended as it is not viable. This option requires additional regulatory approvals from the CNSC and Ministry of Environment which would result in a significant delay to the project that would not meet Refurbishment's schedule. D_2O is classified as nuclear material due to the tritium concentrations, and as a result, building a new facility outside the protected area would require a new protected area to be zoned and then built. Although technically feasible, the additional costs and time required to secure all regulatory approvals (such as evaluation of impact to the exclusion and protected zones), re-zone land for creation of a new protected area, and connecting interfacing systems at the current Heavy Water Management Building would not meet the Darlington refurbishment program needs and would result in significant risk to delaying the start of refurbishment. As this option is not a viable alternative, a financial evaluation has not been completed for it.

Part D: Project Cash Flows									
k$	LTD	2012	2013	2014	2015	2016	2017	Future	Total
Currently Released	3,034	7,413	8,842						19,289
Requested Now	-	3,275	8,366						11,641
Future Required	-		21,574	40,880	14,667				77,121
Total Project Cost	3,034	10,688	38,782	40,880	14,667				108,051
Ongoing Costs	-				348	637	663	on going OMA	
Grand Total	3,034	10,688	38,782	40,880	14,667				108,051

Estimate Class:	Class 2	Estimate at Completion:	$84,128 k	OAR Approval Amount:	$108,051 k

Additional Information on Project Cash Flows (optional):

Grand Total does not include on-going costs (OM&A).

Part E: Financial Evaluation					
k$	Base Case	Preferred Alternative	Alternative 2	Alternative 3	Alternative 4
Project Cost	N/A	105,017	48,600	119,000	84,300
NPV (after tax)	0	67,100	59,900	64,200	0
Other (e.g., LUEC)					

Summary of Financial Model Key Assumptions (see Guidance on this Type 3 BCS Form):

1. Project Costs shown are incremental (going forward) costs.
2. NPV values are for the Heavy Water Management Operational Improvements scope of work.
3. The interest has been included in the total project cost above, but has not been included for the NPV evaluation.
4. Alternative 5 does not meet the business need and therefore is not evaluated.
5. Assumptions used to calculate the NPV include:
    1. Operational improvements result in more efficient utilization of the Darlington TRF and improved heavy water management (e.g. decreased impact from TRF outages, potential for 3rd party D_2O sales, dose savings at OPG stations)
    2. Operational improvements reduces probability of refurbishing existing TRF, or construction of a new TRF facility due to ability to stock pile low curie D_2O
    3. Between 2 and 4 staff (depending on which alternative) are required to support operation of the new facility

Part F: Qualitative Factors

Other qualitative factors associated with this project are as follows:

Government Relations

- Reduce tritium emissions throughout Ontario through improved efficiency for the detritiation of OPG and Bruce Power D_2O inventory
- Reduce risk of infringing on tritium emission regulatory limits
- Reduce risk of infringing on OPG's Operating Policies and Principles limits through maintenance of unit tritium levels in the moderator and primary heat transport below required limits

Customer Relations

- Increasing OPG's capability and flexibility to process D_2O will improve customer relations by providing flexibility in meeting contractual obligations with Bruce Power for detritiation services and provide the ability to increase detritiation services to third parties.

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Health and Safety

- Reduced tritium levels due to increased TRF efficiency will reduce worker dose
- Additional drum storage will improve housekeeping and reduce drum handling requirements, thereby reducing the related health and safety concerns
- Reduce operator work around and extra operation actions that are required to maneuver various grades of D_2O into unconventional storage arrangements

Part G: Risk Assessment

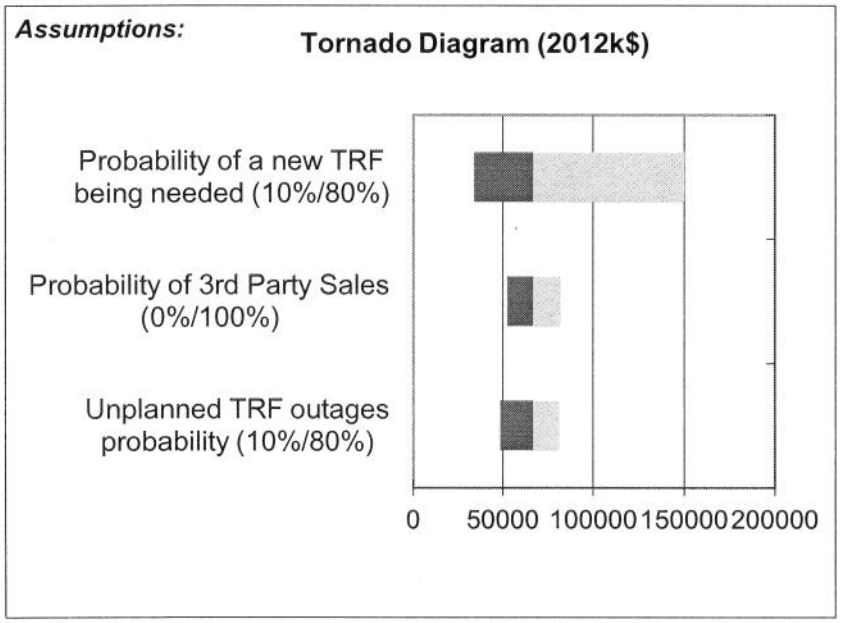
Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	Potential for tritum present in ground water and soil at preferred site, forcing design changes and/or additional soil/groundwater disposal costs.	Project 16-38940 is conducting an environmental site assessment, including the proposed location of the new facility. This will assess the situation and proposed mitigation options, including a contaminated soil disposal plan. The Mitigation and Disposal Plans will be incorporated into the Contract via the Change Management process as necessary.	Medium	Medium
Scope	Legacy registration issues on Design, and configuration management issues	Scope includes Contractor to conduct an SCR/OPEX/documentation review early in design process to identify any current conditions. Contractor to review current TSSA registration as part of their design.	Medium	Medium
Schedule	Delays to project schedule due to regulatory approvals (such as Environmental Assessment) taking longer than planned.	Advise regulatory agencies in advance of the pending changes. Stage design release strategy to provided reasonable time, based on operating experience, for regulatory agencies to review each package. Escalated to Senior Management to expedite the Environmental Assessment approval to allow start of site preparation. Use of schedule contingency allowance if necessary.	High	High
Resources	Design and Procurement Engineering deliverables not reviewed by OPG in a timely manner which supports the schedule.	Appropriate in-house or Owner Support Service Engineering resourcing - project to have dedicated multidisciplinary support and expertise for timely reviews. Clear and appropriately frequent communication of review expectations with all stakeholders.	Medium	High
Quality/ Performance	Design Deliverables not delivered to required quality.	The oversight process is not currently defined. However, the project has budgeted for dedicated multidisciplinary support for appropriate Engineering oversight and in-line reviews.	Medium	High
Technical	Cost of EPC contract increases due to discovery work, existing systems do not have adequate capacity, and uncertainty in the estimate (AACE Class 3 -20/+30%)	This risk will be mitigated, with appropriate contingency assigned.	Medium	Medium
Other	Additional buried services, concrete, etc are present than currently accounted for.	A complete ground scan of the area was conducted. As per contract terms, Contractor is responsible for his own independent scan. Ensure Contractor begins detailed design with relocation of buried services EC's.	Medium	High

Additional Risk Analysis:

As per N-INS-00120-10014 Project Risk Management, the Extensive Risk Management process was applied to this release. Risk workshops were used to identify risks and determine the risk exposure. In addition to the Most Likely costs for the risk impact estimates, the Minimum (optimistic) and Maximum (pessimistic) costs were identified. All risks were evaluated as documented in the Risk Register. A Monte Carlo analysis was completed using the set of risk range estimates, and the contingency as identified in this BCS was allocated to provide residual risk impact coverage at a confidence level of 85% (P85).

The location of the new facility has groundwater contaminated with tritium from the 2009 Injection Water Storage Tank spill. The latest geotechnical and environment sampling reports do not indicate a significant level of soil contamination; however, the groundwater is contaminated with low concentrations of tritium. Disposal costs for both the soil and contaminated ground water are included in the total project cost estimate of $108,051k. The risk remains that the tritium contamination is greater than the geotechnical investigation currently indicates. Therefore, the risk of additional disposal costs to dispose of contaminated groundwater due to larger than anticipated tritium concentrations, and the risk that some soil is contaminated and will require disposal to a contaminated landfill, are captured as a specific item in the risk management plan for this project.

The tornado diagram, below, shows the sensitivity of the NPV for the Heavy Water Management Operational Improvements scope of work to changes in assumptions regarding the major benefits.



The table below illustrates the contingency by release and year.

	2012 ($k)	2013 ($k)	2014 ($k)	2015 ($k)	Total ($k)
Full Definition (currently released)	921	1,975	0	0	2,896
Partial Execution (requested now)	705	3,392	0	0	4,097
Sub-Total	*1,626*	*5,367*	*0*	*0*	*6,993*
Full Execution (requested later)	0	5,547	8,461	2,922	16,930
Total	**1,626**	**10,914**	**8,461**	**2,922**	**23,923**

Part H: Post Implementation Review (PIR) Plan				
Type of PIR		**Target Project In Service Date**		**Target PIR Completion Date**
Comprehensive		2015-10-15		2016-10-15
Measurable Parameter	**Current Baseline**	**Target Result**	**How will it be measured?**	**Who will measure it? (person/group)**
D_2O storage volume to meet needs of Refurb. Project	No refurbishment storage	1700 m^3 D_2O storage for Refurb project	Storage volume available in time for Refurb schedule	Refurb Prog – Project and Controls
D_2O storage volume for TRF Operations	Insufficient storage to support optimal TRF operations	400 m^3 provided for improved TRF operation	Storage volume for operational improvements	TRF Manager
Amount of drum Handling, Cleaning and Testing Facility at DNGS	No capability to clean and test drums in-house	Ability to clean and test 100/drums per year	Number of drums cleaned and tested per year	TRF Manager

Part I: Definitions and Acronyms

AACE – The Association for the Advancement of Cost Estimating
BCS – Business Case Summary
CNSC – Canadian Nuclear Safety Commission
DNGS – Darlington Nuclear Generating Station
EPC – Engineer, Procure, Construct
HWMB – Heavy Water Management Building
OPG – Ontario Power Generation
PDRI – Project Definition Rating Index
PIR – Post Implementation Review
PNGS – Pickering Nuclear Generating Station
PO – Purchase Order
TRF – Tritium Removal Facility
TSSA – Technical Standards and Safety Authority
T&C – Terms and Conditions

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Type 3 Business Case Summary

For Internal Project Cost Control

Type 3 Business Case Summary

Appendix A: Summary of Estimate										
Project Number:	16-31555		**Facility:**	Darlington						
Project Title:	D2O Storage And Drum Handling Project									
Estimated Cost in k$										
	LTD	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Future**	**Total**	**%**
OPG Project Management	770	657	663	1,007	782				3,879	4
OPG Engineering	829	1,232	1,983	873	1,179				6,096	6
Permanent Materials	-	2,020	4,124	6,859	1,091				14,094	13
Design and Construction	[redacted]									
Consultants	-									
Other Contracts/Costs										
Interest										
Subtotal										
Contingency										
Total	3,034	10,688	38,782	40,880	14,667				108,051	100
Removal Costs Included			650						650	1

Notes			
Project Start Date	2006-11-11	**Project Completion or In-Service Date**	15-Oct-15
Interest Rate	5.0%	**Escalation Rate**	2.0%
Definition Cost Included	$16,393 k	**Estimate at Completion**	$84,128 k

Prepared by:	Approved by:
Mike Veilleux Project Manager 31-July-2012	Dianne Gaine Director, Darlington Projects 31-July-2012

Type 3 Business Case Summary

Appendix B: Comparison of Total Project Estimates										
Phase	Release	Date (YYYY-MM-DD)	Total Project Estimate in Choose an item. (by year including contingency)						Later	Total Project Estimate
			2007	2008	2009	2010	2011	2012		
Definition	Partial	2006-10-22	1,872	1,728	3,992	13,253	14,938	600	0	36,383
Definition	Full	2012-06-14	1,564	306	-10	0	1,174	10,779	94,479	108,292
Execution	Partial	2012-07-18	1,564	306	-10	0	1,174	10,688	94,329	108,051

Project Variance Analysis					
Estimated Cost in k$					
k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management	770	3,954	3,879	(75)	The last BCS assumed that the full $3.6M from the previously approved Developmental Release would be spent. At the completion of the developmental release, the project had under spent. This, combined with the resulting interest reduction, is the cause of the variance between the last BCS and this BCS. As well, minor rounding resulted in a $1k reduction in the Design and Construction Costs.
OPG Engineering	829	6,155	6,096	(59)	
Permanent Materials		14,094	14,094	0	
Design and Construction					
Consultants					
Other Contracts/Costs					
Interest					
Subtotal					
Contingency					
Total	3,034	108,292	108,051	(241)	
Removal Costs Included			650	650	Project includes removal of services and structures, such as TRF Truck Dock and TRF Trailers.

Appendix C: Financial Evaluation Assumptions

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

Project Cost:

(1) A fixed price has been provided for Phase I, and a second performance target price has been provided to include both Phase II and Phase III. These performance target prices are the basis of the design and construction costs.

Financial:

(1) 2% escalation
(2) 7% discount rate

Project Life:

(1) 2016 to 2055 for D_2O Operational Improvements Storage Tanks
(2) 2016 – 2024 for Refurbishment D_2O Storage tanks

Energy Production:

(1) Alternative 2 (Drum warehouse for Refurbishment D_2O) – 2011 update for System Economic Values (energy + capacity) used to calculate value of 4 month critical path outage extension of unit refurbishment outage.

Operating Cost:

(1) For the Preferred Alternative, the following incremental staff requirements were assumed to be required for the life of the new facility: Operator – 2 FTE, Control Maintainer – 0.5 FTE, Mechanical Maintainer – 0.5 FTE, Engineer – 0.5 FTE

Other:

Benefits for Operational Improvements

1. Avoids capital cost of refurbishing TRF or new TRF facility in 2035. Assume cost of $532M (2012$) and 30% probability
2. Reduces impact of an unplanned TRF outages on OPG ability to manage heavy water inventories. Assume 50% probability of saving $7.2M/yr (2012$) during 2025-2055
3. Improves ability to achieve incremental third party D_2O sales. Assume 50% probability of $3.1M/yr during 2016-2043
4. OPG achieves dose savings during outages. Assume $450k/year (2012$) from 2016 to 2055
5. Reduces risk of need to detritiate primary heat transport D_2O after storage in moderator S&I tanks during a Vacuum Building Outage/Station Containment Outage. Assume one occurrence eliminated saving $3.6M (2012$) and modeled as $600k (2012$) every 6 years
6. Elimination of Kinetrics Drum Handling Contract (pressure test. Assume saving of $30k/yr (2012$) from 2016 - 2055
7. Avoids risk of downgrading reactor grade D_2O during acute recovery events or SUP outage. Assume savings of $0.9M (2012$) over 40 years, or $22k/yr

Note: For alternative 3, these benefits were started in 2018 when the D_2O Operational Improvements were put in service.

Benefits for Building Refurbishment Tank Storage (1,700 m^3)

1. Avoid capital cost of building storage for Darlington D_2O as part of decommissioning in 2055. Assume $78M (2012$)

Attach further detail as appropriate from the Financial Evaluation spreadsheet.

The following is the breakdown of released funds, including contingency, following approval of this BCS.

	$k
LTD – under Developmental Release	[redacted]
Full Definition Release Project Costs	
Full Definition Contingency	
Partial Execution Release Project Costs	
Partial Execution Release Contingency	
Total	$30,930

The below table outlines the approved Phase I and requested Phase II cost break down.

Deliverable	Approved Full Definition Release ($k)	Requested Now Partial Execution Release ($k)	Total ($k)
EPC Contract - Detailed Design	[redacted]		
Contingency			
EPC Contract - Site Preparation			
EPC Materials			
OSS Design Support (Phase I and II)			
Interest	$683	-	$683
Project Management Oversight	[redacted]		
OPG Design Oversight	$306	$143	$449
OP PE Oversight	[redacted]		
TRF Oversight			
OPG Field Engineering - Site Prep	-	$166	$166
OPG Field Engineering - Design Phase	$121	-	$121
DCC Group Engineering	[redacted]		
Travelling Expenses			
New Horizons LAN Spec.			
Total	$15,689	$11,641	$27,330

Appendix D: References

DNGS D_2O Storage and Drum Handling Project Developmental BCS, D-BCS-38000-10001-R001
Project Charter, N-PCH-09701-10001
Life Extension Strategy for TRF, NK38-CORR-39000-0412581
Adverse Trend for Drum Handling Issues, SCR D-2012-04114
OPEX review of Drum Handling Issues, NK38-REF-38000-0427531
Project 16-31555: Office Space Requirements Within The New D_2O Storage Facility, NK38-CORR-38000-0400715
Long Term Strategy for D_2O Storage Upon Station Shutdown, N-REP-03800-10004 (Pickering Shutdown)

This Guidance section should be deleted prior to submission of the BCS.

Guidance for Completing this Type 3 Form:

Always use the latest revision of the Form!
Verify this is the latest revision through PowerSearch,
or Finance BCS Toolkit intranet website.

Final Security Classification

Determine the Final Security Classification of the BCS from the drop-down list before both the Executive Summary and Recommendations and Part A. Refer to OPG-STD-0030 Classification, Protection and Release of Information.

Executive Summary and Recommendations

Records File Information

Refer to OPG-PROC-0019, Records and Document Management for the requirements and expectations of record filing after the BCS is submitted.

The SCI used for record filing should be:

- *00120.3* for Nuclear BCSs.
- *08707.021* for BCSs of all other business units and corporate groups.

Submitted BCSs shall also be filed according to local BU governance, which may require different SCIs.

Project Overview

State the following:

- What needs to be done and why it needs to be done.
- When the investment/project will be completed.
- Key business objectives.
- Expected benefits of the investment/project.
- Whether the investment/project is within the original scope as specified in the approved Business Plan and/or Life Cycle Plan.
- Brief history of previous releases.
- Level of confidence for current request.
- If critical to the decision, any constraints on the investment/project or its timing.

Project Cash Flows

This table in the Executive Summary and Recommendations section is the same as the table in Part D: Project Cash Flows. See guidance for Part D: Project Cash Flow.

Approvals

Provide the title and name of the individuals making the three required signatures: the Project Sponsor, the individual providing Finance Approval, and the Approver of the BCS per the OAR. The Comments cell is to allow brief hand-written comments. For example, "see comment on Part D", which would refer to a hand-written comment later in the BCS document. These comments would be minor in nature; otherwise a reviewer would require revisions to the BCS before signing the document.

Business Case Summary

Part A: Business Need

This section describes the business needs or opportunities that gave rise to the investment. It provides background and context for the investment including: the investment's purpose, what's driving the investment, why the investment needs to be addressed now, what are the impacts of not proceeding, key assumptions, identification of any subsequent commitments or obligations, and the benefits or constraints that the investment will create. Provide studies, experience or lessons learned from similar investments, if available. If this submission relates to a subsequent approval, provide a quick overview of investment history.

If the investment is a subset of a program, or if the issue to be addressed is symptomatic of a broader issue that requires additional response, provide the context and identify the related response, whether planned or anticipated.

Part B: Preferred Alternative

This section describes expected business results and objectives, including resourcing requirements, when the investment will be completed, and any major milestones. The proposal section must put the investment into the proper context by providing the link between the investment and the business strategy for the asset and/or other planned investments in that asset.

Describe the link between this investment and business strategy or other investments. Disclose if the resourcing is in place. Alternatively, if the investment is not in the business plan, or if the scope has changed relative to the Business Plan, reasons for the change(s) must be provided.

State the expected benefits and what is being delivered, without specifying vendor name(s). Describe briefly project execution strategy, regulatory approvals, third party agreements, project management, and basis for the cost and schedule contingencies, if applicable. Highlight any constraints on the investment or on its timing, and any constraints or obligations created by the investment.

Deliverables

In the Deliverables section, list the project deliverables and target completion dates, including associated milestones (such as unit in-service dates and external or regulatory milestones).

Part C: Other Alternatives

This section describes viable alternatives considered, including associated risks. At minimum, include a Base Case: Status Quo – No Project. Other alternatives may include:

- Deferring the project.
- Different means to meet the same business need.
- Completing partial scope.
- Alternatives with additional scope.

Part D: Project Cash Flows

This table in Part D: Project Cash Flows is very similar to the table under Project Cash Flows in the Executive Summary and Recommendations section.

This table provides a yearly breakdown of estimated project costs, including amounts currently released from earlier BCSs if applicable, the new amounts being requested now in this BCS, and estimated future requirements not currently requested. Contingency shall be included in these amounts.

The new amounts being requested are for actual work to be completed and for any costs that will be committed to through that work. For example, if an equipment purchase is bundled with a maintenance contract for a committed period, the committed payments under the maintenance contract must be included in the current request. Ongoing Costs include any costs related to the investment that would not be part of the project budget, including ongoing incremental operating costs, and acquisition of inventory.

The Future column is the sum of expected future cash flows beyond the last year shown in the table.

Estimate Class

Estimate Class is a cost estimate classification system developed by the Association for the Advancement of Cost Engineering International (AACE) which defines the estimate "quality" based on the input information used and the project's stage of development. AACE uses five estimate classes with Class 5 being the least accurate, and Class 1 being the most accurate.

Estimate Class	Class 5	Class 4	Class 3	Class 2	Class 1
Phase	**Identification**	**Initiation**	**Definition**	**Execution**	**Execution**
Level of Project Definition (%)	0% to 2	1 to 15	10 to 40	30 to 75	65 to 100
Expected Accuracy Range (%)	-50 to +100	-30 to +50	-20 to +30	-15 to +20	-10 to +15

OAR Approval Amount

For BCSs up to and including Definition Phase work, the OAR Approval Amount is the cumulative total actual and committed cost to date, not the estimated total investment/project cost. For Execution Phase BCSs or BCSs that cover multiple phases including Execution, the OAR Approval Amount is the estimated total investment/project cost, including cumulative cost to date.

Additional Information on Project Cash Flows (optional)

Relevant information such as the delta between approved business plan cash flows and requested release, may be entered into this open-field table cell.

Part E: Financial Evaluation

This section describes and compares the key alternatives considered. Only the most relevant alternatives shall be listed in this table for comparison. The analysis includes financial evaluations, economic analysis, and comparisons of the alternatives based on total project cost, after-tax NPV, and any other financial metric deemed appropriate by the project sponsor (e.g., IRR, discounted payback, etc.) The BCS Financial Evaluation Model is available on the Finance website and is updated periodically to help facilitate financial analysis. Attach further detail as appropriate from the Financial Evaluation spreadsheet.

Summary of Financial Model Key Assumptions

List key assumptions used in the Financial Evaluation. For Part E, provide a brief summary of the most important assumptions that are listed in Appendix C.

Part F: Qualitative Factors

Qualitative factors gained (or lost) from the investment and how an initial specification will be measured within the post implementation review (to the extent feasible). Qualitative factors could include: sustainable energy development impacts; community, government, and customer relations; staff relations issues, technical or operational considerations, reliability, health and safety issues, and other intangibles.

Part G: Risk Assessment

This section identifies the risks associated with the investment and the plans to manage or mitigate these risks. Refer to OPG-STD-0062, Project Risk Management Standard and local business unit standards for guidance on completing and documenting risk assessments. Each BU can add risk areas specific to its business.

Extra Risk Classes may be added by changing "Other" to a specific risk class and/or inserting extra rows to the table.

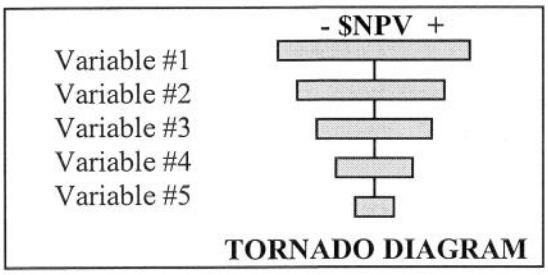
The Risk Analysis section discusses, as appropriate for the project, quantitative risk factors that relate to the project financial evaluation, including considerations such as:

- Present and discuss material impacts/consequences of variations in the basic assumptions, e.g., price of electricity used for revenue, sales forecast, service life, etc. Discuss likelihood of occurrence.

- Based on risks identified and mitigation measures implemented, indicate whether the financial analysis completed for the recommended alternative includes the contingency required for OPG residual risks, and their impact on the estimated in-service date.

- The extent of the risk assessment and the risk analysis techniques employed should be commensurate with the magnitude of the cash flows and the degree of uncertainty associated with the critical assumptions upon which the investment is based.

- For Major Projects, the risk analysis section will typically include sensitivities of the investment to various risk factors or scenarios, and a discussion of their likelihood of occurrence. A convenient way of presenting the results of the risk assessment on the variability of the NPV to changes in the critical variable is to include a graph or tornado diagram as shown below.



- For larger investments, more advanced risk analysis techniques such as Monte Carlo may be suitable. These techniques require analysts with appropriate training; contact your local Finance support to discuss applicability and to arrange Finance analytical support if required. The limitations of Monte Carlo or any other risk assessment technique must be considered in their application, and require a time commitment from the project team and stakeholders to develop and estimate model inputs.

Part H: Post Implementation Review (PIR) Plan

PIR plan is a succinct description of the project benefits using measurable parameters. The PIR plan should clearly specify what is to be measured, who is responsible for measuring it, and when the measurement should take place, along with any requirements for establishing pre-project baseline information for comparison purposes.

Extra PIR metrics may be added by inserting extra rows to the table.

The PIR plan should contain the following five main elements:

- What: Key deliverables or benefits of the project clearly defined in measurable parameters, including a clear description of the reference or baseline from which the incremental benefits or changes due to the project are to be measured.

- How: A brief description of how each parameter is going to be measured.

- Who: The name of the group, department, or individual that will be measuring the benefits.

- When: When the measurement of the benefits will take place.

In addition, the Project Sponsor and key stakeholders may specify other items such as the types of lessons learned and recommendations to be captured during the execution of the PIR.

Part I: Definitions and Acronyms

Define key technical terms and list acronyms to assist reviewers of the document.

Appendix A: Summary of Estimate

Note: All content from Appendix A onwards, including this Guidance section, contains a level of detail that is intended for OPG internal use only and should be removed before a copy of a BCS is released to an external party.

To assist the reviewer in understanding the cost estimate in the BCS, this table provides a breakdown of various cost components by year, with explanatory notes as appropriate.

Note: The label "Project Completion or In-Service Date" is intended to provide flexibility for projects that do not have a specific "In-Service Date", such as engineering studies in future decisions or for future regulatory documents.

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

This section provides the history of past releases and their associated estimates, with explanations of changes as appropriate.

Appendix C: Financial Evaluation Assumptions

This section is intended to provide a reviewer with an overall understanding of the key assumptions used in the financial evaluation, to help a reviewer confirm that relevant drivers and appropriate assumptions were used in the analysis. The main considerations in the economic evaluation of the alternatives are outlined below:

Cost and Schedule Estimates

The work breakdown structure (WBS) of the project usually provides detailed information on the cost of the project and should be referred to while estimating the costs and schedule. Best practices in project cost and schedule estimating should be applied wherever possible including using lessons from similar experiences and benchmarks. Requests for quotations from competitive sources are another option to obtain detailed estimates. Schedule and cost estimates must obtain stakeholders' inputs and be reviewed by the key stakeholders of the project before being finalized.

Taxes

All investments must be assessed on an after-tax basis. Users will be required to properly classify the capital assets for Capital Cost Allowance (CCA) purposes. The financial evaluation model provided on the Finance website will compute the initial income tax impacts for most types of investments; the model also contains the latest CCA rates for most types of investments. For further information on CCA, sales taxes and tax shields, please contact your local Finance support group.

Cost of Capital

An appropriate cost of capital or discount rate must be used to ensure that an adequate return is provided to shareholders. For investments related to the manufacturing and processing of electricity for regulated nuclear and base-loaded hydroelectric facilities, the discount rate is generally lower than for unregulated facilities. This is partly due to regulated assets having a more predictable revenue stream, and hence lower risk than unregulated generation facilities.

For projects and business opportunities that are clearly outside of OPG's core business, or are not related to the manufacturing and processing of electricity, the project's cost of capital should be used, instead of OPG's cost of capital. Updated rates for OPG's core business are posted in the BCS Financial Evaluation Model. Contact Investment Planning for assistance.

Revenue Forecasts

The revenue forecast from generation assets must be based on the OPG System Economic Values (SEVs). The appropriate SEVs for the applicable time frame are selected based on the characteristics of the generation asset being evaluated (e.g., peaking vs. baseload). Contact your local Finance support group for further guidance on using SEVs.

Appendix D: References

The reference documentation and attachments contain the detailed numbers, calculations, and any other analysis done probing the need and substantiating the justification for the investment. This documentation includes: cost estimates, financial evaluation sheets, risk assessment tables, modeling assumptions, project execution plan, technical studies, and any other specific studies related to the investment.

Additional Attachments

Additional documents be prepared as separate documents and enclosed with the BCS for reviews and approvals (e.g., multiple file attachments to e-mails).

The final signed version of the BCS may then be combined with all the attachments in a single PDF file.