DARLINGTON REFURBISHMENT AND NEW NUCLEAR AT DARLINGTON

1.0 PURPOSE

This evidence presents an overview of the activities and expenditures associated with the Darlington Refurbishment and new nuclear at Darlington ("NND") projects. Darlington Refurbishment is considered in section 2 and NND is considered in section 3.

2.0 DARLINGTON REFURBISHMENT PROJECT

2.1 Overview

OPG's decision to proceed with the definition phase of the Darlington Refurbishment project and to begin the associated capitalization of project costs as of January 1, 2010, results in a number of impacts to the revenue requirement.

For example, the decision to proceed with the definition phase of the Darlington refurbishment project extends, for purposes of calculating depreciation, the service life of the Darlington nuclear generation station to 2051. The decision to proceed with the definition phase also changes the valuation of the nuclear used fuel and decommissioning liabilities (see Ex. C2-T1-S2). This, in turn, results in changes to the asset retirement costs of Darlington, Pickering A, Pickering B and the Bruce facilities (see Ex. C2-T1-S1). The changes in the asset retirement costs cause changes in rate base (see Ex. B1-T1-S1, section 3.1.2) and depreciation expense for Pickering A, Pickering B and Darlington (see Ex. F4-T1-S1, section 3.2) and changes in the costs associated with the Bruce lease (Ex. G2-T2-S1, section 5).

In addition, given the size of the project, OPG is proposing to increase rate base to reflect the inclusion of Construction Work in Progress ("CWIP") for the Darlington's Refurbishment Project as presented in Ex. D2-T2-S2.

The net effect of all of the impacts that flow from the Darlington Refurbishment project is a reduction to the revenue requirement during the test period of $197.1M, as shown on Ex. D2-

T2-S1 Table 2 and reproduced below as Chart 1. As can be seen from Chart 1, the net figure incorporates the changes in the nuclear liabilities, the CWIP in rate base proposal, the extension to the service life of the plant, and the related impacts on the Bruce Lease costs and revenues.

Chart 1 Revenue Requirement Impact of Darlington Refurbishment Project ($M)

Line No.	Description	Test Period Revenue Requirement Impact
		(a)
	PRESCRIBED FACILITIES	
	Return on Rate Base:	
1	**Accretion Rate on Lesser of ARC and UNL**	73.2
2	**CWIP in Rate Base Impacts**	32.7
3	**Extension to Darlington Service Life Impacts**	7.3
4	**Total Return on Rate Base Impact**	113.3
	Depreciation Expense:	
5	**Asset Retirement Costs**	(181.1)
6	**Extension to Darlington Service Life Impacts**	(48.5)
7	**Total Depreciation Expense Impact**	(229.6)
	Other Expenses:	
8	**Darlington Refurbishment Project OM&A**	10.4
9	**Used Fuel Storage and Disposal Variable Expenses**	8.2
10	**Total Other Expenses**	18.6
	Income Taxes:	
11	**Accretion Rate on Lesser of ARC and UNL**	25.3
12	**CWIP in Rate Base Impacts**	5.2
13	**Extension to Darlington Service Life Impacts**	1.2
14	**Depreciation Expense on Asset Retirement Costs**	(62.8)
15	**Used Fuel Storage and Disposal Variable Expenses**	2.8
16	**Depreciation Expense on Darlington Service Life**	(16.8)
17	**Total Income Tax Impact**	(45.0)
18	**Total Revenue Requirement Impact - Prescribed Facilities**	(142.7)
	(line 4 + line 7 + line 10 + line 17)	
	BRUCE FACILITIES	
19	**Rate Base**	0.0
20	**Depreciation Expense Impact: Asset Retirement Costs**	(40.2)
	Other Expenses:	
21	**Accretion**	(18.3)
22	**Used Fuel Storage and Disposal Variable Expenses**	4.2
23	**Total Other Expenses Impact**	(14.1)
	Income Taxes:	
24	**Impact on Bruce Facilities' Income Tax Calculation**	13.9
25	**Impact on Prescribed Facilities' Income Tax Calculation**	(14.0)
26	**Total Income Tax Impact**	(0.1)
27	**Total Revenue Requirement Impact - Bruce Facilities**	(54.4)
	(line 19 + line 20 + line 23 + line 26)	
28	**Total Revenue Requirement Impact of Darlington Refurbishment Project**	(197.1)
	(line 18 + line 27)	

The section of the 2010-2014 Business Plan for Refurbishment, Projects and Support relating to refurbishment is provided in Attachment 1.

OPG's capital expenditures for the Darlington Refurbishment project in the test period are $105.2M in 2011 and $255.8M in 2012, as presented in Ex. D2-T2-S1 Table 3.

OPG is seeking the following approvals related to the Darlington Refurbishment project:

- Approval of test period OM&A costs (which form part of the nuclear revenue requirement) of $5.9M and $4.5M in 2011 and 2012, respectively, for definition phase work for the Darlington Refurbishment project as presented in Ex. F2-T7-S1 Table 1.
- Changes in rate base, return on rate base, depreciation expense, tax expense and Bruce lease net revenues that result from the impacts of the service life extension, for purposes of calculating depreciation, and the change in the nuclear liabilities associated with Darlington Refurbishment**.** These changes are presented in Ex. D2-T2-S1 Tables 1 and 2.
- An increase in rate base to reflect the inclusion of CWIP for the Darlington Refurbishment Project as presented in Ex. D2-T2-S2.
- The recovery of the difference between forecast 2010 non-capital costs associated with the Darlington Refurbishment project and the costs underlying the payment amounts established in EB-2007-0905, as explained in Ex. H1-T2-S1.

This evidence also describes the process that OPG will use to manage the Darlington Refurbishment project, a process which received OPG Board approval in November 2009 (see Attachment 2). The Darlington Refurbishment project is a major undertaking that will require several years of planning and preparation prior to the first outage in 2016. To mitigate risk, the project is being managed in phases, requiring that certain milestones be achieved before proceeding to a subsequent phase and before OPG Board authorization of the expenditure of funds associated with activities in that phase.

Although a significant amount of work will be required to develop a "release quality" estimate, OPG has high confidence that the project will have a Levelized Unit Energy Cost ("LUEC") of

between 6 and 8 cents per kilowatt-hour (2009$). With a LUEC in this range, the refurbishment of Darlington is an economical project which has the concurrence of the Minister of Energy and Infrastructure (see Attachment 3).

In addition, the Ontario Power Authority ("OPA") has commented on the Darlington refurbishment project in a letter provided at Ex. F2-T2-S3 Attachment 2. The letter concludes: "The OPA therefore supports the refurbishment of Darlington NGS based on expected electricity costs in the range of 6 to 8 cents per kilowatt-hour."

Sections 2.2 through 2.5 below provide further detail of the Darlington Refurbishment project. The Economic Feasibility Assessment for the project is provided in Attachment 4.

2.2 Background

A nuclear unit's production life is primarily determined by life-limiting components, the replacement or refurbishment of which would require a multi-year outage. At Darlington, these components are the fuel channels and feeders. The production life of other station components can be extended through ongoing maintenance or less extensive replacement activities, which would be integrated with normal outages or, if more efficient, be carried out as part of the major outages associated with refurbishment.

Given the need to properly prepare and plan for the execution of major projects, and the long lead times to procure critical components, OPG began exploratory work in 2007 to evaluate the feasibility of refurbishing and continuing to operate the Darlington units beyond their currently expected nominal life. Based on original design assumptions, the Darlington units were expected to reach their nominal end of life between 2018 and 2020. Nominal end of life is defined by a pressure tube life of 210,000 equivalent full power hours ("EFPH") which was based on predicted hydrogen uptake in the pressure tubes. The levels of hydrogen uptake are evaluated routinely as part of inspection and maintenance plans carried out during unit outages. The actual end of life is predicted based on the trend of these results over time and results of inspections on other life limiting components, specifically, the feeders. This information forms the basis of the strategy and timing for the refurbishment.

In June 2006, the Province directed OPG to undertake feasibility studies on refurbishing its existing nuclear units. The letter containing this direction is provided in Attachment 5.

2.3 Darlington Refurbishment Project Processes

The goal of the Darlington Refurbishment project is to extend the operating life of the plant to provide approximately 30 additional years of post-refurbishment generation. A major nuclear unit refurbishment project involves a multi-year outage for replacement of life-limiting critical components, as well as the maintenance/replacement of other components which are most cost-effectively done during the extended outage period.

The regulatory requirements for refurbishment are set out in Canadian Nuclear Safety Commission ("CNSC") Regulatory Document RD-360, Life Extension of Nuclear Power Plants. These requirements include an Environmental Assessment ("EA"), an Integrated Safety Review ("ISR"), and a Global Assessment. The results of these assessments are compiled into an Integrated Improvement Plan ("IIP") which is approved by the CNSC and forms the basis of the scope of work for the refurbishment. The results of the IIP, other reliability enhancing improvements, and necessary infrastructure projects make up the scope of the refurbishment.

OPG's approach to refurbishing Darlington is based on the Project Management Institute's Project Management Body of Knowledge, as well as other industry standards, the experience gained internally, and through comparisons with other nuclear entities undergoing major refurbishment projects.

OPG is managing the Darlington Refurbishment project in phases, specifically:

- Project Initiation - Preliminary assessment and viability recommendation.
- Project Definition - Front-end project planning including detailed engineering and the development of the project scope, cost, and schedule baseline.
- Execution - Outage preparation and refurbishment outage execution, including project monitoring and control.
- Close-out - Close-out of the major project.

2.4 Darlington Refurbishment – Project Initiation Phase

2.4.1 Overview

The initiation phase of the Darlington refurbishment project began in late 2007 following the June 2006 direction from the Province requiring OPG to undertake feasibility studies on refurbishing its existing nuclear units (see Attachment 5).

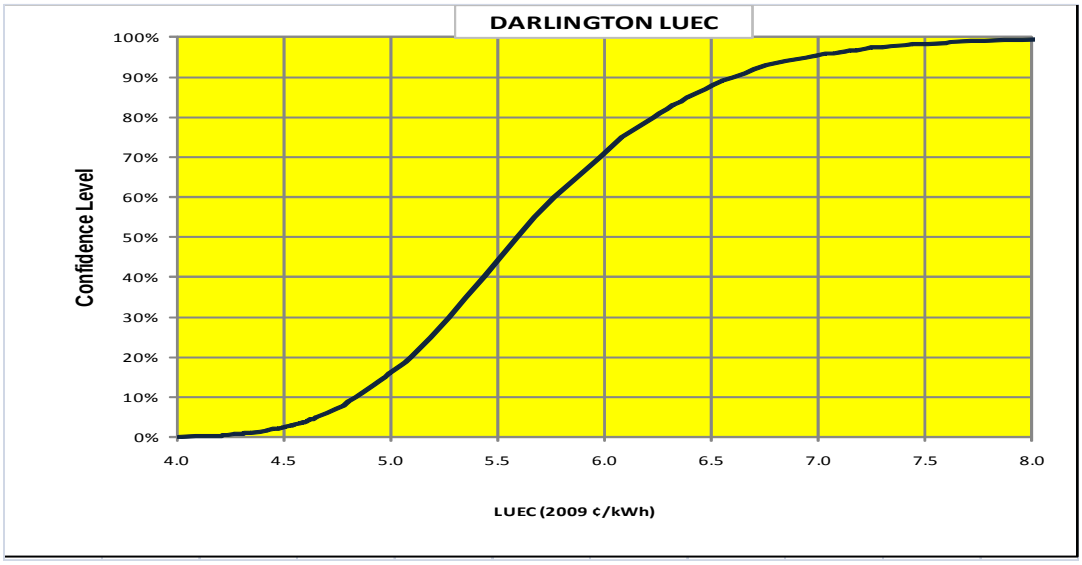
Work completed in 2008 and 2009, in support of the feasibility assessment, included: technical assessments of the major systems, a component condition assessment, initial outage planning to determine the refurbishment reference schedule, and the development of initial project governance, including a Project Execution Plan (see Attachment 2**).**

In 2009, OPG completed a review of modern codes and standards in accordance with the requirements of the ISR. Planning related to the preparation of the EA was performed including the installation of groundwater monitoring wells in 2009 in order to start baseline monitoring in early 2010.

Based on the feasibility work completed to date, OPG prepared an economic feasibility assessment of Darlington refurbishment and a preliminary release business case. This document is provided in Attachment 4. Given the uncertainties associated with major nuclear refurbishments and also given the early stage of scope, schedule, and cost estimate development for this project, OPG currently has a very high confidence that the refurbishment of Darlington will result in a Levelized Unit Energy Cost ("LUEC"), as shown in Figure 1, of less than 8¢/kWh (2009 dollars). This estimate is based on preliminary planning done to date, a review of current refurbishment experience in the industry, as well as a conservative view of the post-refurbishment operational cost and performance.

Figure 1

Levelized Unit Energy Cost Confidence Ranges



The LUEC range shown in Figure 1 above is based on a number of planning assumptions; including 1) refurbishment project cost, 2) refurbishment schedule, 3) post refurbishment operations costs, and 4) post refurbishment operating performance:

1) Refurbishment Project Cost - Based on the current level of planning as well as a review of industry experience, the current projected cost of the refurbishment project is in the range of $6B to $10B (2009 dollars).
2) Refurbishment Schedule - OPG's planning assumption was that the first unit refurbishment outage would commence in October 2016 and that each unit outage will last approximately 36 months. It is also assumed that unit refurbishment outages will be overlapped with a maximum of two units in a refurbishment state at any point in time. These assumptions are based on the current predicted end of service life, information received from technical studies on the project's critical path duration and replacement costs, and the current experience of other refurbishments.
3) Post-Refurbishment Operations Costs – A range of $450M to $525M per year (2009 dollars) of post-refurbishment station costs, including operations, outages, and projects,

were considered in the feasibility assessment. The current annual business plan average is $458M (2009 dollars). The high-level confidence LUEC assumes a post-refurbishment station cost of approximately $525 million per annum. Nuclear and corporate support costs in addition to the post-refurbishment station costs were also included in the LUEC assessment.

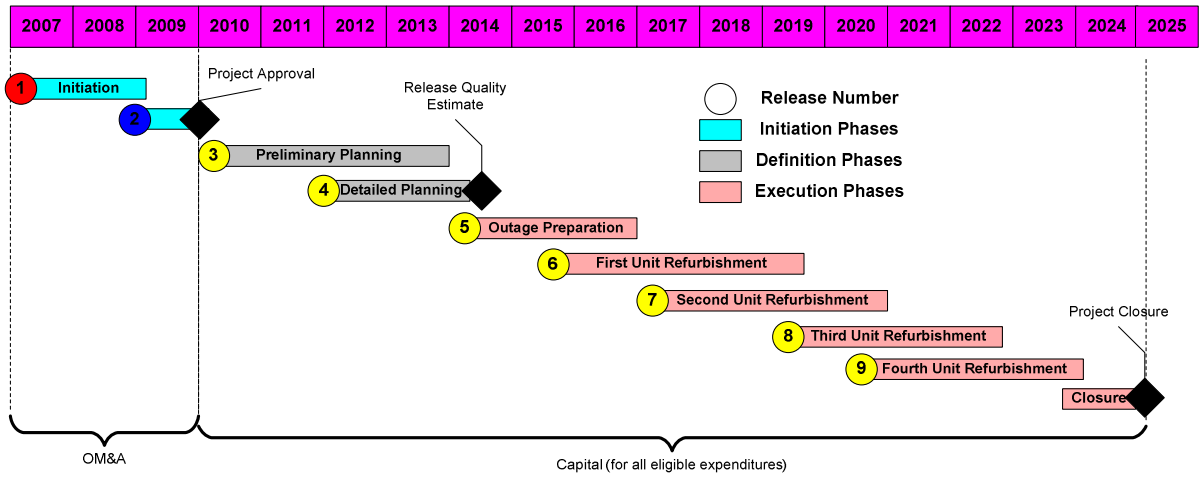
4) Post-Refurbishment Performance – The estimate of the performance of the Darlington units in the post-refurbishment period is based on a number of factors, including historical performance. Recent performance has been excellent; with Gross Capability Factor in the range of 85 per cent to 90 per cent. The recent planned outage performance and forced loss rates ("FLR") have also been very good (see Ex. E2-T1-S1). The high level confidence LUEC assumes an ongoing Gross Capability Factor of 82 per cent, which is lower than current performance. The medium level confidence LUEC assumes an ongoing Gross Capability Factor of 87 per cent which is equivalent to Darlington's average performance over the last 10 years. Additionally, sensitivities on post-refurbishment unit service life (25 to 35 years) are included in the assessment.

These planning assumptions form the basis of the LUEC ranges shown in Figure 1. OPG will continue to refine these assumptions during the definition phase of the project. At these LUEC ranges, and based on publicly available information, the economics of Darlington refurbishment are more attractive than alternative generation options including new nuclear and combined cycle gas turbines.

During the initiation phase, OPG also developed a timeline and release strategy (see Appendix A of the Economic Feasibility Assessment in Attachment 4) for the entire project as shown in Figure 2. The release strategy outlines the process under which OPG will develop its project plan and seek the release of funds to continue the project. The release strategy requires certain deliverables to be achieved prior to moving to the next phase of the project.

Figure 2

Overview of the Darlington Refurbishment Release Strategy



OPG will, during the definition phase of the project (see section 2.5 below), confirm the project scope, cost, and baseline schedule. In 2014, OPG will revise its feasibility assessment, establish the project scope, cost, and schedule and prepare a recommendation to the OPG Board to proceed to the execution phase of the project, assuming that the economics of the project remain favorable.

2.4.2 Expenditure Summary – Project Initiation Phase

As shown below in Chart 2, actual OM&A expenditures for Darlington refurbishment in 2008 were below budget by $11.1M. The primary reasons for the 2008 OM&A budget variance were due to continued focus on Pickering B refurbishment to complete the EA and the ISR, which delayed the start of some of the Darlington refurbishment planning activities. There were no capital expenditures budgeted or incurred in 2008.

Actual expenditures in 2009 were below budget by $1.0M. The primary reasons for the 2009 OM&A budget variance is due to lower costs related to the completion of the Plant Condition Assessment; as well as a cancellation of a steam generator replacement study due to a decision by OPG management not to replace the steam generators at Darlington.

The post April 1, 2008 variances, as noted above, will be captured in the Capacity Refurbishment Variance Account as discussed at H1-T1-S1.

2.5 Darlington Refurbishment – Project Definition Phase

In accordance with the OPG Board of Directors approval and the Provincial concurrence (see Attachment 3), work commenced in 2010 on the definition phase of the Darlington Refurbishment project.

OM&A and capital expenditures on Darlington refurbishment for the period 2010 to 2012 are presented in Ex. F2-T7-S1 Table 1 and Ex. D2-T2-S1 Table 3, and also summarized in Chart 2 below. The majority of the Darlington Refurbishment expenditures are being capitalized effective January 1, 2010. These expenditures are for definition phase activities including the establishment of the project organization, scope finalization, engineering, planning and estimating, procurement of long lead items and contract establishment. Additionally, all regulatory work will be completed in this phase including the EA, ISR, Global Assessment, and the IIP. A release quality project cost and schedule will be prepared at the end of the definition phase.

Additional infrastructure projects, referred to as the Darlington Site “Campus Master Plan” in Chart 2 will also commence in the definition phase. The Campus Master Plan includes facilities and infrastructure upgrades required to directly support the current operation of Darlington, the refurbishment outages, and operation of the station for an additional 30 years post-refurbishment. Attachment 6 identifies all Campus Master Plan infrastructure projects with expenditures in the test period, along with start date, projected in-service date and conceptual total project cost. Engineering, design and contracting of certain facilities, i.e., the Training and Mockup Facility, is required to commence in 2010 in order to ensure readiness to commence the refurbishment outage in 2016. Each Campus Master Plan infrastructure release will be supported by its own business case.

To the extent that there are variances between actual and approved OM&A and capital costs associated with Darlington Refurbishment, OPG proposes that such variances be captured in

the Capacity Refurbishment Variance Account, thus ensuring that OPG only recovers the OM&A and capital costs that were actually spent. A description of the variance account is further discussed in Ex. H1-T1-S1.

Chart 2

Darlington Refurbishment Costs ($M)

	Actual 2007	Actual 2008	Budget 2008	Variance	Actual 2009	Budget 2009	Variance	Budget 2010	Plan 2011	Plan 2012
OM&A										
Initiation/Definition Phase	$0.4	$7.3	$18.4	($11.1)	$21.7	$22.7	($1.0)	$4.2	$5.0	$2.9
Campus Master Plan	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$1.3	$0.9	$1.6
OM&A -Total	**$0.4**	**$7.3**	**$18.4**	**($11.1)**	**$21.7**	**$22.7**	**($1.0)**	**$5.5**	**$5.9**	**$4.5**
Capital										
Definition Phase	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$44.4	$42.2	$149.2
Campus Master Plan	$0.0	$0.0	$0.0	$0.0	$1.0	$0.0	$1.0	$28.6	$63.0	$106.6
Capital - Total	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$1.0**	**$0.0**	**$1.0**	**$72.9**	**$105.2**	**$255.8**

3.0 NEW NUCLEAR AT DARLINGTON ("NND")

3.1 Overview

OPG's nuclear revenue requirement for the test period does not include any costs for new nuclear at Darlington ("NND"). The province has not yet determined the cost recovery mechanism for new nuclear. When it does, OPG will develop its future applications accordingly. For the purposes of this application, OPG has not made any assumption on the form of that mechanism.

In Ex. H1-T2-S1, OPG seeks approval to dispose of the forecast balance at the end of 2010 in the Nuclear Development Variance Account. If costs for planning and preparation of new nuclear arise in the test period and there is no new cost recovery mechanism, they will be collected through the Nuclear Development Variance Account, consistent with the requirements of O. Reg. 53/05.

Section 3.2 below summarizes the activities that have been undertaken to date on this project, and also work that will continue until the end of 2010 to ensure that the value of preparatory work already undertaken is preserved, such that a site will be licensed and available when the project resumes. Section 3.3 summarizes the 2007- 2012 costs for NND.

3.2 Status Update

Following the 2006 direction from the Province to begin a regulatory approval process for building new nuclear generating units (see Attachment 5), OPG began the initial planning work for new nuclear at Darlington. Consistent with project management processes, as described for the Darlington Refurbishment project (see section 2.3 above), OPG is managing the NND project in similar phases; namely Regulatory Approvals, Definition, Execution and Closeout.

In early 2008, the Province announced a two-phased competitive procurement process, led by Infrastructure Ontario ("IO"), to select a single preferred vendor for new nuclear reactors at Darlington. On June 29, 2009, after the submission and review of final bids from potential suppliers, the Province announced that it was suspending the competitive procurement process. This process has since expired on February 19, 2010. The Province noted that the process had not provided suitable options to allow for the continuation of the procurement at this time but that it remained committed to the modernization of Ontario's nuclear fleet and the construction of new nuclear units at Darlington.

In response to the Province's decision to suspend the request for proposals ("RFP") process for new nuclear reactors at Darlington, OPG immediately suspended certain NND activities including:

- Staffing of the engineering, procurement, quality, project controls and safety areas of the project execution team.
- Activities in support of the Infrastructure Ontario procurement process.
- Contracts with various stakeholders for the execution of work necessary to prepare the site (e.g., Hydro One).
- Completion of the governance framework for the project execution.

While the Provincial efforts to select a vendor and associated technology are suspended, certain OPG work activities, which are necessary due to the long lead time associated with planning and licensing new nuclear units, are continuing to ensure the new nuclear initiative is well positioned to resume the process when re-initiated.

OPG's activities that are continuing include:

- Securing acceptance/approval of the EA and other licenses.
- Maintaining community support for the project.
- Optimizing the value of the planning work done to date through 2007 to 2009.

On September 30, 2009, OPG submitted the Environmental Impact Statement ("EIS") and the updated "Application for a Licence to Prepare Site for the Future Construction of OPG New Nuclear at Darlington" ("LTPSA") for the new nuclear project to the CNSC. OPG also submitted preliminary applications for other federal approvals which require early consideration.

The EIS documents the work completed since the fall of 2006 to assess potential project-environment interactions and to evaluate their significance. The studies included consultation with the local, First Nations and Métis communities.

OPG's LTPSA documents the work completed to demonstrate that 1) the site is appropriate for a nuclear power plant; and 2) the CNSC regulatory requirements are satisfied.

Continuation of these activities is consistent with the Province's 2006 directive (see Attachment 5) and reinforced by the latest communication from the Ontario Power Authority in which they supported continued expenditures on the preparatory work for NND. The letter of support from the Ontario Power Authority is provided in Attachment 7.

3.3 Expenditure and Activity Summary

OM&A expenditures on New Nuclear at Darlington during the regulatory approvals phase for the period 2007 to 2012 are set out in Ex. F2-T7-S1 and summarized below in Chart 3.

Planning work undertaken over the period 2007 to 2009 included.

- Activities for carrying out an EA under the *Canadian Environmental Assessment Act* and obtaining required governmental licences, authorizations, permits or other approvals, including the Licence to Prepare Site from the federal authorities,
- Activities for evaluating and reviewing the available nuclear plant technology options in support of selecting the technology to be deployed in Ontario,
- Activities in support of the Provincial procurement process, being conducted by Infrastructure Ontario,
- Preparatory activities in support of entering the project definition phase for the project including the eventual procurement of the nuclear power plant and related components and preparing the site for turnover to the successful vendor.

In 2010, the majority of the work and related OM&A expenditures will be focused on obtaining acceptance/approval of the Environmental Impact Statement/Licence to Prepare Site application from the federally appointed Joint Review Panel.

OPG's 2010 - 2014 business plan assumes that the new nuclear project at Darlington will resume on January 1, 2011. This planning assumption is based on the resumption of the procurement process in July 2010, followed by the negotiations with the vendors and the execution of a final contract in December 2010.

Due to the uncertainty in timing of the resumption of NND, there is corresponding uncertainty with respect to forecast expenditures during 2010. Any positive or negative differences in 2010 expenditures relative to forecast will be entered in the Nuclear Development Variance Account for subsequent disposition.

Other NND work activities in 2010 include a planned resumption of the procurement process to select a nuclear reactor vendor plus development of a project cost estimate and schedule, including contingency.

The province has not yet determined the cost recovery mechanism for new nuclear. Accordingly, OPG has not included any capital or non-capital costs for new nuclear in its test period revenue requirement. If costs for planning and preparation of new nuclear arise in the test period and there is no new cost recovery mechanisms, they will be recovered through the Nuclear Development Variance Account, consistent with the requirements of O. Reg. 53/05.

Chart 3

New Nuclear At Darlington Costs ($M)

	Actual 2007	Actual 2008	Budget 2008	Variance	Actual 2009	Budget 2009	Variance	Budget 2010	Plan 2011	Plan 2012
Base OM&A	$11.2	$26.2	$75.4	($49.2)	$57.9	$67.2	($9.3)	$35.0	$0.0	$0.0
Capital	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

LIST OF ATTACHMENTS

Attachment 1: Refurbishment Excerpt from Nuclear Refurbishment, Projects and Support 2010 – 2014 Business Plan

Attachment 2: Project Execution Plan, Darlington Nuclear Refurbishment Project

Attachment 3: Letter from Brad Duguid, Minister of Energy and Infrastructure to Tom Mitchell, OPG dated February 4, 2010

Attachment 4: Economic Feasibility Assessment of Darlington Refurbishment

Attachment 5: Letter from Dwight Duncan, Minister of Energy to James Hankinson, OPG dated June 16, 2006

Attachment 6: Campus Master Plan: Project Listing

Attachment 7: Letter from Amir Shalaby, Ontario Power Authority to Albert Sweetnam, OPG dated February 8, 2010 re: Darlington Environment Impact Statement and License to Prepare the Site – Support for EIS Guidelines Section 07.1-IR #5

Note: Attachments 1 and 4 are marked “Confidential” because the original documents in their entirety contain confidential information. The excerpt or redacted version provided as pre-filed evidence is not confidential.

Filed: 2010-05-26
EB-2010-0008
Exhibit D2-2-1
Attachment 1

Nuclear Refurbishment, Projects and Support

Business Plan 2010-2014

Nuclear Refurbishment, Projects, and Support – Strategic Goals

Nuclear Refurbishment, Projects, and Support	▪ **Complete the transition and establishment of the Nuclear Refurbishment, Projects, and Support organization.**
Nuclear Refurbishment	▪ Initiate the definition phase of the Darlington Refurbishment Project, including Infrastructure (Facility) improvements ▪ Complete the Pickering B Refurbishment Planning Activities project and a Pickering End-of-Life plan.
Projects and Modifications	▪ Manage and execute high value projects for Nuclear Operations, on time and on budget.
Commercial Projects And Facilities	▪ Implement a commercial approach to the management of Nuclear facilities. ▪ Develop an interim leasing plan for off-site accommodations ▪ Leverage opportunities to reduce costs and improve project management and facility services.
Pickering A Safe Storage	▪ Completion of the Pickering A Safe Storage Project – placing units 2 and 3 in a Safe Storage state.
Inspection, Maintenance, and Commercial Services	▪ Develop new inspection methodologies to meet life-cycle demands while reducing inspection durations. ▪ Effectively remove IM&CS from Bruce Power lease and establish internal Inspection and Maintenance organization.

Nuclear Refurbishment, Projects & Support – SVP Office

Nuclear Refurbishment, Projects, and Support

- **Provide executive oversight to the Nuclear Refurbishment, Projects, and Support organization.**
- **Complete the transition and establishment of the Nuclear Refurbishment, Projects, and Support organization.**
- **Provide funding for Graduate Engineer's in Training (GEITs). The GEITs will be deployed to the DN Refurbishment project or to the Nuclear Operations organization upon the completion of their training.**
- **The following Chart summarizes the cash flows and FTE's requested in this Business Plan for SVP, Nuclear Refurbishment, Projects & Support:**

Projects		Category	2009 ($M) LTD	2010 ($M)	2011 ($M)	2012 ($M)	2013 ($M)	2014 ($M)	Cum LTD ($M)	Bus Plan ($M)
SVP - NR, Proj & Support			0.0	4.3	4.3	2.9	0.7	0.7	12.9	12.9
	SVP Office and GEITS	OM&A	0.0	4.3	4.3	2.9	0.7	0.7	12.9	12.9
	FTE OPG		0.0	33.0	22.0	15.0	0.0	0.0		

Notes:

- The 2009 year End Forecast is included with the Nuclear Refurbishment organization, based on 2009 organization structure.

Nuclear Refurbishment Key Objectives

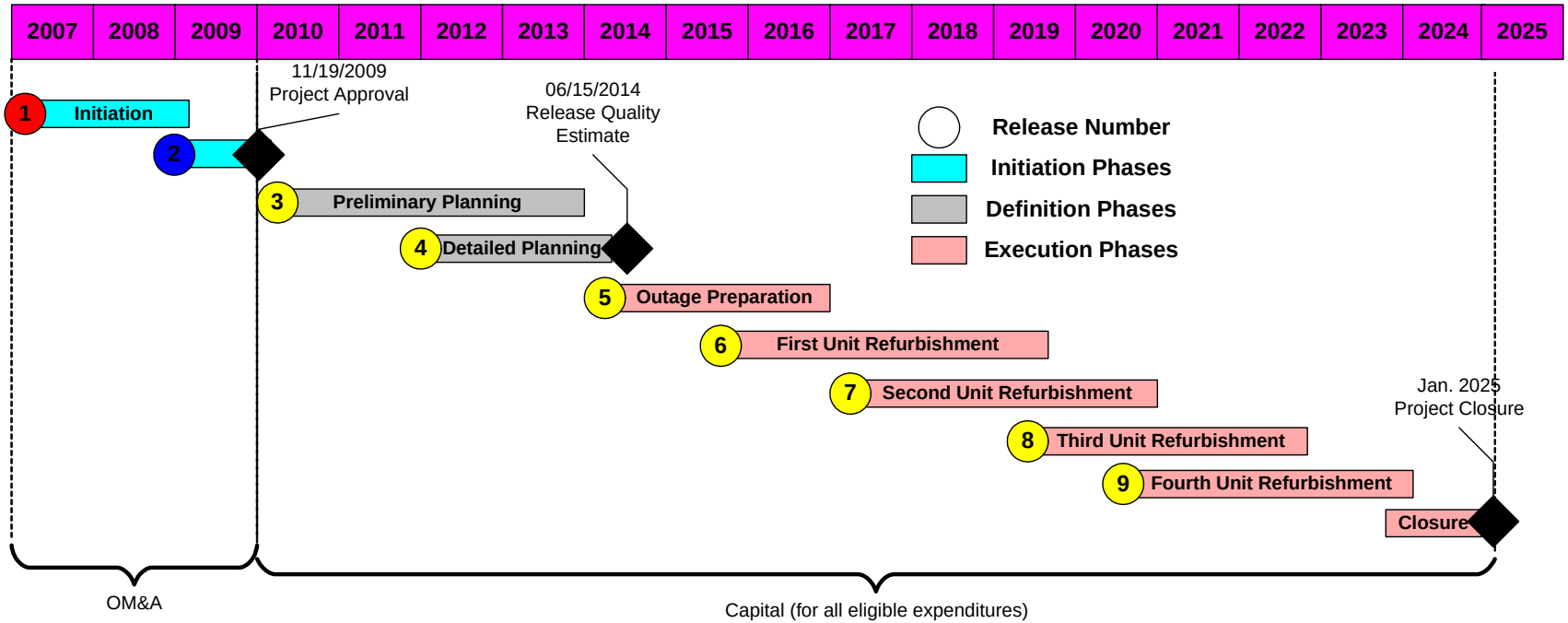
Nuclear Refurbishment

- **Prepare for the refurbishment of Darlington starting October 2016, however, increase flexibility to start as early as October, 2015.**
- **Implement the Fuel Channel Life Management Project to increase confidence of operating Darlington to 210k EFPH(1) and Pickering B to 240k EFPH or beyond in order to maximize refurbishment lead times.**
- **Obtain CNSC approval of the Pickering B Final ISR Report and develop the Pickering End-of-Life plan.**
- **Implement infrastructure improvements in support of the DN Refurbishment project and post-refurbishment operations, as part of the Darlington Campus Master Plan.**

(1) Effective Full Production Hours (EFPH)

DN Refurbishment Release Strategy

- **A release strategy, to obtain funding for each phase of the project, will be implemented:**



Notes:

- Releases 3 and 4 are definition phase releases. A Release Quality Estimate will be completed prior to Release # 5 (mid 2014); the project will have spent approx. 10 to 12% of total funds at this point (excluding Campus Plan and Infrastructure improvements).
- Releases 6 to 9 are for the unit outage execution phases. Overall unit outage months is 144; each unit is assumed to be 36 months. The overall outage duration, due to unit overlaps, is 88 months elapsed time (Oct. 2016 to January 2024).
- Release strategy is tied to an October 2016 1st unit outage, an advancement to October 2015 would result in advancement of Releases 5 - 9.

Nuclear Refurbishment Financial Plan

- **The following Chart summarizes the cash flows and FTE's requested in this Business Plan for Nuclear Refurbishment:**

Projects		Category	2009 ($M) LTD	2010 ($M)	2011 ($M)	2012 ($M)	2013 ($M)	2014 ($M)	Cum LTD ($M)	Bus Plan ($M)
Darlington Refurbishment			**31.7**	**74.3**	**112.9**	**273.2**	**374.5**	**499.9**	**589.5**	**1,334.8**
	Release # 3			74.3	112.9	35.5	17.1	0.9	240.7	240.7
	Preliminary Planning	Capital		44.4	45.2	8.1	3.9	0.9	102.5	102.5
	Campus Plan/ Infrastructure	Capital		28.6	66.1	27.4	13.2		135.3	135.3
	Campus Plan/ Infrastructure	OM&A		1.3	1.6				2.9	2.9
	Future Releases			0.0	0.0	237.7	357.4	499.0	348.8	1,094.1
	Preliminary Planning	Capital				150.3	285.6	441.6	877.5	877.5
	Campus Plan/ Infrastructure	Capital				85.8	71.6	56.1	213.5	213.5
	Campus Plan/ Infrastructure	OM&A				1.6	0.2	1.3	3.1	3.1
	FTE OPG		98.0	102.7	122.6	148.0	145.0	145.0		
Pickering Refurbishment			**49.7**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**50.9**	**1.2**
	Preliminary Planning	Capital	49.7	1.2					50.9	1.2
	FTE OPG		5.3	1.5						
Fuel Channel LCM Project			**2.5**	**9.7**	**7.7**	**4.0**	**0.9**	**0.0**	**24.8**	**22.4**
	Full Release Project	OM&A	2.5	9.7	7.7	4.0	0.9		24.8	22.4

Notes:
- Pickering B Refurbishment cash flows in 2010 are primarily CNSC fees.
- Capital cash flows for the Darlington Refurbishment Project will be released via a project BCS in accordance with the project release strategy.
- Cash flows related to 'Future Releases' are conceptual and will be firmed up in the Preliminary Planning Phase

DN Refurb - Preliminary Planning (Release # 3) Work Programs

Work Program	Total	Deliverables
Project Management	**24.6**	Project Management oversight and control, including development of detailed governance for definition phase, including governance to prepare Release Quality estimate and schedule. Project Management systems and tools in place. Includes infrastructure costs such as leases; costs for Finance, HR, Public Affairs, etc.
Supply Chain	**9.6**	Contracting Strategy and governance developed. Major component contracts ready to issue.
Quality Mgmt	**1.1**	Quality Program established, governance in place.
O&M Commissioning	**1.9**	O&M and Commissioning strategies developed and governance in place.
Construction	**1.9**	Construction strategies developed and initial governance in place.
EA	**13.8**	EA completed, submitted to the CNSC, and approved by the CNSC.
ISR	**15.5**	Final ISR Report completed, submitted to the CNSC, and approved by the CNSC.
Engineering	**10.7**	Technical specifications for major component contracts prepared, issued, evaluated. Detaild outage preparation planning and scope review process in place. All tgechnical assessments to determine scope completed.
Licensing Support	**2.2**	Relicensing strategy established, IIP prepared, submitted, and approved by CNSC.
CNSC Fees	**6.3**	
Interest	[redacted]	
Contingency	[redacted]	
Totals	**102.5**	

DN Refurb - Preliminary Planning (Release # 3) Infrastructure

Work Program	Total	Deliverables
Training and Mock-up Building	[redacted]	Design and Construction by late 2012; full use by 2013.
Project Offices, warehouses, security building, and other facilities		Upgrades to Info Centre, design of additional infrastructure needs, vehical garage, salt shed, contractor trailer camp, warehouses.
Water and Sewar Upgrades		Upgrades complete by 2012 (to site, across site).
Transformer Upgrades		Upgrades complete by late 2012.
Road and Parking Upgrades		Road upgrades ready by 2013
OSB Refurbishment		Initial Design work.
Boiler House		Desgin Work
Design of Heavy Water and Waste Storage Facilities		Design initiated in 2011
Conceptual Design		Preliminary design work prior to BCS
Demolitions		Removal of facilities.
Interest		
Unallocated Projects and Contingency		Estimates are conceptual. Funding will be released through a BCS
Totals	**138.2**	

Notes: - Each infrastructure project will be released only upon approval of a Project BCS, per OPG's OAR, for each facility or infrastructure improvement.

Nuclear Refurbishment Key Risks

RISK	IMPACT	CONSEQUENCE	PROBABILITY	MITIGATION
Darlington units do not reach predicted EOSL (based on 210k EFPH) resulting in idle units and/or advancement of DN Refurbishment.	• Increased idle time of units and/or starting refurbishment without adequate plans.	High	Medium	• Fuel Channel Life Management project will review confidence of reaching 210k EFPH. • Advanced planning activities to be ready by 2015. • Assets will be life-managed to achieve 2015.
Insufficient infrastructure planning or time to develop infrastructure	• Not ready to start refurbishment due to incomplete infrastructure.	High	Low	• Infrastructure planning and development commencing in 2010 with a partial release included in Release # 3.
CNSC timing/ costs to complete the review and provide approval to EA, ISR, IIP.	• Delay in refurbishment outage start date.	High	Medium	• Working with the CNSC to develop a plan to obtain approval of all documents.

ONTARIO POWER GENERATION

Project Execution Plan

Internal Use Only	
Document Number: NK38-PEP-09701-10001	
Sheet Number: N/A	Revision: R001

Title:
DARLINGTON NUCLEAR REFURBISHMENT PROJECT

Darlington Nuclear Refurbishment Project

NK38-PEP-09701-10001-R001

2009-10-30

Order Number: N/A
Other Reference Number: 10-27959

Internal use Only

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Approved by:

B. Robinson Date
Senior Vice President
Nuclear Refurbishment, Projects, and Support

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Revision Summary

Revision Number	Date	Comments
R001	2009-11-04	• Updated to incorporate Darlington Retube and Feeder Replacement Study findings and reorganization changes. • This document contains 22 “physical” pages.
R000	2009-06-30	Initial issue. This document contains 25 “physical” pages.

1.0 PROJECT DEFINITION

1.1 Needs Statement (Background)

Nuclear facilities are aging and there is a need to assess and make recommendations with respect to the feasibility of continuing to operate these stations beyond the current nominal end-of-service life dates. Current medium confidence estimates, based on Darlington pressure tubes fitness for service, predict that the Darlington NGS (DNGS) reactors will reach the end of their current operating lives between 2018 and 2020.

Service life predictions are developed by assessing the impacts of a number of operating, technical and regulatory considerations on both unit and station economics. A decision to remove a unit from service will likely be primarily an economic decision as the number of components requiring replacement grows and the frequency and duration of inspections required to ensure a unit's Fitness-for-Service increases. End-of-service life predictions are continually reviewed as new inspection information and knowledge of possible degradation mechanisms become available and future production levels are revised.

In June 2006, the Ontario Government directed OPG to begin technical feasibility studies on refurbishing its existing nuclear plants. The need for refurbishment is also addressed in the Ontario Power Authority's Integrated Power System Plan (IPSP). The Ontario Power Authority, in response to a Directive from the Ontario Minister of Energy, is planning for up to 14,000 MW of nuclear generation to meet Ontario's requirements for electrical energy. While the IPSP recognizes that refurbishment decisions rest with facility owners, the IPSP reference plan does assume substantial nuclear unit refurbishments, including the Darlington units.

The goal of the refurbishment project would be to extend the service life of the units by an additional 210,000 Effective-Full-Power-Hours (EFPH). The refurbishment would involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which are most effectively done during the refurbishment outage period.

The Nuclear Refurbishment (NR) organization has been established with the responsibility of assessing and making recommendations to OPG's Senior Management with respect to the feasibility of refurbishment and executing all activities associated with refurbishment.

For the Darlington station, *NR* will undertake the Darlington Refurbishment Project, in phases as authorized by OPG Management, the OPG Board of Directors, and/or OPG's Shareholder, to:

- Assess the technical feasibility of refurbishing Darlington and operating it for an additional 210,000 EFPH.

- Make recommendations as to the lead time required to be prepared to refurbish each unit

- Fully defining refurbishment scope.
- Execute front end planning including developing contract management strategies, cost estimates, schedules, a full risk assessment, and a release quality estimate for the project.
- Manage the refurbishment pre-outage planning and preparation activities.
- Outage execution and commissioning.
- Project closeout.

This project has been defined in Project Charter: D-PCH-09701-10000 R001 prepared by the Manager, Project Infrastructure, Nuclear Refurbishment, recommended by the Director, Project Planning and Control, Nuclear Refurbishment, and approved by the Senior Vice-President, Nuclear Refurbishment.

1.2 Execution Plan Purpose

Nuclear Refurbishment (NR) governing documents provide the overriding Charter, Programs, Procedures, and where necessary, instructions for carrying out selected OPG processes that need particular rigour to ensure objectives regarding nuclear and conventional safety, environmental protection, quality, budget, schedule, minimal impact on existing operations and stakeholder relations are achieved. The combination of Governance, Project Charter, Project Execution Plan (PEP), and Project Organization comprise a Management System that supports a successful project result.

The PEP is part of the NR Management System. Its purpose is to:

- Ensure that all key issues relevant to the successful execution of the Project are identified, defined and understood at the earliest possible stage.
- Provide Project team members, end users, line authority and stakeholders with a common understanding of the Project and the planned method of execution.
- Provide a reference for approved governing documents that comprise the NR Management System.

The level of detail in the PEP will be consistent with each phase of the Project, based on the time frame. This initial document will focus on the Definition - Preliminary Planning phase and provide fewer details around the later phases. In addition to the items above, the PEP provides:

- Direction on project controls.
- Direction on managing risk.

- Direction on document management processes that are not included in Governing Documents.

The PEP is intended to be a living document. It will be reviewed and updated as necessary during the Definition and Execution Phases of the Project, nominally every 6 months.

It is the responsibility of the Director, Planning and Controls to facilitate development of, and to maintain, the PEP with the support of, and in consultation with, the project participants. Each section of the PEP is assigned to a functional owner (see Appendix A) who will be responsible for collecting updates for that section for submission to the Director, Planning and Controls.

1.3 Project Objectives (Critical Success Factors)

The principal objective of the project is to assess the feasibility of refurbishing Darlington NGS reactors, plan and execute the refurbishment and to enable operations for an additional 210,000 EFPH.

Subsidiary objectives needed to ensure the principal objective is achieved are as follows:

- Obtain the necessary corporate, government and regulatory approvals (e.g., Environmental Assessments, Integrated Safety Review, and Integrated Improvement Plan) for refurbishment in a timely and cost effective manner.

- Establish regulatory certainty, to the degree possible, for the refurbishment project and subsequently bounding the uncertainty prior to submitting the recommendation to the OPG Board.

- Timely and comprehensive completion of technical studies and a plant condition assessment to determine the appropriate project scope.

- Implement appropriate contract and procurement strategies to execute the work and obtain all required materials in advance of the outage.

- Engineering and detailed outage planning in order to finalize the project scope, cost, and schedule and prepare a release quality estimate for the full project

- Form the project team that will manage the execution of the DNGS units' refurbishment.

- Execution of the refurbishment outages in a managed and controlled fashioned that results in meeting the approved project cost and schedule.

- Provide adequate and accurate information to OPG Senior Management, the Board of Directors, the Shareholder, and other external parties as required, in order to facilitate decisions around the project and obtain phased based funding for the project.

- Establish, develop and maintain project infrastructure, systems, methods and processes for estimating, scheduling, budgets, cost management, forecasting, change control, document control, project performance reporting, executive and Board of Directors reporting and oversight.

- Implement appropriate governing procedures for each phase of work.

1.4 Project Scope

The scope of the complete Darlington Refurbishment project will be developed during the Initiation and Definition phases. The complete scope will be based on:

(a) Scope for the refurbishment outages as developed under the NK38-PLAN-01060-10003, DNGS Refurbishment Project Reference Plan - Scope Definition. This includes:

(1) Conducting an overall condition assessment of systems, structures, and components and preparing the summary results as a key input to the ISR.

(2) Conducting various engineering technical assessment and studies, examples are Fuel Handling, Steam Generator (SG), Turbine Generator, Fuel Channel and Feeder Replacement study, Tritium Removal Facilities (TRF)/Heavy Water Management, Waste Management, and Construction Island.

(3) Developing engineering solutions for nuclear safety, Environmental Assessment (EA) and other gaps and performing associated Benefit Cost Analyses.

(4) An assessment of the on-going work (cyclic and outage) required to support operation of the station for the extended operating life.

(5) Review and approval by a Darlington Refurbishment Scope Review Board per NK38-PLAN-09701-10003, Darlington NGS Refurbishment - Scope Review Board - Reference Plan.

(b) An ISR Program approved by the regulator per N-PROC-LE-0005, NR Integrated Safety Review - Darlington.

(c) An Integrated Improvement Plan (IIP) approved by the regulator per N-PROC-LE-0007, NR Integrated Implementation Plan - Darlington.

(d) An EA Program approved by the regulator per N-PROC-LE-0002, Conduct of Environmental Assessment.

(e) A Managed System Oversight (Quality) plan, per N-PROG-LE-0002, Nuclear Refurbishment Darlington and subordinate Procedures. The plan will be developed in stages to address quality requirements for the next project phase, see Section 2.2, Roles and Responsibilities for Director, Refurbishment Quality Programs.

(f) Project organization and infrastructure estimates based on the contracting strategy.

(g) Risk contingencies and other allowances.

1.5 Priority/Timing

Refurbishment timing will be developed as part of the project definition and front end planning process and will be based on the following elements:

- Risk/Uncertainty around Technical Life Limits for major components.
- Lead Time for obtaining regulatory certainty and acquiring tooling and materials necessary for the refurbishment.
- Value of energy and capacity and impact on OPG's revenue, market share, and sustainability.
- Industry capability to execute the refurbishment, given timing of Other Refurbishments or New Nuclear projects.
- Shareholder direction.

Currently, the approved reference plan is to refurbish the four units sequentially, each with refurbishment outage duration of approximately 36 months with a 19-month overlap between first and second units, 16-month overlap between second and third units and a 19-month between the third and fourth units, with the first unit outage commencing in October 2016. The current reference schedule is as follows:

- Initiation Phase - 2008-2009
- Definition Phase - Preliminary Planning - 2009-2011
- Definition Phase - Engineering and Detailed Outage Planning - 2012-2014
- Outage Preparation Phase - 2014-2016
- Field Execution and Closeout Phase (four units) - 2016-2024
- Operation Phase (Return to service of Units) - Starting in 2019

The reference plan will continue to be re-evaluated as front-end planning progresses and will be adjusted as the level of information increases.

During the Initiation and Definition Phases, project timing is constrained by the following factors:

(a) Time required for DNGS to complete the Level 3 Darlington Risk Assessment (DARA), which is a key input to the ISR and EA Programs. The current plan is that DARA Level 3 will be completed in March of 2011.

(b) Time required to obtain Canadian Nuclear Safety Commission (CNSC) approval of the ISR, currently estimated as 2 years from the Final ISR submission (Tentative Completion Date (TCD): December 2013).

(c) Time required to obtain CNSC approval of the EA (TCD: October 2012) - currently estimated as approximately 18 months from the submission of the EA Project Description (TCD: May 2011).

(d) Time required obtaining CNSC approval of the Integrated Implementation Plan (IIP). The current plan is that it will take about half a year from IIP submittal to obtaining CNSC approval (TCD: Oct 2014).

(e) Time required for field work to prepare for the first refurbishment outage, currently estimated as 27 months required prior to the 1st outage, thus requiring the Outage Preparation phase to commence in July 2014. This work is largely dependent on approval of the EA by the CNSC in order to commence certain field work, and where possible and in order to increase flexibility in starting the first unit refurbishment up to one year earlier then planned (i.e., October 2015), infrastructure development will commence during the definition phase.

(f) The licensing strategy (which is under review) for the renewal of the current DNGS operating license in February 2013.

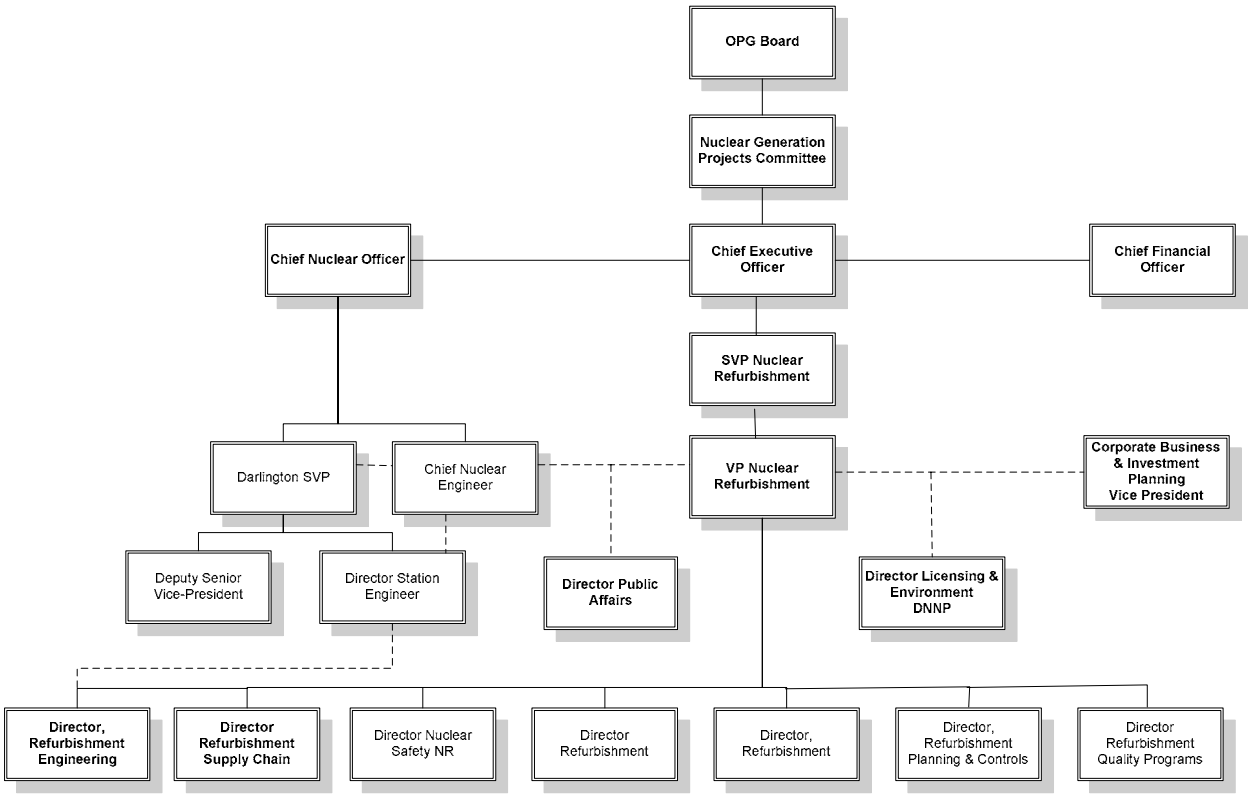
(g) Time needed to design, procure and commission the required retube tooling and mockup, as well as ordering and supply of all long lead retube components. Current estimates suggest this time to be between 2.5 and 4 years prior to the outage start.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Organization

Figure 1 shows the key project roles of the Darlington Refurbishment project including the Nuclear Refurbishment organization. This organization will be further refined as the project is developed in the Definition Phase of the project.

Figure 1: Refurbishment Project - Key Project Roles



2.2 Roles and Responsibilities

The responsibilities of the key project roles are described below. A Responsibility Matrix that maps the WBS to the organization will be developed as part of the project definition.

Position or Function	Reports To	Overview of Responsibilities
OPG Board	Shareholder	• Establishes strategic direction for the project. • Informed of overall project performance.
OPG NGPC	OPG Board	• Overview of project execution approach and advice regarding planning and configuration of project. • Provides strategic advice regarding project delivery. • Advises OPG Board on project approval and ongoing performance.
OPG President and CEO	OPG Board	• Provides senior management oversight. • Provides guidance in terms of corporate direction, priorities, and business drivers. • Provides the project link to the OPG Board and shareholder (the Ontario Government). • Recommends to the NGPC and the OPG Board approval of the Project. • Reports on performance of the Project to the OPG Board • Approves project scope, budget, and schedule. • Provides oversight of advocacy and government relations activities • Overview of project team performance.
Senior Vice President, Nuclear Refurbishment, Projects, and Support	OPG President and CEO	• Approves the Project Charter and acts as the Project Sponsor at the corporate level. • Provides oversight of the execution of activities associated with the refurbishment of DNGS as authorized by OPG Senior Management, Board of Directors and/or Shareholder. • Assessing options and making recommendations to the OPG Senior Management with respect to the technical feasibility of refurbishment and continuing to operate DNGS beyond current nominal end-of-service life dates.

Position or Function	Reports To	Overview of Responsibilities
Vice President, Nuclear Refurbishment	Senior Vice President, Nuclear Refurbishment	The VP-NR is responsible for developing the project scope, obtaining regulatory certainty, developing the project estimates, obtaining project approval and phase based releases of funds, and establishing the project organization to plan and execute the Darlington Refurbishment Project. The VP-NR is responsible for the following project related activities: • Provides direction to the NR quality program and governance in accordance with N-PROG-LE-0002. • Provides oversight of the NR quality program and governance in accordance with N-CHAR-AS-0003. • Assessing options and making recommendations to the Senior Vice President, Nuclear Refurbishment with respect to the technical feasibility of refurbishment and continuing to operate DNGS beyond current nominal end-of-service life dates. • Executing all activities associated with the refurbishment of DNGS as authorized by OPG Senior Management, Board of Directors, and/or Shareholder. • Is the authorized representative for all Nuclear Refurbishment correspondence to CNSC where the correspondence (or contents of attachment/enclosure) does not impact on existing, or create new, commitments to CNSC and does not have an incremental impact on Darlington resources, schedules or budget. • Submission of ISR basis documents (governance/CDs) and joint approval of Final ISR/Global assessment (with SVP-DNGS). • Is an approving member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope.
Senior Vice President, Darlington NGS	Chief Nuclear Officer (CNO)	The SVP-DNGS is responsible for the life cycle of the facility and is, therefore, key for the input and confirmation of the adequacy of the proposed refurbishment. The SVP-DNGS is responsible for planning the scope and schedule for shutdown or continued operation of the Darlington units. The SVP-DNGS is specifically responsible for the following activities: • Plans and sets strategic direction on improvements to the safety and performance of DNGS. • Maintains station condition, physical configuration management and equipment environmental qualification. • Maintains and enhances relationships, related to DNGS operation, with local public and regulatory agencies. • Establishes the life cycle plan for the facility and updates the plan to ensure programs shall continue to assure safe and reliable plant operation. • Acts as the formal point of contact with regulatory and external agencies for the existing site. • Establishes site requirements and priorities, and monitors the quality and quantity of services provided by nuclear support organizations. • Is an approving member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope. • Approves submission, jointly with SVP-NR, of all ISR and IIP Report submittals to the CNSC. • Approves DNGS Refurbishment EA submittal to the CNSC.

Position or Function	Reports To	Overview of Responsibilities
Deputy Senior Vice President, Darlington NGS	Senior Vice President, Darlington NGS	• Approves reviewer(s) at station for the ISR Safety Factors Reports, ISR Global Assessment, and Final ISR Report. • Concurs with resolution of gaps that require an operational change at Darlington NGS. • Approves any formal commitments to the CNSC that may impact on station operation. • Accepts ISR for Darlington NGS on behalf of the station.
Chief Nuclear Engineer (CNE)	Chief Nuclear Officer (CNO)	• The Chief Nuclear Engineer is responsible for the life cycle management plans for major components; e.g., Steam Generators, Feeders, Fuel Channels, and Reactor Assembly Components and determines the Predicted End of Service Life (PEOSL) dates. This is the key input to confirming the adequacy of the refurbishment and continued operation scope and the schedule for refurbishment. • Ensures the timely and effective provision of specialized engineering analysis required for the refurbishment project. • Specifies inspection requirements and disposition findings for structures, systems, components, including steam generators and fuel channels. • Ensures the development and maintenance of station specific Probabilistic Risk Assessment (PRA) and develops risk based “tools” and monitors implementation in support of the preparation of the ISR, EA, and IIP. • Provides oversight of delegated Local Design Authority. • Is an approving member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope.
Chief Financial Officer (CFO)	OPG President and CEO	Responsible for facilitating required financing and cost recovery agreements with OEFC, OPA, and/or other parties as required.

Position or Function	Reports To	Overview of Responsibilities

VP of Corporate Business and Investment Planning	Chief Financial Officer (CFO)	Responsible for facilitating the development of the BCS, on behalf of the SVP - NR, by:
		• Providing advice and input on the development of appropriate cost models for assessing the Darlington refurbishment business case.
		• Providing advice and analytical support for decisions around the appropriate timing of the refurbishment.
		• Providing advice and consultations on the development of scope, schedule and costs of the Darlington Refurbishment outages.
		• Coordinating the gathering of post-refurbishment cost estimates required to develop the business case for Darlington Refurbishment in accordance with N-INS-09701-10000, Process for Estimation of Post-Refurbishment Costs for OPG Nuclear Stations.
		• On behalf of the Chief Financial Officer and the members of the Executive Committee, facilitate the decision-making on the business case by:
		  • Challenging the information provided on refurbishment costs and schedules and post-refurbishment costs to test for completeness and robustness.
		  • Providing analytical support on financial considerations which are important to the business case development, such as treatment of contingencies, economic analysis, project financing, affordability, rate impacts, corporate structure, price and other market considerations, comparisons to other investment options, benchmarking of project costs and post-refurbishment costs, etc.
		  • Attends all Darlington Refurbishment Project Advisory meetings and all Nuclear Generation Projects sub-committee meetings of the Board of Directors.
		  • Is a voting member for economic scope decisions of the Darlington Refurbishment Scope Review Board.

Position or Function	Reports To	Overview of Responsibilities
Director, Refurbishment Planning and Control	Vice President, Nuclear Refurbishment	• Accountable to develop and maintain project infrastructure, systems, methods and processes for estimating, scheduling, budgets, cost management, forecasting, change control, document control, project performance reporting, executive and Board of Directors reporting. • Develop and implement appropriate project methodologies to support the refurbishment of the DNGS, including implementation of tools and processes with respect to estimating, scheduling, reporting, change control and document management. • Develop contract management strategies for the project. • Implement a Risk Management Program, in conjunction with Corporate Risk Services and maintain a project risk register. • Support all external audits with respect to project financial and milestone reporting. • Manage project infrastructure functions such as preparation and management of project documents, including PEP, to support the effective oversight the project. • Is a voting member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope. • Interface with VP of Corporate Business and Investment Planning in preparation and approval of business cases, funding releases, and overall schedule (timing) for Darlington Refurbishment. • Interface with CFO and/or delegates to confirm required financing and cost recovery mechanisms for the project. • Develop and implement the process for the Project Definition Readiness Index (PDRI) and/or other Readiness measures.
Director, Refurbishment Quality Programs	Vice President, Nuclear Refurbishment	• Establish, on behalf of the Vice President (VP), a management system governance structure that addresses the regulatory, business and stakeholder requirements and manage the overall quality program for the Refurbishment Project. • Provide assurance to the VP that the management system of the project meets the requirements of applicable laws, codes and standards. • Verify through monitoring and assessing that the implementation of the management system is effective and compliant. • Develop governance to ensure consistent exercise of the management oversight role and adherence to this program document and other related OPGN and OPG governance. • Review the Project governance to ensure quality requirements are properly imbedded. • Perform periodic reviews and/or audits to ensure compliance with oversight requirements. • Manage the Corrective Action Program for the Project. • Work with internal and external stakeholders to ensure the management system requirements are satisfied. • Interface with regulatory authorities and other jurisdictions regarding the management system.

Position or Function	Reports To	Overview of Responsibilities
Director, Refurbishment Supply Chain	Vice President, Nuclear Refurbishment	• Assess procurement/contracting strategy needs and options to do the refurbishment work (co-responsibility with Law Division). • Support NR procurement activities in accordance with Supply Chain governance.
Director, Nuclear Safety - NR	Vice President, Nuclear Refurbishment	• Conducts the ISR for DNGS Refurbishment. • Commissions, conducts, and reviews Nuclear Safety Assessments as required. • Keeps senior management informed in a timely manner of Nuclear Safety and regulatory issues with potential implications to the refurbishment of the Darlington reactors. • Participates in industry groups, such as, but not limited to, the Candu Owners Group (COG) Plant Refurbishment Working Group. • Establishes and maintains a good working relationship and communication with the CNSC staff. • Conducts and reviews benefit cost assessments related to safety and regulatory issues. • Performs reviews of issues or documents/reports for approval. • Provides advice in areas of responsibility and expertise.
Director, Refurbishment Engineering	Vice President, Nuclear Refurbishment	• Develop and control Darlington Refurbishment project scope in accordance with NK38-PLAN-09701-10003, Darlington NGS Refurbishment - Scope Review Board - Reference Plan, and NK38-INS-09701-10001, Darlington Refurbishment Outage Scope Review Instruction. • Establish initial costs and schedule estimate for all project scope through completion of various feasibility studies. • Interface with Nuclear Waste Management Division (NWMD) on development of cost estimates for refurbishment waste management needs. • Coordinate technical assessments and determine the condition of major components at the Darlington stations in order to determine project scope. • Mitigate technical gaps from the ISR and/or EA review processes and/or identify regulatory scope items. • Prepare conceptual Refurbishment Outage Plans in support of front end planning. • Finalize reports and coordinates review and approval by the DNGS Director Station Engineering. • Is the Chairman and a voting member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope.
Director, Refurbishment Construction	Vice President, Nuclear Refurbishment	• Develop, establish and maintain Darlington Refurbishment Construction program and plans. • Provide input to Refurbishment program cost and schedule estimates.
Director, Refurbishment Operations and Maintenance	Vice President, Nuclear Refurbishment	• Develop, establish and maintain Darlington Refurbishment Operations and Maintenance program and plans. • Provide input to Refurbishment program cost and schedule estimates.

Position or Function	Reports To	Overview of Responsibilities
Station Engineering Director, Darlington NGS	Senior Vice President, Darlington NGS	• Overall Engineering Authority for the interpretation and application of the SOE, Design and Licensing Bases for the site. • Ensures engineering activities including regulatory commitments are prioritized, planned, scheduled, tracked and completed and that standard and consistent processes and tools are used. • Ensures plant structures, systems and components are examined, maintained or inspected at the frequencies specified, to the extent required, and by qualified personnel. • Accountable for achieving and sustaining equipment performance through life cycle plans. • Perform a plant condition assessment. • Is a voting member of the Darlington Refurbishment Scope Review Board, which approves all Refurbishment Scope. • Accountable for the establishment and implementation of the integrated aging management program whose results relative to the actual condition of plant structures, system and components shall be utilized in the ISR. • Accountable for review, acceptance, and/or approval of other ISR supporting documents, as required.
Nuclear Refurbishment - Manager, Licensing Support	Vice President, Nuclear Refurbishment	• Develop and coordinate Licensing Strategy with respect to Life Extension. • Perform the role of Designated Licensing Authority (DLA) for project. • Develop the IIP. • Prepares and review documents/reports for approval by DNGS.

2.3 Design Authority

(a) Design Authority for DNGS resides with the Senior Manager, Station Design Engineering, Darlington.

(b) Design Authority for the Darlington Waste Management Facility, where wastes from the refurbishment may be stored as well as on-going dry storage of used fuel, resides with the Manager, Safety Assessment and Licensing, Nuclear Waste Management Division (NWMD).

(c) Design changes proposed during this Initiation Phase will be approved by the appropriate Design Authority.

(d) In the Definition Phase, appropriate engineering governance will be developed for managing changes based on the refurbishment scope, including approving Contractor developed design and equipment changes and resulting documentation, such as drawings, specifications, etc.

2.4 Project Meetings and the Nuclear Generation Projects Committee

Darlington Project team meetings are held monthly per N-PLAN-09701-10003, Darlington Project Meeting Terms of Reference. Meetings will follow the Terms of Reference developed for the meetings. A standard meeting package will be sent to all attendees for each recurring meeting.

The Nuclear Generation Projects Committee (NGPC) - meets approximately quarterly and assists the Board in providing oversight of the refurbishment and life extension projects for existing nuclear plants.

2.5 Refurbishment Scope Review Board

A Scope Review Board has been defined by the Darlington Refurbishment Scope Review Board Reference Plan, NK38-PLAN-01060-10005, to provide the refurbishment scope control function.

2.6 Support From Other OPG Business Units (OBU)

Support from other OPG business units will be required to accomplish the project objectives. Support is generally of two kinds:

(a) Services directly supporting the Project's processes and deliverables. Examples are: Engineering and Modifications providing information related to conditions of critical components, and Station Engineering providing input to ISR Safety Factor Reports.

(b) Services that provide project infrastructure support; e.g., Supply Chain, Human Resources, Records Management, Nuclear Facilities, etc.

A list of the Other OPG Business Units with brief descriptions of the support work required from them by NR will be developed during project definition. As part of the business planning process, NR directors will assess and discuss the support requirements with the supporting units to establish the necessary interface agreements.

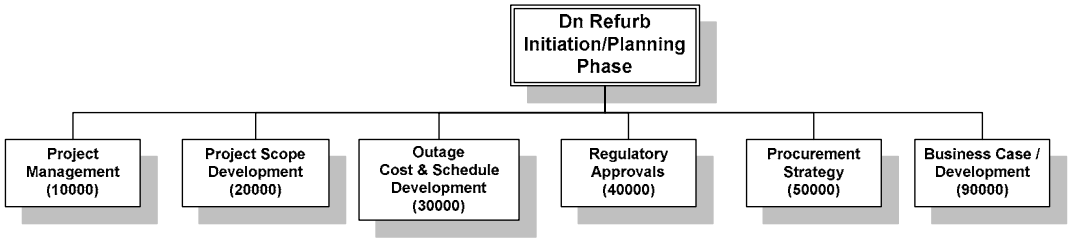
3.0 WORK SCOPE AND SCHEDULE

3.1 Work Breakdown Structure (WBS)

A WBS establishes a systematic, hierarchal approach for identification of all of the work elements in the Project.

An initial WBS was created for the Project Initiation Phase, shown in Figure 2. An overall project WBS is under development and will be implemented early in the Preliminary Planning Phase. This WBS will encompass all work programs for the entire refurbishment project. This WBS will be the foundation of the overall schedule for all phases through to closeout and will clearly define the deliverables at the program and project levels.

Figure 2: Darlington Refurbishment WBS - Level 1



10000 - Project Management: Provide project management services, which include establishing project management governance, project reporting, project controls including an integrated and resourced project schedule, and project programs such as risk and quality assurance. This program also includes project oversight, estimating organizational infrastructure and contingencies, and establishing a staffing strategy for the Definition and Execution Phases.

20000 - Refurbishment Scope Development: Develop the scope for the refurbishment outages. This program includes preparation of condition assessments and other engineering studies for replacement of critical components, and a scope review process.

30000 - Refurbishment Cost and Schedule Development: Develop an Outage Preparation Plan, Outage Schedule and total project Cost Estimate to be used for the BCS.

40000 - Regulatory Approvals: Define regulatory requirements for refurbishment and obtain regulatory approvals for refurbishment. This program contains three main deliverables: EA, ISR and the IIP.

50000 - Contracting/Procurement Strategy: Assess the various options and recommend a strategy for executing the Definition and Execution Phases of the Refurbishment projects. Identify long lead items and prepare purchase requisition documents.

90000 - Business Case/Recommendation: Prepare an economic assessment and a business recommendation for the Board of Directors as to whether or not to refurbish DNGS.

3.2 Approved Schedule

The Approved Level 1 Schedule Milestones report is attached as Appendix B.

The following summarizes the key attributes of the schedule:

(a) The project was approved in November 2009 and is estimated to end in early 2025 with the final refurbished unit returning to service and the site being returned to Operations control in 2024.

(b) Funding for the project will be released in phases, see Section 5.4.

(c) Condition Assessments for the plant and critical Nuclear Safety components will be completed in early 2010.

(d) The ISR Program began in 2008 and will, in 2011, incorporate the Level 3 DARA findings, being developed by DNGS for re-licensing in 2013, to complete the final ISR Report. The ISR Report will be submitted to the CNSC in late 2011 and CNSC approval is expected in 2013.

(e) The EA will begin in 2010 and a final EA Report will be submitted to the CNSC in 2012. CNSC approval is expected in the same year.

(f) The IIP Report will be prepared after obtaining CNSC approvals of EA and ISR. IIP approval is expected to be in 2014.

(g) Outage Preparation Design work will begin in 2010. Field Preparation work is expected to begin in the 2012 to 2014 timeframe.

(h) A Release Quality Estimate for the full project will be prepared by mid-2014.

3.3 Major Milestones

Appendix B lists the projects major milestones based on the schedule discussed in Section 3.2. Any changes to these milestones will be made through a change control process described in Section 6.0, Project Controls.

4.0 PROJECT RESOURCES

Staffing requirements will change as the project develops. For the Initiation Phase, the project will be resourced in three ways:

(a) Direct staff reporting to the Nuclear Refurbishment organization and contributing to deliverables for each refurbishment project (i.e., Pickering B and Darlington).

(b) Support from other OPG Business Units as planned in the Business Planning process and documented in individual procedures and/or interface agreements.

(c) External purchased services contracts including Augmentation Service and managed task contracts.

Processes to manage identifying and funding support from other OPG Business Units will be developed by the Director, Planning and Control during the Initiation phase. Details of the three sources of human resources will be developed and maintained in the Project Business Plan.

Managing the performance quality and costs of deliverables from other OPG Business Units is the responsibility of the NR Director for whom the support has been contracted.

Identifying future resource requirements for OPG and major projects such as Refurbishment has been delegated to the Director, Project and Modifications. The Director, Planning and Control - NR is NR's representative on the OPG Resourcing Strategy Team.

5.0 PROJECT COSTS

5.1 Cost Breakdown Structure

A Cost Breakdown Structure (CBS) establishes a systematic, hierarchical approach for identification of all the work elements in the project. Costs will be budgeted and collected based on the project Work Breakdown Structure (WBS), project Organizational Breakdown Structure (OBS) and Resource Type. This allows the project to monitor and assess cost performance against the work program, the organization and resource type.

5.2 Project Estimates and Assumptions

The project estimate will be based on the project assumptions, discussed in Section 1.0, regarding scope, schedule and resources and will include all incremental costs to fund other business units supporting the project.

The preliminary (bounding) cost estimate will be developed in the Initiation Phase of the project and refined throughout the Definition Phase of the project. A release quality estimate will be finalized at the end of the Definition Phase - Engineering and Detailed Planning and will form the basis of measuring project success against the preliminary estimate.

An appropriate level of contingency will be added to the project cost estimate and will be relative to the level of planning within the project estimate, i.e., as the quality level of the estimate improves, the contingency amount is expected to decline and risks pass.

The cost estimate, including the project contingency, will form the basis for project approval and funding releases once approved by OPG Senior Management, OPG's Board of Directors, and the Shareholder.

5.3 Project Cash Flows

As the project cost and schedule is developed, a resource loaded schedule will be derived and will form the basis of the project cash flows to be used as part of the Business Planning process and published in regular project reports. The change control process will be used to re-schedule activities resulting in changes to the project cash flows.

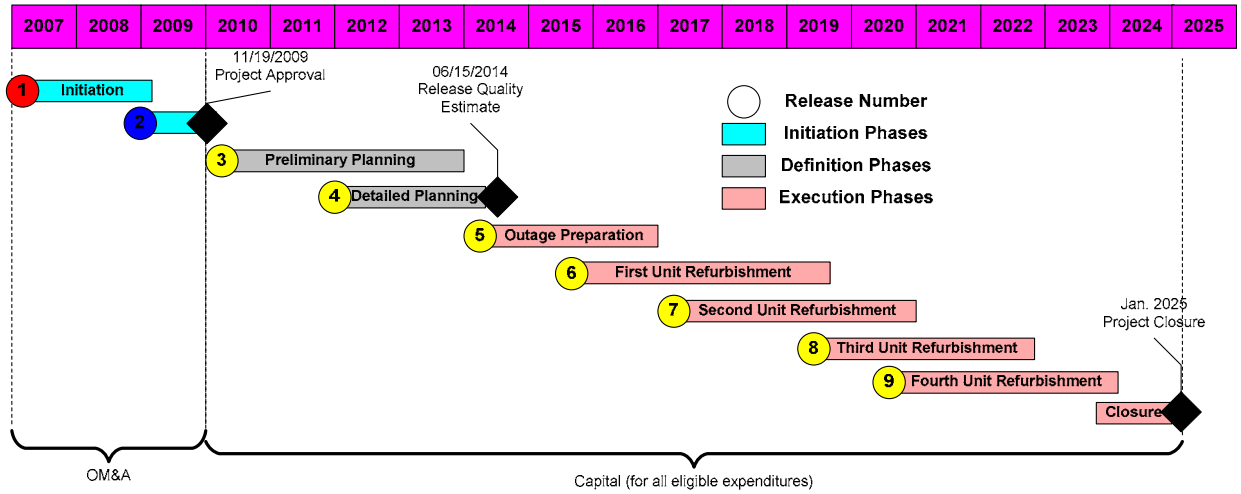
5.4 Project Release Strategy

Funding for the Darlington Refurbishment project will be released in phases using a gating methodology, i.e., the project cannot proceed from one phase to the next without completing certain deliverables and providing an updated Business Case assessment on the total project.

The release requested in this Board memo is a partial release for preliminary planning work to be performed within the definition phase and includes the completion the Environmental Assessment, the Integrated Safety Review, finalization of all technical scope, definition of the contracting strategy and tendering of contracts for major component suppliers, i.e., Retube.

The overall phase based release strategy is described in Figure 3 below and described in the following sub-sections.

Figure 3: Overview of the Darlington Refurbishment Release Strategy



5.4.1 Initiation Phase - Phases 1 to 2

During the Initiation Phase, the following activities will be performed:

- Determine preliminary project scope through the completion of a Plant Condition Assessment (PCA) with a special focus on the life-limiting components, such as feeders and fuel channels. Studies would also be conducted to assess the condition of all major station components and methods and timing for carrying out the required refurbishment scope would be proposed.

- Initiate planning for the Integrated Safety Review (ISR), including a review of modern codes and standards, and an Environmental Assessment (EA).
  Note: Darlington Nuclear Refurbishment project will follow NK054-PROC-0049, Conduct of Environmental Assessment, in developing its EA.

- Assess the various execution options (e.g., contracting, project management, work management, governance) for the Definition and Execution Phases of the Refurbishment Project, and recommend an execution strategy.

- Identification of an initial project organization for the Definition and Execution Phases.

- Develop a communications plan to ensure stakeholders are informed of OPG's Refurbishment Project and obtain their support for the decision.

- Develop Project Management support such as Project Controls, performance measures, schedules, risk and contingency processes, project metrics and reports.

- Develop a preliminary Schedule and Cost Estimate for the refurbishment outages, and a Refurbishment Outage Preparation Plan that include both key and supporting scope (organization, infrastructure, oversight, plant and programmatic work, risk contingencies and allowances). Construction Islanding is a key study to determine the supporting scope.

- Prepare a recommendation with respect to proceeding to refurbish the Darlington station to OPG Senior Management, OPG's Board of Directors and Shareholder. Support this recommendation through the completion of a Business Case Summary (BCS).

5.4.2 Definition Phase - Preliminary Planning - Phase 3

The Definition Phase - Preliminary Planning Work Program includes:

- Establishment of the Project Management organization for the Definition phase of the project.

- Establish contracting relationships with key vendors for the Definition phase of the project, including for major component work programs, i.e., Retube, Fuel Handling, Turbines and Generators.

- Confirm contracting strategies for balance of plant and execution phase work.

- Completion of the ISR, to assess key safety factors against modern codes and standards including review and acceptance by the Canadian Nuclear Safety Commission (CNSC). Identified issues would be assessed for inclusion in the refurbishment project scope.

- Completion of the Environmental Assessment and obtaining acceptance by the CNSC.

- Infrastructure planning and design completed. Contracts issued for initial infrastructure projects, including the Training and Mockup Building, Water and Sewer work.

- Development of a Human Resources and Labour strategy for the project.

- Confirmation of Cost Recovery and Financing means for the project. Finalize financing arrangements and cost recovery arrangements with required internal and external parties.

- Full development of all project controls governance. Further development of the project schedule, cost estimate, Project Controls, metrics and reports.

5.4.3 Definition Phase - Engineering and Detailed Planning - Phase 4

The Definition Phase - Engineering and Detailed Planning work program includes:

- Completion of all Outage preparation plans. Infrastructure development commences, where possible prior to EA approval.

- Integrated Implementation Plan submitted to the CNSC.

- Finalization of all project scope.

- Orders for long lead items issued and delivery dates confirmed, where required.

- Contracts released to key vendors for engineering, detailed planning, or pre-execution outage work, i.e., development of mockup and tooling for retube.

- A release quality estimate prepared, detailed cost and schedule developed, and an updated Business Case Summary (BCS) prepared, with full project cost estimate, and presented to Senior Management, the Board of Directors and Shareholder, with a project execution strategy recommendation, for approval.

5.4.4 Execution Phase - Outage Preparation - Phase 5

The Definition Phase - Outage Preparation Work Program includes:

- Establishment and release of direct work contracts to execute the major component replacement packages (fuel channels and feeders).
- All trades/project staff hired and trained
- Procurement of all required material for the first unit outage.
- Completion of all engineering.
- Site preparation/infrastructure facilities in place.
- A detailed project schedule and cost estimate for the refurbishment outage execution.
- Full Release (1st Unit) BCS prepared.

5.4.5 Field Execution and Closeout Phase - Phases 6 to 9

The Field Execution and Closeout Phase will involve completion of all planned aspects of refurbishment and associated re-commissioning and re-licensing tasks.

Releases for subsequent units will be developed and approved throughout this phase.

A Full Release BCS will be prepared for each of the subsequent units (2nd, 3rd, and 4th Units), including any updates to cost and schedule estimates, for each of these subsequent releases. Release 9, for the 4th and final unit, will include project closure costs.

5.4.6 Operations Phase

The Operations phase is the return to service of the units, starting around 2019, when the first unit refurbishment is complete.

5.5 Project Financing

Financing for the project will be established during the Definition - Preliminary Planning phase.

5.6 Cost Recovery

Cost Recovery options and requirements will be reviewed, and, if required, will be established during the Definition - Preliminary Planning phase.

6.0 PROJECT CONTROLS

6.1 Project Controls Program

The Project is in the Initiation Phase of the project management cycle. The project will implement an industry standard project controls environment as documented in N-PROG-LE-0003, Nuclear Refurbishment Project Controls. The following procedures ere developed during the Initiation Phase and will be further developed for use in subsequent phases of the project.

- N-PROC-LE-0008, Nuclear Refurbishment Assumptions & Issues Management
- N-PROC-LE-0009, Nuclear Refurbishment Schedule Management
- N-PROC-LE-0010, Nuclear Refurbishment Cost, Schedule and Budget Change Control
- N-PROC-LE-0011, Nuclear Refurbishment Cost Estimating
- N-PROC-LE-0012, Nuclear Refurbishment Cost Management and Reporting
- N-PROC-LE-0013, Nuclear Refurbishment Contingency Management

N-PROC-LE-0014, Nuclear Refurbishment, Project Scope Management, will be developed in the definition phase.

In addition, Planning and Control - NR will develop processes for capturing Operating Experience (OPEX) from OPG, Bruce Power, Point Lepreau, and the wider Nuclear community, and capturing Lessons Learned from each phase of the project. This information will be used in developing contingencies and allowances in conjunction with the Risk Management process, see Section 8, Risk Management and Contingencies.

6.2 Project Execution Plan

The level of detail in the PEP will be consistent with each phase of the project, based on the time frame. This initial document will focus on the Initiation and Definition Phase and provide fewer details around, yet-to-be-developed, later phases. Refer to Section 1.2, Execution Plan Purpose, for details.

6.3 Project Execution Plan Maintenance

Project execution will be periodically assessed against the PEP by the Director, Refurbishment Quality Programs to ensure that the plan is being followed and continuous improvement principles are being effectively used. Refer to Section 1.2, Execution Plan Purpose, for details.

7.0 PERFORMANCE MEASUREMENT AND EVALUATION

The Project's Performance Management will be carried out in accordance with project specific processes described in N-PROC-LE-0012, Nuclear Refurbishment Cost Management and Reporting, or the PEP.

The main interval for all progress monitoring and status reporting will be monthly during the Initiation Phase. During the Execution Phase, progress reporting will be done weekly with some performance reporting, to be defined, performed daily.

At present, there are a number of reports being used to monitor the Project's deliverables from a performance perspective such as:

(a) Internal reporting

(1) **Monthly Project Status Report:** A compilation of the project status using the earned value method (CPI and SPI). Additional metrics to be utilized include schedule variances against key milestones, work down and workup curves for project deliverables, and a WBS based project cost summary and analysis.

(2) **Monthly Cost Reports:** Departmental and Divisional cost reports used to review actual cost performance versus organizational budgets.

(3) **Key Results:** A summary of project performance for review by OPG Senior management.

(4) **Key Risks and Issues:** A summary for the key risks and issues will be prepared monthly and reviewed at the monthly project status meeting.

(5) **Other:** Other reports will be developed to meet internal stakeholder needs as required.

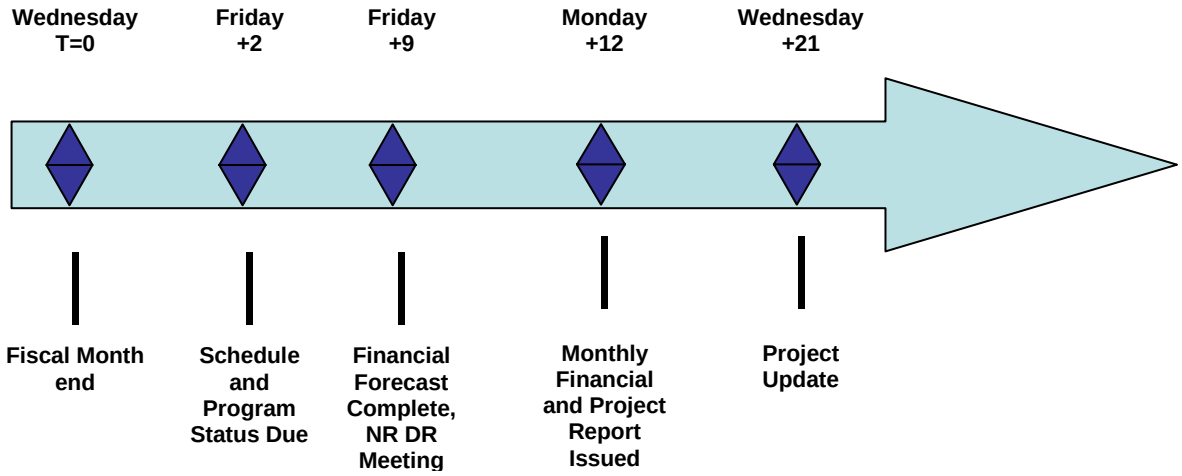
(b) External reporting

(1) **Management Advisory Committee, NGPC, OPG Board of Directors:** A quarterly report is prepared for review by the Darlington Refurbishment Management Advisory Committee, the NGPC, and OPG's Board of Directors. This report will provide highlights of achievements, risks and issues, and overall project performance.

(2) For the general external audience. Public Affairs may produce a newsletter to be distributed to the public in communities surrounding the Darlington site.

A single Project Monthly report will be developed in such a way as to allow the above existing reports, targeted for specific audiences, to be generated and disseminated efficiently.

On a monthly basis, reports will be generated using the following cycle:



7.1 Project Management Measures

Project management measures are described in N-PROC-LE-0012, Nuclear Refurbishment Cost Management and Reporting, or the PEP. They will be further developed during the Development phase.

7.2 Effectiveness Measures

Project effectiveness measures will be developed and used.

7.3 Ongoing Performance Monitoring

Project performance will be monitored by WBS on a regular basis and will be integrated into an overall project view through the project management function. Project reports will be prepared at least monthly and reviewed as part of the monthly project status meeting.

7.4 Performance Management Information Management Systems

Nuclear Refurbishment will establish project information management systems that meet the needs of the project and provide the ability to consolidate necessary information from EPC and other Contractors required to meet OPG's project reporting and performance management needs. The systems will be required to cover the full range of project technical processes and project controls processes including planning, estimating, scheduling, cost management, risk management, earned value performance analysis, cost and schedule forecasting, invoicing, accounting, requests for information, change control, metrics, and reporting.

It is the projects intention to utilize tools currently owned and licensed by OPG if those tools meet the business requirement needs of the project. This will minimize the number of tools supported by OPG and avoid further development of costly and error prone interfaces with existing OPG tools such as PassPort.

The following tools, as part of the Projects and Modifications Cost and Schedule Improvement project will be considered for utilization by the Darlington Refurbishment project.

(a) Estimating - US Cost Success Estimator

(b) Schedule Risk - Pertmaster

(c) Contractor Management - Decision Dynamics Oncore

(d) Scheduling - Primavera Planner Version 6

(e) Project Cost and Schedule Performance Management System - Meridian Proliance with Cognos Reporting and Brava document exchange

Additional integrations with PassPort and other OPG tools and systems, such as Sharepoint, will be evaluated and implemented as deemed necessary.

8.0 RISK MANAGEMENT AND CONTINGENCY PLAN

Risks, including major assumptions, issues and decisions, will be documented and processed following OPG-PROC-0025, Project Risk Management, and N-PROC-LE-0008, Assumptions and Issues Management. Contingency Management will be performed per N-PROC-LE-0013, Nuclear Refurbishment Contingency Management.

8.1 Risk Assessment and Risk Management

Project specific Risk Management governance will not be developed for NR. Sections 8.2 to 8.5 describe the steps the project shall follow in implementing OPG-PROC-00025.

8.2 Overview

Undertakings such as the Darlington Refurbishment Project generally face significant technical and other challenges during their planning, design, construction, commissioning and operational phases. Systematic identification, analysis, remediation and effective management of the myriad of risks associated with this Project are critical to its successful outcome. A formal risk assessment process also enables informed communication with project stakeholders such as owners, funding partners, insurers, designers, contractors, insurers and the regulatory authorities, with regard to issues and expectations.

8.3 Description of Process

At the start of the Darlington Refurbishment Project, a concentrated effort shall be performed to identify and address risks, organize risks in order to improve manageability, and developing and using a risk breakdown structure to group together lower-level risks into a manageable number of high level risk categories.

Risk management is an iterative process. New risks shall be identified and addressed on a continuous basis by all project staff and stakeholders. Risks and their associated mitigation actions shall be monitored and reviewed by management on a regular basis. The "value" of a risk can also change over time based upon new information and/or additional/new mitigation measures embedded into project plans.

The impact of risks on project schedule will be modeled utilizing a software tool to perform Monte Carlo simulations. The model will have associated cost values; these can be utilized as an input to development of project contingency. The impact of risks on project cost shall be modeled utilizing a software tool to perform Monte Carlo simulations. The model can be utilized as an input to development of project contingency. The "importance/rating" of a risk is identified through Monte Carlo modeling/simulations of the impact of the risk on project cost and schedule and illustrated with sensitivity ("tornado") graphs.

Risk strategies shall be developed for risks and will be one of acceptance, planning for and monitoring of, avoidance, proactive mitigation, or mitigation after the fact (i.e., remediation); strategies will be approved at the appropriate managerial level consistent with the magnitude of the risks impact. Proactive mitigation implies setting up of project tasks in order to reduce uncertainty or the likelihood/impact of a risk event. This typically increases project known costs. Mitigation after the fact implies addressing the uncertainty or the risk event when it occurs. Typical forms of this include insurance (pay out if event occurs), liquidated damages (in contracts), and contingency (use if event occurs).

8.4 Nuclear Refurbishment Project Specific Risk Management

The project risk management plan shall be compliant with OPG's project risk management process, OPG-PROC-0025-R01, for project management and OPG's Corporate Risk Management process, FIN-PROG-RM-001, for Business Risks against the Business Plan.

A computer application such as Microsoft Access or Excel shall be established in order to record risk information. Risk information collected at a point in time reflects people's perception of the risk and is based upon implicit assumptions or knowledge of mitigation/remediation in place or envisioned.

Risks and their associated mitigation actions shall be monitored and reviewed by management at a management review meeting on a regular basis.

A file number shall be established in the OPG records management in order to facilitate storing of risk management documentation.

8.5 Risk Management Responsibilities

General responsibilities for risk management may be summarized as follows.

Position(s) or Function(s)	Risk Management Roles and Responsibilities
SVP - NR	• Risk Management Process Sponsor. • Interface with OPG executives and OPG business units on the subject of project risks.
Director, Planning and Controls	• Risk Management Process Owner. • Oversees project Risk Management activities. • Provide a budget for risk management. • Develop project cost and schedule contingencies from the risks identified. • Manages project risk information (i.e., Risk Register) on behalf of the project. • Report to the SVP, Nuclear Refurbishment, on a regular basis, the status of risks and mitigating actions. • Periodically assesses process to ensure it is meeting the needs of the project.
Manager, Operational Risk, Risk Services	Provide Risk Management Support to Director, Planning and Control, as follows: • Provides risk management expertise to the project. • Facilitate the development of key project risks and associated probability and impact distributions, including performing the role of a facilitator at all project risk meetings. • As required, ensures that personnel with the requisite capabilities are used to assist the project team with risk management.
VP Corporate Business and Investment Planning	Provide Support to Director, Planning and Control, as follows: • Accountable for incorporating contingency information into the models used to determine LUEC and project cost to complete • Accountable for the preparation if the Darlington BCS on behalf of the SVP Nuclear Refurbishment. • Participates in risk review workshops to ensure that the outputs meet the requirements to enable finalization of the BCS.
Management Team	• Ensure that risks are assessed and monitored in their area. • Ensure that mitigating actions have been developed, where appropriate, and incorporated into the project plan for risks in their area. • As part of the management team, will review and endorse risks and associated mitigating actions. • Ensures that staff has the appropriate knowledge, skills, and training with respect to risk management.
All Staff	• Responsible for identifying potential project risks or changes to project risks. • As assigned, responsible for active management of a risk including assessment and mitigation (i.e., a risk owner).

9.0 PROJECT COMMUNICATION PLANS

Communication Plans will be developed for the Project using the following process:

- Identify key project stakeholders.

- Assess the communications requirements of each stakeholder.
- Review communications experience from previous similar projects.
- Prepare communications plan(s) based on these requirements. Where possible, align differing needs to enhance the communications program efficiency.
- Design, prepare and issue communications for specific stakeholders or groups of stakeholders, as required.
- Manage the communications program and update the plan as needed and document lessons learned.

9.1 Communications Strategy

The purpose for the communications strategy is to ensure support for the Project; protect OPG's reputation during the Project Phase; and ensure that OPG, as a publicly-owned organization is seen as open and transparent in its communications.

9.2 External Communications

The strategy for Project communications builds on the foundation already existing through extensive work and relationships in the host communities, communities of interest and with relevant stakeholders, including government and media, over the past several years. The strong relationships and processes in place allow the Darlington Nuclear Refurbishment Project, with the support of Public Affairs, to proactively lay the ground for Project success and to mitigate challenges and issues should they arise. See Section 9.7 for Key External Stakeholders.

9.2.1 Key Principles of the Strategy

The key principles of the Project strategy are:

- Gain support for the Project through proactive engagement of relevant stakeholders at the right time.
- Demonstrate in communications that the Project is well-managed by OPG.
- Provide a communications platform that is seen as open, transparent and following public process.
- Protect and maintain OPG reputation.

9.2.2 Key Tactics

- **Timing:** Timely, accurate notification of Project approvals, commencement of refurbishment activities, key milestones; EA milestones and Project completion.
- **Relationships:** Notification to appropriate stakeholders internal and external to OPG including government, media, interest groups, general public and host community opinion leaders.

- **Vehicles:** Effective use of various proven media (print, web-based, broadcast and other media to deliver messages) as well as community committees, neighbourhood walks and other forums for face-to-face communication.

9.3 Internal Communications

The strategy recognizes that OPG employees are in themselves key message receptors and carriers who must receive messages and information that mirror the messaging prepared for public audiences. Every external communication plan factors in the messaging, and the timing of messaging, to employees prior to delivery outside the company. See Section 9.7 for Key Internal Stakeholders.

9.3.1 Key Principles of the Strategy

- Employees, wherever possible should learn of the messages before they are shared outside the organization.

- The messages to employees should mirror the messages that will be shared externally.

- The messages to employees should be presented in a format that is easy to digest and share outside the company.

9.3.2 Key Tactics

Varieties of internal, well-established tactics exist within the OPG internal communications infrastructure and form a foundation on which to build Darlington Nuclear Refurbishment Project communications. As well, other tactics, where appropriate will be explored, to support refurbishment-specific communications. Examples of tactics include:

- Face-to-face forums
- Internal publications with Project articles
- Intranet site dedicated to the Project
- Email interface

9.4 Approvals and Processes

Public Affairs will oversee project communications with review and approval by the SVP Nuclear Refurbishment, SVP Corporate Affairs, and Chief Nuclear Officer.

9.5 Documentation/Filing

The Project shall follow OPGN's Records and Document Control, N-PROG-AS-0006. A NR Instruction may be developed to provide project-specific requirements in support of the Nuclear process.

9.6 Additional Communication

The project will consider the utilization of the following additional communication forums to provide information on the status of the Darlington Refurbishment Project:

(a) Intranet - setup an Intranet site to communicate reports, events, schedules, etc.

(b) Internet - setup a page on the OPG website to communicate to the community the status of the DN Refurbishment project (initially via EA process)

(c) Newsletters

9.7 Stakeholder Analysis

Stakeholder	Monthly Project Meeting	NGPC Project Meeting	Key Results/Shareholder Updates	External Updates (EA Process)	Licensing Status Meetings	Newsletter
Shareholder			✓			
Nuclear Generation Projects Committee (NGPC)/Board of Directors		✓				
Chief Executive Officer (CEO)		✓	✓			
Chief Nuclear Officer (CNO)		✓	✓			
Chief Financial Officer (CFO)		✓	✓			
SVP - Nuclear Refurbishment		✓	✓			
VP - Nuclear Refurbishment	✓	✓	✓			
Director - Planning and Control, Nuclear Refurbishment	✓	✓	✓			
Directors - Nuclear Refurbishment	✓					
SVP - Darlington	✓	✓				
SVPs/VPs - Nuclear Operations						
VP - Nuclear Finance			✓			
VP - Corporate Investment Planning	✓	✓	✓			
SVPs/VPs - Non-Nuclear Operations			✓			
Nuclear Refurbishment Staff						✓
Darlington Staff						✓
All OPG employees						✓
Union representatives			✓			
Pickering Community Advisory Council				✓		
Darlington Site Planning Committee				✓		
CNSC			✓		✓	✓

Stakeholder	Monthly Project Meeting	NGPC Project Meeting	Key Results/Shareholder Updates	External Updates (EA Process)	Licensing Status Meetings	Newsletter
General public within the host community and community of interest general public				✓		✓
Media, government and the opinion leaders within the host community, industry and other communities of interest			✓	✓		
Engaged activists and Project followers			✓	✓		✓

10.0 PROJECT CLOSURE

Project closure will follow relevant OPG processes and procedures applicable at the time. Closure document package will include Lessons Learned to provide Operating Experience (OPEX) to the wider Nuclear community.

Director, Planning and Control - NR will develop the project closure process and requirements during the Definition phase and prepare interim Project Closure packages for each unit with input from the Director, Engineering - NR, Director, Construction - NR, Director, Refurbishment Quality Programs - NR. A final Project Closure package will also be prepared after the site has been returned to Operations.

VP, Corporate Business and Investment Planning will be responsible for the Post Implementation Review (PIR), in accordance with FIN-PROC-PA-0012, Post Implementation Review Procedure, FIN-PROC-PA-0008, Investment Management Framework, and OPG-PROC-0050, Developing and Documenting Business Cases

11.0 REFERENCES

The following governance and documents have been or will be developed for the deliverables and processes described in this document:

(a) Benefit Cost Analysis and Gap Resolution

(1) N-INS-00770-10004, NR ISR Gap Resolution Process - Darlington

(2) N-INS-00770-10005, NR Process for Prioritization of ISR and EA issues - Darlington

(3) N-INS-00770-10006, NR Benefit Cost Analysis - Darlington

(b) Business Case Summary

(1) FIN-PROC-PA-0008, Investment Management Framework

(2) OPG-PROC-0050, Developing and Documenting Business Cases

(3) FIN-PROC-PA-0012, Post Implementation Review Procedure

(4) N-PROG-AS-0005, Business Planning Program

(c) Project Management and Controls

(1) D-PCH-09701-10000, Darlington Refurbishment Project Charter

(2) N-PROG-LE-0002, Nuclear Refurbishment - Darlington

(3) N-PROG-LE-0003, Nuclear Refurbishment Project Controls

(4) N-PROC-LE-0008, Nuclear Refurbishment Assumptions & Issues Management

(5) N-PROC-LE-0009, Nuclear Refurbishment Schedule Management

(6) N-PROC-LE-0010, Nuclear Refurbishment Cost, Schedule and Budget Change Control

(7) N-PROC-LE-0011, Nuclear Refurbishment Cost Estimating

(8) N-PROC-LE-0012, Nuclear Refurbishment Project Reporting

(9) N-PROC-LE-0013, Nuclear Refurbishment Contingency Management

(10) N-PROC-LE-0014, Nuclear Refurbishment Project Scope Management

(11) N-INS-00100-10000, Project Cost Estimating

(12) OPG-PROC-0025, Project Risk Management

(d) Scope, cost and schedule development

(1) NK38-PLAN-01210-10002, Darlington Refurbishment Outage Planning & Execution Phase 1 Implementation Plan

(2) NK38-PLAN-01060-10003, Darlington Refurbishment Project - Reference Plan Scope Definition

(3) NK38-PLAN-09701-10003, Darlington NGS Refurbishment - Scope Review Board - Reference Plan

(4) NK38-INS-09701-10001, Darlington Refurbishment Outage Scope Review Instruction

12.0 GLOSSARY

BCS	Business Case Summary
CFO	Chief Financial Officer
CNE	Chief Nuclear Engineer
CNSC	Canadian Nuclear Safety Commission
DARA	Darlington A Risk Assessment
DNGS	Darlington Nuclear Generating Station
EFPH	Effective Full Power Hours
IIP	Integrated Implementation Plan
ISR	Integrated Safety Review
NR	Nuclear Refurbishment
NWMD	Nuclear Waste Management Division
OPG	Ontario Power Generation
OPGN	Ontario Power Generation Nuclear
PCA	Plant Condition Assessment
PDRI	Project Development Rating Index
SG	Steam Generator
SVP	Senior Vice President
TCD	Tentative Completion Date
TRF	Tritium Removal Facilities
VP	Vice President

Appendix A PEP Section Responsibilities

PEP Section Number	Title	Document Section Owner	Document Section SPOC
1.1	Needs Statement and Background	Director, Planning and Controls	Manager, Project Infrastructure
1.2	Project Objectives	Director, Planning and Controls	Manager, Project Infrastructure
1.3	Project Scope	Director, Planning and Controls	Manager, Project Infrastructure
1.3.1	Project Scope - Initiation Phase	Director, Planning and Controls	Manager, Project Infrastructure
1.3.2	Project Scope - Definition Phase	Director, Planning and Controls	Manager, Project Infrastructure
1.3.3	Project Scope - Detailed Engineering and Outage Planning Phase	Director, Engineering Nuclear Refurbishment	Manager, Engineering Support
1.3.4	Project Scope - Field Execution and Closeout Phase	Director, Engineering Nuclear Refurbishment	Manager, Engineering Support
1.3.5	Project Scope - Operations Phase	Director, Commissioning, Operations and Maintenance, Nuclear Refurbishment	TBD
1.4	Priority/Timing	Director, Engineering Nuclear Refurbishment	Manager, Engineering Support
2.1	Project Organization	Director, Planning and Controls	Manager, Project Infrastructure
2.2	Project Roles and Responsibilities	Director, Planning and Controls	Manager, Project Infrastructure
2.3	Design Authority	TBD	TBD
2.4	Advisory and Oversight Committees	Director, Planning and Controls	Manager, Project Infrastructure
2.5	Scope Review Board	Director, Engineering Nuclear Refurbishment	Manager, Engineering Support
2.6	Support from Other OPG Business Units	Director, Planning and Controls	Manager, Project Infrastructure
3.1	Work Breakdown Structure	Director, Planning and Controls	Manager, Scheduling
3.2	Approved Schedule	Director, Planning and Controls	Manager, Scheduling
3.3	Major Milestones	Director, Planning and Controls	Manager, Scheduling
4.0	Project Resources	SVP Nuclear Refurbishment	Manager, HR
5.1	Cost Breakdown Structure	Director, Planning and Controls	Manager, Reporting NR
5.2	Project Estimate and Cost Assumptions	Director, Planning and Controls	Manager, Reporting NR
5.3	Project Cash Flows	Director, Planning and Controls	Manager, Scheduling

PEP Section Number	Title	Document Section Owner	Document Section SPOC
5.4	Project Funding and Release	Director, Planning and Controls	Manager, Reporting NR
6.0	Project Controls	Director, Planning and Controls	Manager, Project Infrastructure
7.0	Performance Measurement and Evaluation	Director, Planning and Controls	Manager, Project Infrastructure
8.0	Risk Management and Contingency Plan	Director, Planning and Controls	Manager, Project Infrastructure
9.0	Project Communication Plan	Director, Planning and Controls	Manager, Public Affairs NGD
10.0	Project Closure	Director, Planning and Controls	Manager, Project Infrastructure NR
11.0	References	Director, Planning and Controls	Manager, Project Infrastructure NR
12.0	Glossary	Director, Planning and Controls	Manager, Project Infrastructure NR
To be developed	Responsibility Matrix	Director, Planning and Controls	Manager, Project Infrastructure
To be developed	Support from Other Business Units	Director, Planning and Controls	Manager, Reporting NR
Appendix A	PEP Section Responsibilities	Director, Planning and Controls	Manager, Project Infrastructure
Appendix B	Major Milestones	Director, Planning and Controls	Manager, Reporting NR
Appendix C	Project Overview Schedule	Director, Planning and Controls	Manager, Scheduling NR

Appendix B Major Milestones

Activity ID	Activity description	Early start	Early finish
199	Project Start	01JAN09*	
200	Development BCS/Project Approval	01-Jan-09	19-Nov-09
205	Feasibility assessment/ Aug BOD mtg	01-Jan-09	12-Aug-09
210	Cost and schedule Development	01-Jan-09	31-Dec-13
220	Definition Phase BCS/Project Approval		19-Nov-09
225	Work Program-Preliminary Eng &Planning Release	01DEC09*	
230	Definition Phase-Detailed Eng & Planning Release	01NOV11*	
240	Execution Phase -Outage Preparation Release	27JUN14*	
245	Full Release BCS/Execution Approval		29JUN15*
250	First Unit release	18-Sep-15	
255	Second Unit release	03-Feb-17	
260	Third Unit release	10-Sep-18	
265	Fourth unit and close out release	27-Jan-20	
275	Outage Planning	01-Jan-09	31-Mar-11
284	OPP Complete		31-Mar-11
285	CCA and Tech Studies	01JAN09*	31-Dec-09
290	ISR work	01-Jan-09	19-Dec-11
295	ISR final report submited to CNSC		19-Dec-11
296	ISR Revewed by CNSC	20-Dec-11	19-Dec-13
300	ISR approved by CNSC		19DEC13*
301	DARA Work	01JAN09*	28-Mar-11
308	EA Work	01JAN09*	30-Apr-12
310	Prepare EA Project Description Draft	01NOV10*	30-May-11
311	Issue EA Project Description to the CNSC		30-May-11
312	Submit EA to CNSC		30-Apr-12
314	EA Reviewed by CNSC	01-May-12	30-Oct-12
315	EA Approved by CNSC		30-Oct-12
320	Re licence application	20FEB12*	
330	Licence End date		29MAR13*

Project Execution Plan

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Title:
DARLINGTON NUCLEAR REFURBISHMENT PROJECT

Activity ID	Activity description	Early start	Early finish
340	Licencing & IIP work	01APR13*	16-May-14
350	Submit IIP		16-May-14
355	IIP Reviewed by CNSC	19-May-14	23-Oct-14
360	IIP Approved		23-Oct-14
380	Detail planning	01NOV11*	16-Jun-14
400	Field Work	27JUN14*	03-Oct-16
410	Contracting	20-Nov-09	15-Sep-11
420	Engineering, Procurement	01-Nov-11	30-Sep-16
440	Pre-outage Work	18-Sep-15	22-Sep-16
450	Breaker open 1st Unit	23SEP16*	
452	Outage Work First Unit	23-Sep-16	13-Sep-19
470	Breaker Closed 1st Unit		13-Sep-19
480	Post Outage Work	16-Sep-19	15-Sep-20
540	Pre-outage Work	03-Feb-17	08-Feb-18
550	Breaker open 2nd Unit	09-Feb-18	
552	Outage Work Second Unit	09-Feb-18	29-Jan-21
570	Breaker Closed 2nd Unit		29-Jan-21
580	Post Outage Work	01-Feb-21	01-Feb-22
640	Pre-outage Work	10-Sep-18	13-Sep-19
650	Breaker open 3rd Unit	14-Sep-19	
651	Outage Work Third Unit	14-Sep-19	03-Sep-22
670	Breaker Closed 3rd Unit		03-Sep-22
680	Post Outage Work	05-Sep-22	05-Sep-23
740	Pre-outage Work	27-Jan-20	29-Jan-21
750	Breaker open 4th Unit	30-Jan-21	
752	Outage Work Fourth Unit	30-Jan-21	20-Jan-24
770	Breaker Closed 4 th Unit		20-Jan-24
780	Post Outage Work	22-Jan-24	11-Feb-25

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Project Execution Plan

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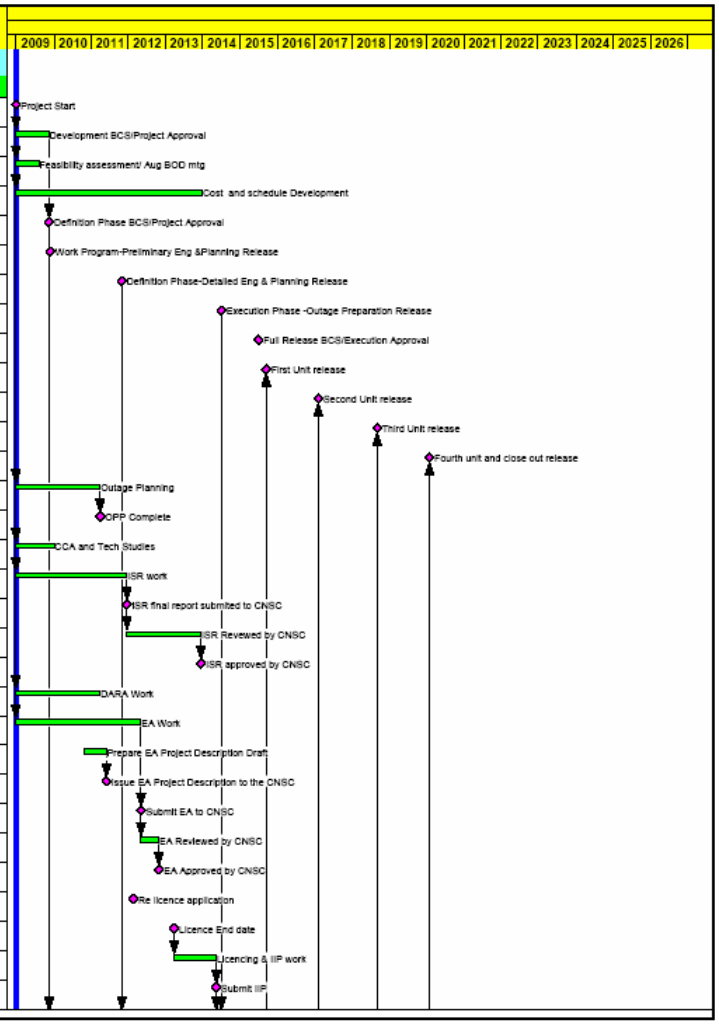
Title:
DARLINGTON NUCLEAR REFURBISHMENT PROJECT

Appendix C Project Overview Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
DNG Refurb- 1st Outage Sept 23/16				
PROJECT MANAGEMENT				
199	Project Start	0	01JAN09*	
200	Development BCS/Project Approval	231	01JAN09	19NOV09
205	Feasibility assessment/ Aug BOD mtg	160	01JAN09	12AUG09
210	Cost and schedule Development	1,304	01JAN09	31DEC13
220	Definition Phase BCS/Project Approval	0		19NOV09
225	Work Program-Preliminary Eng &Planning Release	0	01DEC09*	
230	Definition Phase-Detailed Eng & Planning Release	0	01NOV11*	
240	Execution Phase -Outage Preparation Release	0	27JUN14*	
245	Full Release BCS/Execution Approval	0		29JUN15*
250	First Unit release	0	18SEP15	
255	Second Unit release	0	03FEB17	
260	Third Unit release	0	10SEP18	
265	Fourth unit and close out release	0	27JAN20	
275	Outage Planning	586	01JAN09	31MAR11
284	OPP Complete	0		31MAR11
285	CCA and Tech Studies	261	01JAN09*	31DEC09
290	ISR work	773	01JAN09	19DEC11
295	ISR final report submited to CNSC	0		19DEC11
296	ISR Revewed by CNSC	523	20DEC11	19DEC13
300	ISR approved by CNSC	0		19DEC13*
301	DARA Work	583	01JAN09*	28MAR11
308	EA Work	868	01JAN09*	30APR12
310	Prepare EA Project Description Draft	151	01NOV10*	30MAY11
311	Issue EA Project Description to the CNSC	0		30MAY11
312	Submit EA to CNSC	0		30APR12
314	EA Reviewed by CNSC	131	01MAY12	30OCT12
315	EA Approved by CNSC	0		30OCT12
320	Re licence application	0	20FEB12*	
330	Licence End date	0		29MAR13*
340	Licencing & IIP work	295	01APR13*	16MAY14
350	Submit IIP	0		16MAY14



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Project Execution Plan

Title:
DARLINGTON NUCLEAR REFURBISHMENT PROJECT

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
355	IIP Reviewed by CNSC	114	19MAY14	23OCT14
360	IIP Approved	0		23OCT14
PROJECT	Phase 2			
380	Detail planning	42	01NOV11*	16JUN14
400	Field Work	592	27JUN14*	03OCT16
410	Contracting	475	20NOV09	15SEP11
420	Engineering, Procurement	1,284	01NOV11	30SEP16
PROJECT	Phase 3			
440	Pre-outage Work	265	18SEP15	22SEP16
450	Breaker open 1st Unit	0	23SEP16*	
452	Outage Work First Unit	1,086	23SEP16	13SEP19
470	Breaker Closed 1st Unit	0		13SEP19
480	Post Outage Work	262	16SEP19	15SEP20
540	Pre-outage Work	265	03FEB17	08FEB18
550	Breaker open 2nd Unit	0	09FEB18	
552	Outage Work Second Unit	1,086	09FEB18	29JAN21
570	Breaker Closed 2nd Unit	0		29JAN21
580	Post Outage Work	262	01FEB21	01FEB22
640	Pre-outage Work	265	10SEP18	13SEP19
650	Breaker open 3rd Unit	0	14SEP19	
651	Outage Work Third Unit	1,086	14SEP19	03SEP22
670	Breaker Closed 3rd Unit	0		03SEP22
680	Post Outage Work	262	05SEP22	05SEP23
740	Pre-outage Work	265	27JAN20	29JAN21
750	Breaker open 4th Unit	0	30JAN21	
752	Outage Work Fourth Unit	1,086	30JAN21	20JAN24
770	Breaker Closed 4 th Unit	0		20JAN24
780	Post Outage Work	277	22JAN24	11FEB25

Copy to: Wayne Robbins
Bill Robinson
Bruce Boland
Donn Hanbidge

Minister of Energy and Infrastructure

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Ontario

OFFICE OF THE PRESIDENT & CEO

FEB 08 2010

FEB - 4 2010

Mr. Tom Mitchell
President and CEO
Ontario Power Generation
700 University Avenue
Toronto ON M5G 1X6

Dear Mr. ~~Mitchell~~ TOM:

I am writing in response to your letter of November 20, 2009, in which you provide detail of OPG's board decisions regarding the life management of two of its nuclear assets, as laid out in the company's business plan 2010-2014.

The overall plan implements several key strategic initiatives with the objective of providing the people of Ontario with a clean, reliable supply of electricity. One such initiative is the implementation of plans to refurbish the Darlington units and to continue to operate the units at Pickering B.

Implementation of these initiatives satisfies the government's directive of June 2006 in which OPG was directed to begin feasibility studies on refurbishment of existing nuclear units and to begin an environmental assessment on the refurbishment of the four units at Pickering B.

The nuclear fleet will continue to be of significant importance in the province's electricity supply in the future as we continue to reduce greenhouse gas emissions from electricity generating sources.

The government is satisfied that the detailed technical, regulatory and risk analyses performed by OPG resulted in the optimal decisions regarding refurbishment and future operation of the Darlington and Pickering B units respectively, and concurs with the November 19, 2009 decision by the OPG Board of Directors.

Sincerely,

Brad Duguid
Minister

ONTARIO POWER GENERATION

File No: N-REP-00120.3-10000-R000

Project ID - 16-27959

Economic Feasibility Assessment of Darlington Refurbishment

November 13, 2009

OPG Confidential & Commercially Sensitive

Contents

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

1.0 RECOMMENDATION:

The purpose of this Business Case is to document the progress of work on assessing the feasibility of refurbishing the 4 units at the Darlington Nuclear Plant in support of the November 2009 recommendation to the Board that the Darlington Refurbishment Project should proceed to the Definition Phase of the project. Additionally, funding is being requested to be released to complete preliminary planning within the definition phase of the project and for the development of required infrastructure.

OPG has executed the Initiation Phase of the Darlington Refurbishment project over the period of late 2007 to late 2009. This work included:

1) Scope Definition – Engineering studies were initiated to determine the scope and cost of replacing plant critical components including fuel channels and feeders. In addition, a Plant Condition Assessment (PCA) was commenced in order to assess the condition of the "balance of plant" systems.
2) Commencement of the Integrated Safety Review (ISR), which is an assessment of key safety factors against modern codes and standards. Issues identified would be assessed for inclusion in the refurbishment project scope. This assessment will be reviewed and accepted by the Canadian Nuclear Safety Commission (CNSC) and will be used in the preparation of an Integrated Improvement Plan (IIP).
3) Outage Planning – Preliminary schedules have been developed for the refurbishment. These will be continually refined based on the results of the engineering studies, the PCA, the ISR and the Environmental Assessment (EA) and the refurbishment scope, cost and schedule will be updated as required.
4) Project Planning – Key project governance such as the Project Charter, Project Execution Plan and Risk Management Plan, as well as project controls procedures, have been prepared. Additionally, the DN Refurbishment program document was created and issued; governance related to ISR and EA completion, Plant Condition Assessments, Scope Reviews, IIP submission, etc. has also been issued.

Management continues to update the economic assessment as new information becomes available. [redacted] Given the uncertainties associated with major nuclear refurbishments and also given the early stage of scope, schedule and cost estimate development for this project, OPG currently has very high confidence that the refurbishment of the Darlington units will result in a LUEC of less than 8 ¢/kWh (2009).

Based on publicly available information, the economics of Darlington Refurbishment are more attractive than alternative generation options including New Nuclear and Combined Cycle Gas Turbines (CCGT). Therefore, this Business Case recommends that the following:

1. That the Darlington Refurbishment project be approved to proceed to the definition phase. This includes preliminary planning activities as well as some outage preparation activities related to infrastructure improvements required for subsequent project phases. Consistent with OPG's accounting rules, all future eligible expenditures will be capitalized.

2. That Release 3, in the amount of $240.7 Million, including $102.5 Million to complete preliminary planning within the definition phase of the project and $138.2 Million for the development of required infrastructure is approved. Preliminary planning includes the completion of regulatory scope (EA and ISR), technical scope definition including plant condition assessments, outage preparation planning, contract strategy finalization and selection of contractors. Infrastructure projects include the design and construction of a Training & Mock-Up Building, as well as initiation of the design on a number of projects including the Operations Support Building, Boiler

House, Retube Waste Building and Heavy Water Storage facilities required prior to the start of refurbishment.

Subsequent releases will be requested in accordance with the release strategy as documented in Appendix A. Regular updates on the progress of the project will be provided to Management on a monthly basis and to the Board of Directors at every meeting.

2.0 SIGNATURES

Submitted By:

W.R. Robinson
Senior Vice President
Nuclear Refurbishment, Projects, and Support

Finance Approval:

D. Hanbidge
Chief Financial Officer

Approval per OAR Element 1.3.

T. Mitchell
President and Chief Executive Officer

3.0 BACKGROUND AND ISSUES

The Darlington Nuclear units are currently predicted to reach their nominal end of service lives in 2019 to 2020. Service life predictions are developed by assessing the impacts of a number of operating, technical and regulatory considerations on both unit and station economics. A decision to remove a unit from service will likely be primarily an economic decision as the number of components requiring replacement grows and the frequency and duration of inspections required ensuring a unit's fitness-for-service increases. End-of-service life predictions are continually reviewed as new inspection information and knowledge of possible degradation mechanisms become available and future productions levels are revised.

In June 2006, the Ontario Government directed OPG to begin feasibility studies on refurbishing its existing nuclear plants. The need for refurbishment is also addressed in the Ontario Power Authority's Integrated Power System Plan (IPSP). While the IPSP recognizes that refurbishment decisions rest with facility owners, the IPSP reference plan does assume substantial nuclear unit refurbishments, including the Darlington units.

OPG commenced the Initiation Phase of the Darlington Refurbishment project, including an economic feasibility assessment, in late 2007. The goal of the refurbishment project is to extend the service life of the units by an additional 30 calendar years. The refurbishment would involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which are most effectively done during the refurbishment outage period.

Status of Work in the Initiation Phase:

The following work has been completed to date in the initiation phase of the project:

a. **Technical Scope**

In June 2008, based on a review of the expected life of the critical components and their current life cycle plans, the CEO approved the reference outage scope and schedule as an initial planning assumption for the Darlington NGS Refurbishment project. That reference outage schedule was based on a start of refurbishment of the first unit in October 2016. Technical studies are now underway to support the refinement of the project scope and cost.

Steam Generators (SG)

As recommended by Management in April, 2009, steam generator (SG) replacement has been excluded from the reference outage scope.

Fuel Handling

Fuel Handling Component Condition Assessment (CCA) is underway in order to finalize refurbishment scope. Scoping and screening is now complete resulting in the need to complete 113 CCAs. The CCAs are on track to be completed by year end 2009.

Turbine/Generators

CCAs related to the Turbine Generator and auxiliaries is underway and on track for completion by year end 2009.

Retube and Feeders

Work is well underway regarding the CCA for Pressure Tubes, Calandria tubes, and Feeders. Initial drafts of the Technical Assessment, Header and Nozzle Assessment, and the Environmental Assessment have been received. Initial information from these reports has been

used to determine the project's critical path (at 36 months). All remaining deliverables are on track for completion in 2009.

Balance of Plant Condition Assessment

An assessment on the condition of the "balance of plant" systems was planned to be completed in 2009 in order to finalize the refurbishment scope, however, due to a breach of contract, the contractor was suspended and subsequently terminated. OPG has now developed a strategy to complete the Plant Condition Assessment by Q1, 2010; this continues to support meeting subsequent milestones including the completion of the Systems, Structures, and Components Safety Factor Report, a component of the ISR.

b. **Environmental Assessment**

OPG will assess whether there is any significant impact on the environment due to the refurbishment and continued operation of Darlington for an additional 25 to 30 years. The Environmental Assessment will commence in 2010, however, data sampling is currently underway in preparation for this work. Nuclear Refurbishment plans to take advantage of the results of the EA completed for the Darlington New Nuclear project in order to submit the EA to the CNSC by December 2011.

c. **Integrated Safety Review (ISR) Update**

An assessment of key safety factors against modern codes and standards is underway. The CNSC has accepted July 31, 2008 as the code effective date for the ISR review. A contract was released in January 2009 to complete 76 ISR code reviews by the end of 2009; this work is on track to be completed by year end 2009.

The Darlington Risk Assessment (DARA), Level 3, is a required input for the ISR and EA programs. The DARA Project is underway and on track to submit DARA Level 3 results to the Refurbishment project, for inclusion in the EA and ISR by March 31, 2011. The two projects continue to work together to ensure an integrated approach to meeting the station and the refurbishment milestones related to DARA.

An Integrated Implementation Plan (IIP), which must be approved by the CNSC prior to re-starting the refurbished units, will be prepared. The IIP document consists of the approved scope and schedule for refurbishment based on completed technical assessments, the Environmental Assessment, the Integrated Safety Review (ISR), which includes a third-party global assessment of plant safety for long term operation to determine the global risk, and an emerging safety issues assessment. The Integrated Implementation Plan (IIP) governance was issued in September, 2009.

d. **Project and Infrastructure Planning**

Project Governance

In June, 2009, the Darlington Refurbishment Program document, the Darlington Refurbishment Project Execution Plan (PEP), and the Project Controls program were all issued. The PEP has been updated in October, 2009 to incorporate the latest information. The Darlington Refurbishment Project Charter and a number of Project Controls procedures have been developed and issued in June and July.

Project Planning

On June 12th, 2008 the CEO approved the initial planning assumptions for Darlington Refurbishment, including the reference schedule, based on a preliminary assessment of the

Pickering B refurbishment schedule. At that time, the planning assumptions were based on a first unit refurbishment start date of October, 2016. Each unit's refurbishment was to last 25 months, and, with a 4 month overlap of unit outages, the overall duration of the refurbishment outage window would be 88 months for the 4 units.

Subsequently, based on information received from the Retube and Feeder CCA contractor, and operating experience (OPEX) from Bruce Power and Pt. Lepreau, the planning assumptions have been modified. The most likely critical path duration of each unit refurbishment is now 36 months, with a 16 or 19 month overlap to ensure that only two units are in a refurbishment state at any point in time. The overall refurbishment window is now 88 months. The reference start date remains at October 2016. This schedule will continue to be refined as the technical studies and regulatory work programs are completed, risks are assessed, and detailed schedules and cost estimates are developed.

The following table summarizes the current refurbishment start dates and overall durations in use for planning purposes.

Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (months)	Overlap on Previous Unit
1st	**October, 2016**	September, 2019	36	
2nd	February, 2018	January, 2021	36	19
3rd	September, 2019	September, 2022	36	16
4th	January, 2021	**January, 2024**	36	19
		Unit Outage Months	144	
		Refurbishment Window	88	

A technical specification document for an islanding strategy, to physically and procedurally isolate the unit from operations during refurbishment, has been prepared.

Contract Strategy

A contract strategy is being developed based on OPEX from current refurbishments and previous OPG experience. The finalization of the contracting strategy and planning for contract tendering will be the focus of the 2010 work plan. Contract strategy finalization and selection of contract partners is a pre-requisite to proceeding to the detailed engineering and planning phase.

e. **Budget Update**

In the 2009 to 2013 Business Plan, the Board of Directors approved a budget of $38M over the 2008 to 2009 period for the planning activities phase of the project, of which $30.3M is allocated to the 2009 work program. Additionally $7.7M was incurred in 2008.

Life-to-date expenditures as of September 30, 2009 for the Darlington Refurbishment Planning Activities Project are $20.7M. The project is forecasting to be $6.4M under plan at year end, resulting in life-to-date expenditures, as of Dec. 31, 2009, of $31.7M.

Schedule for the Refurbishment Project

The overall schedule used in the economic feasibility assessment for the planning and execution of the refurbishment project is as follows:

1.	Initiation Phase and Planning Activities	2008 – 2009
2.	Definition Phase - Preliminary Planning	2009 - 2011
3.	Definition Phase - Engineering and Detailed Outage Planning	2012 – 2014
4.	Outage Preparation Phase	2014 – 2016
5.	Field Execution and Closeout Phase (4 units)	2016 – 2025
6.	Operation Phase (Return to service of Units)	Starting in 2019

A description of the work in each phase is provided in Appendix A including an overview of the project release strategy.

4.0 ALTERNATIVES AND ECONOMIC ANALYSIS

Alternatives

Alternative 1: Approve the overall strategy for the Darlington Refurbishment project and funding to proceed with the definition phase of the project with a release of funding for the Preliminary Planning Work Program in order to be ready to refurbish Darlington units as early as October 2015 – RECOMMENDED.

This alternative positions OPG to be ready to refurbish the Darlington Units as early as the fall of 2015, if required, or as late as October 2016. This alternative maximises the value of the Darlington units to OPG if the current nominal life of the units is achieved (210,000 EFPH). It effectively minimizes the risk of "idle time" on the later units, while forsaking some of the life of the earlier units in order to maximise value. It also positions OPG to be able to potentially start the units as early as 2015, if work programs proceed more expeditiously than planned. Efforts are being made to advance planning and infrastructure development activities to increase the project's flexibility in starting the refurbishment as much as one-year earlier (October 2015 vs. October 2016). This partially mitigates concerns that the pressure tubes in the Darlington units may not remain fit-for-service until their current nominal lives and may need to be refurbished earlier. Currently there is only a medium level of confidence that the nominal lives of the Darlington units will be achieved. OPG has launched the Fuel Channel Life Management Project in conjunction with industry partners in order to increase its confidence in the pressure tube life of the Darlington units.

Alternative 2: Delay the Approval of Proceeding to the Definition Phase of the Darlington Project by 1 or more years – NOT RECOMMENDED.

This alternative would result in a cessation of the work on the Preliminary Planning Work Program, including the development of required infrastructure to execute the program, in the Definition Phase, for 1 or more years, followed by potential subsequent project approval. This alternative would jeopardize OPG's ability to be ready to refurbish the Darlington Units by the Fall of 2016 and would rule out any chance of being ready by the Fall of 2015. The risk of potential "idle time" on units increases significantly, particularly if the pressure tubes in the Darlington units were not to achieve their current nominal lives. Given that there is currently only a medium level of confidence that the nominal lives of the Darlington units will be achieved, this alternative would not be a prudent alternative to undertake.

Alternative 3: Abandon the Darlington Refurbishment Project and do not Plan to Refurbish Darlington – NOT RECOMMENDED

An economic feasibility assessment of the refurbishment of Darlington has indicated that this is one of the most economic generation options available to OPG to maintain a significant footprint in the Ontario Electricity Marketplace. Refurbishment of the Darlington units is also supported by the Ontario Power Authority, as discussed below, as one of the best options to meet the need for base-load generation in the Province of Ontario going forward. Compared to CCGT options, which require a lower capital investment, the refurbishment of Darlington exposes OPG to significant risk exposure because of the high capital cost. However, CCGT options are, even at relatively low forecasts of fuel costs, more expensive on a life cycle basis than the Darlington Refurbishment Project and have significantly higher exposure to the risk of fuel costs increases, including the potential imposition of carbon taxes, during their operating lifetime. CCGT options are not normally selected for baseload supply. The economic assessment of the Darlington Refurbishment Project is discussed in more detail below.

Economic Analysis

The Darlington Refurbishment Project has been assessed against other feasible generation projects which OPG might consider, including new Combined Cycle Gas Plants and New Nuclear Build. The following is a summary of the economic assessment.

Summary of the Economic Assessment

The Darlington Refurbishment Screening Level Economic Assessment was prepared and was endorsed by the Darlington Management Advisory Committee on September 29, 2008 and subsequently reported to the Nuclear Generation Projects Committee of the Board on November 19, 2008.

The economic assessment has since been updated to reflect current knowledge and understanding of the Darlington refurbishment project and to reflect experience from other refurbishment projects.

[redacted].
The current expectation on schedule duration is 36 months per unit, with a total duration of 88 months assuming 19 and 16 month overlaps between units.

The future operating costs and performance of Darlington are a significant aspect of uncertainty related to the economic assessment. Analysis has been completed of past performance in order to forecast the expected capability factor for the Darlington units in the post-refurbishment period. A "high confidence" capability factor of 82% has been used in this economic assessment. Given the historical performance and the bottom-up analysis carried out by Darlington Operations, there is high confidence in achieving this capability factor over the post-refurbishment life of the station.

The following table summarizes the "high confidence" key post-refurbishment costs and performance assumptions used in the economic assessment.

Post-Refurbishment Operations High Confidence Estimates	Average Cost / Unit (Overnight $M 2009)	Comments
Annual Direct Station Costs Post-Refurbishment	135	Current 2008-2010 Business Plan Avg. is $115M. $135M used is a high confidence estimate
Annual Support Costs Post-Refurbishment (1)	50	Based on Business Plan numbers adjusted for high confidence. Incremental analysis performed by OPG personnel
Plant Performance Post Refurbishment	82%	Darlington performance for the past 10 years is 87%; however, the station has achieved 89.6% over the past 3 years. 82% represents the station's performance since in-service and is considered conservative.

(1) The Annual Support Costs shown are the incremental costs of Corporate and Nuclear Support

Table 1: Current High Confidence Darlington Post-Refurbishment Costs and Performance Forecasts

[redacted]
Given the uncertainties associated with major nuclear refurbishments and also given the early stage of scope, schedule and cost estimate development for this project, OPG currently has very high confidence that the refurbishment of the Darlington units will result in a LUEC of less than 8 ¢/kWh.

The assessment found that the Levelized Unit Energy Cost (LUEC) of refurbishing and continuing to operate the Darlington units for a further 30 years is more attractive than alternative generation options, including Pickering B Refurbishment and Combined Cycle Gas Turbine (CCGT). The costs of New Nuclear remain speculative and this time, thus, a firm comparison to Darlington is not possible. Management believes that the LUEC range for Darlington Refurbishment compares very favourably to New Nuclear, based on known public information of the costs of New Nuclear.

On this basis, this Business Case recommends that there is little risk that the economics of Darlington Refurbishment would change significantly enough to make a decision to proceed with the expenditures in the Definition Phase of the Darlington Refurbishment project seem not to be a prudent path forward.

5.0 THE PROPOSAL

Approve the overall strategy for the Darlington Refurbishment project and funding to proceed with the definition phase, which includes the following Preliminary Planning Work Program:

- Establishment of the Project Management organization for the Definition phase of the project.
- Establish contracting relationships with key vendors for the Definition phase of the project, including for major component work programs, i.e. Retube, Fuel Handling, Turbines and Generators.
- Confirm contracting strategies for balance of plant and execution phase work.
- Completion of the ISR, to assess key safety factors against modern codes and standards including review and acceptance by the Canadian Nuclear Safety Commission (CNSC). Identified issues would be assessed for inclusion in the refurbishment project scope.
- Completion of the Environmental Assessment and obtaining acceptance by the CNSC.
- Infrastructure planning and design completed. Contracts issued for initial infrastructure projects, including the Training and Mockup Building, Water and Sewer work.
- Development of a Human Resources and Labour strategy for the project.
- Confirmation of Cost Recovery and Financing means for the project. Finalize financing arrangements and cost recovery arrangements with required internal and external parties.
- Full development of all project controls governance. Further development of the project schedule, cost estimate, Project Controls, metrics and reports.
- The following deliverables are required in order to proceed to the Engineering and Detailed Planning Phase (Release 4) of the project.
    - » Updated Business Case Summary (BCS) based on contracts, ready to issue, with key vendors.
    - » Work program cost and schedule for Release 4.

The key milestones for the preliminary planning phase are displayed in Figure 3 and documented in Table 2.

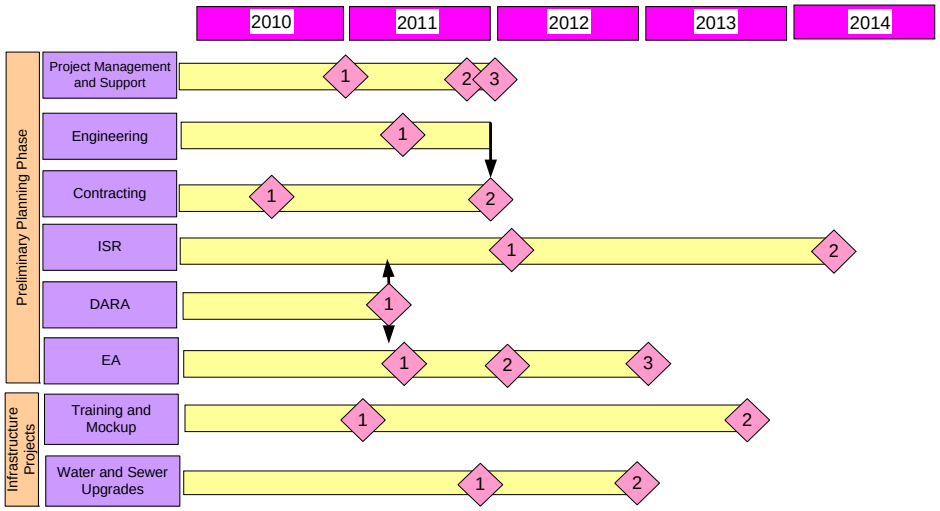


Figure 3: Overview of the Darlington Refurbishment Preliminary Planning Phase Key Milestones

Program	Milestone No.	Milestone Description	Target Date
Project Mgmt and Support	1	Project Management Infrastructure and Governance in Place	Dec-2010
	2	Est. based on evaluated Contract tenders ready for Revised BCS	Sep-2011
	3	Revised BCS Ready (Release #4 Approval)	Nov-2011
Engineering	1	Detail Outage Preparation Plan Complete	May-2011
Contracting	1	Contracting Strategy and Governance Developed	Jun-2010
	2	Contractors selected to complete release quality estimates	Nov-2011
ISR	1	Submit ISR Final Report to CNSC	Dec-2011
	2	CNSC Acceptance of Final ISR	Dec-2013
DARA	1	Level 3 DARA Completed as input into ISR & EA	Mar-2011
EA	1	EA Project Description Submitted to CNSC	May-2011
	2	Submit Final EA Report	Dec-2011
	3	EA Approved by CNSC	Oct-2012
Training and Mockup Building	1	Design Complete	Dec-2010
	2	Construction Complete	June-2013
Water and Sewer	1	Water/Sewer to site boundary	Dec-2011
	2	Water/Sewer connections across DN Site	Dec-2012

Table 2: Overview of the Darlington Refurbishment Preliminary Planning Phase Key Milestones

6.0 QUALITATIVE FACTORS OR FACTORS NOT FULLY QUANTIFIED

CO2 Reduction:

The refurbishment of Darlington retains 3500 MW of nuclear base load generation on the Ontario Electricity system for another 30 years which contributes to Provincial and Federal goals of the reducing CO2 emissions from electricity generation.

Loss of Economies of Scale:

Analysis has shown that OPG's large nuclear operating fleet allows the sharing of Corporate and Support Costs over a broader base of generation, resulting in economies of scale in these costs. A decision not to proceed with the refurbishing of Darlington would add upward pressure on Corporate and Nuclear Support costs on the remainder of OPG's nuclear fleet.

Decommissioning Fund Impacts:

Proceeding with the refurbishment of Darlington results in a slight decrease in the present value of the liability for the eventual decommissioning of Darlington, given that the life would be extended by 30 years. Any surpluses in the decommissioning fund which may result from this decision, while not directly attributable to OPG, would reduce the risk around future cost increases for decommissioning or other assumption changes.

Workforce Impacts:

If Darlington were to be shutdown, there would be a gradual reduction of staff as units are removed from service, prepared for safe storage, then placed in a safe store state over the late 2010s, early 2020s. If Pickering were to also cease operations in the late 2010s, and no Nuclear New Build were to be in-service by that period, significant workforce downsizing would be required in the OPG nuclear program. The loss of these high quality jobs would have a significant economic impact on Durham Region.

A decision not to refurbish Darlington would also have a significant impact on staff morale. Significant management oversight would be required to ensure there is no potential impairment of plant performance for the remaining life of the station.

7.0 RISKS

A risk Management Plan is being developed for the overall refurbishment project. The following table summarizes only those risks which are relevant to the Release #3, i.e. the Preliminary Planning Work Program.

Risks to Preliminary Planning Phase (Release 3)	Prob'y (1)	Conseq (2)	Mitigating Actions	Residual Risk	Contingency ($M)
DARA (Level 3) not complete by March 31, 2011, delaying submission of EA, ISR.	Medium	High	Refurbishment/DARA teams creating a detailed interface agreement, which will define the exact components of DARA needed for refurbishment.	Additional costs to support completion of DARA Level 3 by March 31.	[redacted]
Review Panel EA is required for project (adding 1 year to schedule)	Low	High	DNNP EA process is being used to address a number of Darlington Refurbishment issues, thus reducing the potential of this risk.	DNNP EA not accepted as eliminating need for Review Panel. Schedule delayed; or proceed at risk.	[redacted]
Resource and Contract costs to complete the EA and/or ISR higher than planned.	Medium	Medium	Lessons learned from Pickering EA and ISR have been incorporated into Darlington process. Completion dates are in line with timelines experienced through other projects. Regularly scheduled review meetings. Adequate staffing in place on the EA and ISR teams.	Need to hire additional resources to recover the schedule.	[redacted]
Delay of EA and/or ISR approval by CNSC and/or increased costs by the CNSC to complete the review.	Medium	Medium	OPG in constant communication with CNSC. OPG pushing for ISR acceptance within 1 year of submission, instead of the standard 2-year approval period. Expediting ISR may reduce the amount of overlap with other applications competing for CNSC attention.	Delay is reduced but not eliminated	[redacted]
Inability to obtain key project resources as required (internal or external)	Medium	Medium	Re-organization in OPG Nuclear to align all divisions, leverage talent that exists. Training programs in place to ensure staff are qualified in time.	Resource shortages are mitigated but not eliminated. Schedule is delayed.	[redacted]
Unknown scope required to be performed as part of the Preliminary Planning phase, i.e. additional Supply Chain setup costs.	Medium	High	With others, develop work scope and estimate. Have Nuclear Estimator review estimates & scope.	Funding required performing additional duties to complete Release 3 deliverables.	[redacted]
Estimating uncertainty with respect to infrastructure projects (estimates are conceptual)	High	Low to High (Facility Based)	Develop estimates and prepare a BCS for each facility or infrastructure improvement prior to releasing of funds.	Overall contingency and/or timing of cash flows insufficient.	[redacted]

Notes: (1) Probability: **High** - > 70%, **Low** - < 30%, **Medium** - >30% to <70%

(2) Consequence: **High** - > 3 months delay or $3M, **Low** - < 1 month delay or $0.5M, Medium - > 1 Month to < 3 Months delay or >$0.5M to <$3.0M

8.0 POST IMPLEMENTATION REVIEW (PIR) PLAN

A Comprehensive Post Implementation Review (PIR) shall be carried out by an independent team within twelve months (November 2012) of the completion of the Preliminary Planning Activities Work Program outlined in this BCS in order to: 1) verify that the stated targets were achieved; 2) to make recommendations for the next phases on the project; and, 3) to document the lessons learned for use in the subsequent stages of the project.

The Comprehensive PIR Independent Team should be composed of three to five OPG staff (preferably from different areas of the company) and a Team Leader appointed by the CEO.

The PIR should complete an independent and systematic evaluation of the work completed under this release including the following:

- Review the completeness of the Project Execution Plan for the Definition Phase and the subsequent phases of the project including:
    i. Project Management organization with detailed role and accountability descriptions that are comparable to similar successful projects,
    ii. Development of HR strategy for the project that is consistent with the corporate HR strategy and reflective of the projected skill requirements and availability during the project's life-span,
    iii. Contractual relationships established for major components such as Re-tube, Fuel Handling, Turbines and Generators, which are comparable to similar successful projects,
    iv. Further development of the overall project schedule, cost estimate, metrics and other key sections with detailed input from key stakeholders.
- Finalization of financing and cost recovery arrangements with required internal and external parties in a manner that is comparable to similar successful projects.
- Review of contracting strategies for balance of plant and execution phase work developed based on a process that is comparable to similar successful projects.
- Completion of initial Infrastructure (e.g. Training and Mock-up Building, Water and Sewer work), preliminary planning and design work and issuance of contracts.
- Completion of the Environmental Assessment on schedule and to the correct quality
- Completion of the Independent Safety Review on schedule and to the correct quality
- Preparation of an updated BCS with up to date information, and
- Preparation of program cost and schedule for Release #4 of the project.
- In addition the team will review and make recommendations on:
    » The effective of risk management thus far in the project and the improvements to the risk management plan going forward.
    » The adequacy of the Project Execution Plan and any enhancements required for successful completion of the further phases of the project.

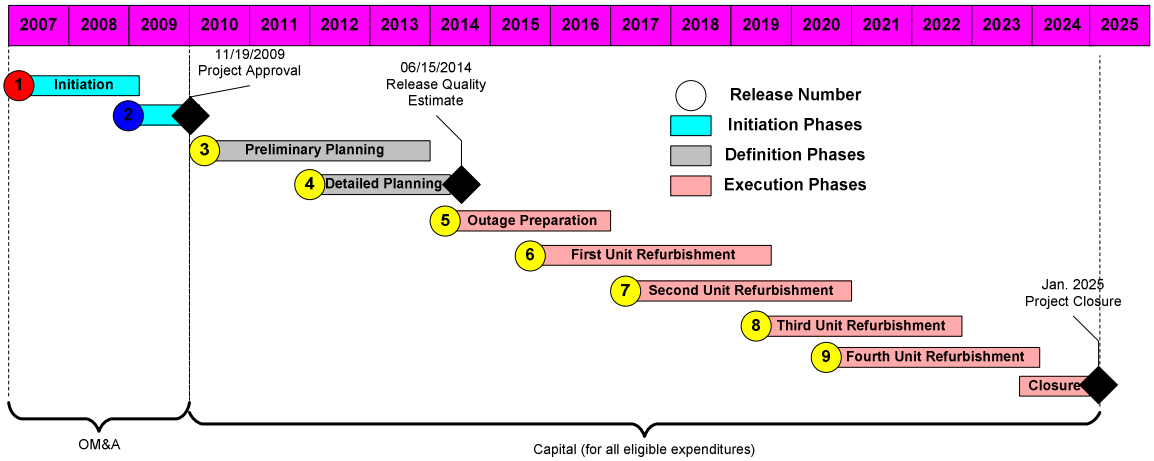
APPENIDX A – RELEASE STRATEGY AND DESCRIPTION OF WORK PHASES

1. Overview of Release Strategy

Funding for the Darlington Refurbishment project will be released in phases using a gating methodology, i.e. the project cannot proceed from one phase to the next without completing certain deliverables and providing an updated Business Case assessment on the total project. Details of the Preliminary Planning Phase (Release #3) are included in the body of this Business case Summary.

The overall release strategy is described in Figure 1.

Figure 1: Overview of the Darlington Refurbishment Release Strategy



This release strategy is based on an October 2016 1st unit outage; i.e. Release 6 is requested 12 months prior to the start of the 1st unit outage in October 2016. Advancement of the refurbishment of the first unit to October 2015 will result in an advancement of releases 5 to 9.

The timing of Release #4 is dependent on the contracting strategy and approach taken by the project. There may be benefits to establishing an earlier contractual relationship with key major component vendors to increase the flexibility with respect to the timing of the first unit outage start. This may result in an advancement of Release #4.

Additionally, as the project progresses through the planning phase, further definition on deliverables and risks, may result in changes to timing and/or deliverables within each release, however, the phase-based gating methodology will be adhered to throughout the Darlington Refurbishment project.

2. Project Phases

The project has been divided into the following phases. A description of the deliverables for each phase has been provided.

2.1 Initiation Phase – Releases 1 to 2

During the Initiation Phase, the following activities will be performed:

- Determine preliminary project scope through the completion of a Plant Condition Assessment (PCA) with a special focus on the life-limiting components, such as feeders and fuel

channels. Studies would also be conducted to assess the condition of all major station components and methods and timing for carrying out the required refurbishment scope would be proposed.

- Initiate planning for the Integrated Safety Review (ISR), including a review of modern codes and standards, and an Environmental Assessment (EA).
- Assess the various execution options (e.g., contracting, project management, work management, governance) for the Definition and Execution Phases of the Refurbishment Project, and recommend an execution strategy.
- Identification of an initial project organization for the Definition and Execution Phases.
- Develop a communications plan to ensure stakeholders are informed of OPG's Refurbishment Project and obtain their support for the decision.
- Develop Project Management support such as Project Controls, performance measures, schedules, risk and contingency processes, project metrics and reports.
- Develop a preliminary Schedule and Cost Estimate for the refurbishment outages, and a Refurbishment Outage Preparation Plan that include both key and supporting scope (organization, infrastructure, oversight, plant and programmatic work, risk contingencies and allowances). Construction Islanding is a key study to determine the supporting scope.
- Prepare a recommendation with respect to proceeding to refurbish the Darlington station to OPG Senior Management, OPG's Board of Directors and Shareholder. Support this recommendation through the completion of a Business Case Summary (BCS).
- The following deliverables are required in order to proceed to Phase 3 of the project.
  - Business Case Summary (BCS) and project recommendation.
  - Project announcement communication plan.
  - Work Program cost and schedule for release 3.

2.2 Definition Phase - Preliminary Planning – Release 3

The Definition Phase - Preliminary Planning Work Program includes:

- Establishment of the Project Management organization for the Definition phase of the project.
- Establish contracting relationships with key vendors for the Definition phase of the project, including for major component work programs, i.e. Retube, Fuel Handling, Turbines and Generators.
- Confirm contracting strategies for balance of plant and execution phase work.
- Completion of the ISR, to assess key safety factors against modern codes and standards including review and acceptance by the Canadian Nuclear Safety Commission (CNSC). Identified issues would be assessed for inclusion in the refurbishment project scope.
- Completion of the Environmental Assessment and obtaining acceptance by the CNSC.
- Infrastructure planning and design completed. Contracts issued for initial infrastructure projects, including the Training and Mockup Building, Water and Sewer work.
- Development of a Human Resources and Labour strategy for the project.
- Confirmation of Cost Recovery and Financing means for the project. Finalize financing arrangements and cost recovery arrangements with required internal and external parties.
- Full development of all project controls governance. Further development of the project schedule, cost estimate, Project Controls, metrics and reports.
- The following deliverables are required in order to proceed to Phase 4 of the project.

- Updated Business Case Summary (BCS) based on contracts, ready to issue, with key vendors.
- Work program cost and schedule for Release 4

2.3 Definition Phase - Engineering and Detailed Planning – Release 4

The Definition Phase - Engineering and Detailed Planning work program includes:

- Completion of all Outage preparation plans. Infrastructure development commences, where possible prior to EA approval.
- Integrated Implementation Plan submitted to the CNSC.
- Finalization of all project scope.
- Orders for long lead items issued and delivery dates confirmed, where required.
- Contracts released to key vendors for engineering, detailed planning, or pre-execution outage work, i.e. development of mockup and tooling for retube.
- A release quality estimate prepared, detailed cost and schedule developed, and an updated business case summary (BCS) prepared, with full project cost estimate, and presented to Senior Management, the Board of Directors and Shareholder, with a project execution strategy recommendation, for approval.
- The following deliverables are required in order to proceed to Phase 5 of the project.
- Updated Business Case Summary (BCS) based on release quality estimate.
- Work program cost and schedule for Release 5

2.4 Execution Phase - Outage Preparation – Release 5

The Definition Phase - Outage Preparation Work Program includes:

- Establishment and release of direct work contracts to execute the major component replacement packages (fuel channels and feeders).
- All trades/project staff hired and trained
- Procurement of all required material for the first unit outage.
- Completion of all engineering.
- Site preparation/infrastructure facilities in place.
- A detailed project schedule and cost estimate for the refurbishment outage execution.
- Full Release (1st Unit) BCS prepared.

2.5 Field Execution and Closeout Phase – Releases 6 to 9

The Field Execution and Closeout Phase will involve completion of all planned aspects of refurbishment and associated re-commissioning and re-licensing tasks.

Releases for subsequent units will be developed and approved throughout this phase.

A Full Release BCS will be prepared for each of the subsequent units (2nd, 3rd, and 4th Units), including any updates to cost and schedule estimates, for each of these subsequent releases. Release 9, for the 4th and final unit, will include project closure costs.

2.6 Operations Phase

The Operations phase is the return to service of the units, starting around 2018, when the first unit refurbishment is complete.

For Internal Project Control

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

APPENIDX B – SUMMARY OF ESTIMATE

APPENDIX B:

ONTARIO POWER GENERATION	**PROJECT** **Summary of Estimate**	Date	November 19, 2009
		Project #	25805 (Capital) 27959 (OM&A)

Facility Name:	Darlington Nuclear Station
Project Title:	**Darlington Refurbishment Project** Preliminary Planning Phase

Estimated Cost in Million $

Year	LTD 2009	2010	2011	2012	2013	2014	Total	%
OPG Project Management	7	19	20				**46**	17
Engineering	14	5.8	4.8					9
Regulatory	11	13	13	7	4	1	**48**	18
Permanent Materials								
Consultants								
Design & Construction (Infrastructure projects)		[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]
Other Contracts / Costs		[redacted]	[redacted]					[redacted]
Interest		2	6				**8**	3
Contingency		[redacted]	[redacted]	[redacted]			[redacted]	[redacted]
Totals	**32**	**74**	**113**	**35**	**17**	**1**	**272**	

Notes:	1.	LTD costs are for the Initiation phase of the project, from 2007 to end of 2009 (Releases #1 and #2). 2010 to 2014 costs are for the Definition Phase, Preliminary Planning (Release # 3). The Preliminary Planning phase includes project planning and infrastructure development. A sub-project BCS will be prepared for each facility/infrastructure improvement made (all funds for this are included in the Design and Construction component of the estimate above).
	2.	Interest and Escalation rates are based on current allocation rates provided by Corporate Finance
	3.	Includes Removal Costs of $1.8M within this phase.

Prepared by:	**Approved by:**
G.Rose Director, Planning and Control Nuclear Refurbishment	**W.R. Robinson** SVP, Nuclear Refurbishment, Projects, and Support

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

APPENIDX B – SUMMARY OF ESTIMATE

Table B1: Details of Preliminary Planning Work Program –Release #3

			Forecast (Release 3 Capital), $M						
Work Program	**LTD 2009**	**Deliverables (LTD)**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**	**Deliverables**
Project Manage-ment	**7.3**	Project Management oversight and Control, including Project management governance (Charter, PEP, and Procedures), Risk Management, Feasibility BCS, Business Planning.	12.1	12.5	-	-	-	**24.6**	Project Management oversight and control, including development of detailed governance for definition phase, including governance to prepare Release Quality estimate and schedule. Project Management systems and tools in place. Includes infrastructure costs such as leases; costs for Finance, HR, Public Affairs, etc.
Supply Chain			5.0	4.7	-	-	-	**9.6**	Contracting Strategy and governance developed. Major component contracts ready to issue. Includes internal/external Legal fees.
Quality Mgmt			0.6	0.6	-	-	-	**1.1**	Quality Program established and governance in place.
O&M Commiss -ioning			0.8	1.1	-	-	-	**1.9**	O&M and Commissioning strategies developed and governance in place.
Construct -ion			0.8	1.1	-	-	-	**1.9**	Construction strategies developed and initial governance in place.
EA	**2.0**	EA Baseline monitoring program	4.4	6.0	3.0	0.4	-	**13.8**	EA completed, submitted to the CNSC, and approved by the CNSC.
ISR	**7.1**	ISR Basis Document, ISR Code Review	7.3	5.8	1.6	0.9	-	**15.5**	Final ISR Report completed, submitted to the CNSC, and approved by the CNSC.
Engineer -ing	**13.8**	Technical Assessments on SG's, Retube and Feeder Replacement, Turbine Generators, Fuel Handling as well as initial PCA's. Outage planning studies including Islanding, HW Management, Nuclear Waste, Safety Margin Improvement, and development of reference plan.	5.8	4.8	-	-	-	**10.7**	Technical specifications for major component contracts prepared, issued, evaluated. Detailed outage preparation planning and scope review process in place. All technical assessments to determine scope completed.
Licensing Support	**0.2**	IIP Governance established.	0.5	0.6	0.5	0.6	-	**2.2**	Re-licensing strategy established, IIP prepared, submitted, and approved by CNSC.
CNSC Fees	**1.3**		0.7	0.7	2.0	2.0	0.9	**6.3**	
Interest	**-**		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Contingency	**-**		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
Totals	**31.7**		**44.4**	**45.2**	**8.0**	**3.9**	**0.9**	**102.5**	

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

APPENIDX B – SUMMARY OF ESTIMATE

Table B2: Details of Infrastructure Projects - Release #3

	Forecast (Release 3), $M						
Work Program	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**	**Deliverables**
Training and Mock-up Building	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	Design and Construction by late 2012; full use by 2013.
Project Offices, warehouses, security building, and other facilities	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	Upgrades to Info Centre, design of additional infrastructure needs, vehicle garage, salt shed, contractor trailer camp, warehouses.
Water and Sewer Upgrades	[redacted]	[redacted]	[redacted]			[redacted]	Upgrades complete by 2012 (to site, across site).
Transformer Upgrades	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	Upgrades complete by late 2012.
Road and Parking Upgrades	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	Road upgrades ready by 2013
OSB Refurbishment	[redacted]	[redacted]				[redacted]	Initial Design work.
Boiler House	[redacted]	[redacted]				[redacted]	Design Work
Design of Heavy Water and Waste Storage Facilities		[redacted]				[redacted]	Design initiated in 2011
Conceptual Design	[redacted]	[redacted]	[redacted]			[redacted]	Preliminary design work prior to BCS
Demolitions	[redacted]	[redacted]				[redacted]	Removal of facilities.
Interest	[redacted]	[redacted]	-	-	-	[redacted]	
Unallocated Projects and Contingency	[redacted]	[redacted]		-	-	[redacted]	Estimates are conceptual. Funding will be released through a BCS
Totals	**29.8**	**67.7**	**27.4**	**13.2**	**-**	**138.2**	

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

APPENIDX C – DETAILS OF THE ECONOMIC ASSESSMENT

1.0 Assessing the Economics of Refurbishment

In order to assess the economics of the refurbishment decision on Darlington, the following key factors must be considered:

- Refurbishment Scope, Cost, Duration and Timing
- Expected Life of each unit post-refurbishment
- Forecast annual operating costs post-refurbishment, including Operation, Maintenance and Administration costs, On-going Project (Capital & OM&A) costs, Outage costs, Fuel costs, Nuclear Waste Management and Decommissioning (Provisions) costs and Overhead (Nuclear and Corporate) costs.
- Forecast Performance post-refurbishment (annual capacity factor/capability factor).
- Economic Indices (e.g. labour and material escalation rates, appropriate discount rate)

The above factors can be used to determine the Levelized Unit Energy Cost of the refurbishment option. In addition, to assess the Net Present Value of the decision, assumptions need to be made about the future electricity price. There are other potential incremental costs or opportunities associated with a decision to go or not to go ahead, such as changes to the present value of the decommissioning liability or incremental transmission costs, which are applicable if one were to take a societal view of the costs and benefits of the project, which may also influence the ultimate decision.

The above items are discussed in more detail in the following sections.

1.1. Refurbishment Scope, Cost and Reference Schedule

1.1.1. Refurbishment Scope

The core scope of work during the refurbishment of each Darlington unit was assumed to be limited to the replacement of fuel channels (pressure tubes and calandria tubes) and feeder pipes (up to the feeder header). The refurbishment scope does not include replacement of the steam generators or a switch to Low Void Reactivity Fuel.

Preliminary assessments have been made about the amount (and cost) of non-core refurbishment work likely to be required on the nuclear steam supply system and the balance of plant for each unit. This work can potentially arise from a need to perform safety upgrades and/or to bring the plant in line with new regulatory requirements; however, the scope of this work will remain not well defined until the completion of the Environmental Assessment process, the Integrated Safety Review and the detailed Plant Condition Assessments.

Included in the allowances for non-core refurbishment scope work are also limited provisions for advancing future life-cycle work (i.e. work that would be necessary in the post-refurbishment life to ensure that the plant can continue to operate safely and reliably during that planned post-refurbishment life), where it makes business sense to advance this work into the refurbishment outage, e.g. because of the duration of the work or the state of the plant required to execute the work.

The outage scope also includes provisions for outage support work (unit islanding, facilities, construction island barriers, D2O management, and radioactive waste management).

Steam Generators: The Executive Committee (EC) on April 14th, and the NGPC, on April 24th, 2009, accepted Management's report to exclude SG's from the Refurbishment scope of Darlington.

This recommendation was based on the following:

- Historically, the Darlington steam generators have performed exceptionally well with minimal incapability caused by these systems since in-service. This performance is partially due to very good chemistry control and maintenance practices. There has been no forced incapability at Darlington due to steam generators since 2000.
- A preliminary technical assessment of the Darlington steam generators by Engineering & Modifications indicated that the steam generators have greater than a high to medium probability of achieving 15 years post-refurbishment without significant deterioration in performance and a medium probability of reaching 30 years post refurbishment life. A preliminary, conservative economic assessment indicated that as long as the steam generators could operate reliably until up to 15 years post-refurbishment, it made economic sense not to replace them during the refurbishment outage
- Refurbishment Outage execution is simplified if steam generators are not replaced which increases the confidence in achieving the planned 36 month outage duration.
- Due to the strategic importance of this scope item, a contract was issued to perform a third-party review on the Condition Assessment of the Steam Generators. The steam generator condition assessment work was completed by Dominion Engineering and their final report was received and approved on December 1, 2008.
- An engineering decision meeting (EDM) was held on December 16, 2008 to review the decision on whether the existing SGs should be refurbished or replaced in the Darlington Refurbishment outage. At that meeting it was agreed that the technical justification for not replacing the steam generators was robust, but additional detail around the economic assessment was requested. This information was compiled and a final recommendation was presented and accepted by the EDM on February 20, 2009.
- On April 14, 2009, the recommendation was endorsed by the Executive Committee. This information was subsequently presented to the Nuclear Generation Projects Committee on April 24, 2009 and was accepted.

Low Void Reactivity Fuel (LVRF): The refurbishment scope does not include a switch to Low Void Reactivity Fuel (LVRF) to address Safety Margin issues. The preferred approach, consistent with industry direction on this item, is to retain natural uranium fuel as the reference basis for Darlington in the post-refurbishment period.

Tritium Removal Facility (TRF): The TRF located at Darlington provides services to Canada's CANDU fleet (OPG, Bruce, Gentilly, Point Lepreau) and other occasional minor customers. Darlington's share of the TRF costs is approximately 40%. The first phase of a Heavy Water (D_2O) Management Strategy Study has been completed. Preliminary findings are that the existing TRF can operate until at least 2024 without major re-investment and will have the capacity to meet the detritiation needs of the fleet for the foreseeable future, with one-time or phased refurbishment as it approaches nominal end-of-life. The preliminary recommendation is therefore to defer any decisions on replacement of the existing TRF until a future date when a better understanding of available technologies and costs of those technologies is developed, and also pending completion of a detailed plant condition assessment of the existing TRF. Should replacement of the existing TRF be found to be required, or should an additional TRF be required, the most advantageous time for executing that project will likely be towards the end of the refurbishment window of the nuclear units. Therefore, TRF replacement (capital) costs are not included as part of the Darlington refurbishment scope. If the Darlington units only were to attract the full costs of TRF replacement and operation (i.e. a current-sized TRF dedicated to Darlington) additional impact on the LUEC is small (0.1 ¢/kWh), therefore the economic assessment of refurbishment remains the same.

1.1.2. Refurbishment Costs

Preliminary cost estimates were developed for the refurbishment scope of work from a variety of sources, including the Pickering B assessment in 2007, industry studies, preliminary technical assessments performed as part of the Darlington Planning Activities project, experience from previous OPG projects and engineering judgment. In addition, some benchmarking has been done against publicly available costs of other on-going CANDU refurbishment projects such as Pt. Lepreau and the Bruce 1 & 2 Units.

Since that time, a detailed technical assessment study has been completed for the major scope of the refurbishment outage, i.e. the retube and re-feeder activities, an islanding study has been completed and additional intelligence has been applied to the outage cost estimates as a result of on-going benchmarking against current refurbishment projects at Bruce Units 1 & 2 and Pt. Lepreau.

The table below summarizes the project costs, at a 90% confidence level, which were utilized in the economic assessment.

DARLINGTON REFURBISHMENT – PRELIMINARY RELEASE BUSINESS CASE

APPENIDX C – DETAILS OF THE ECONOMIC ASSESSMENT

Table 1: Refurbishment Project Costs Used in the Updated Economic Assessment

Cost Element	DN 1st Unit ($2009M)	DN - 2nd/3rd/4th Unit ($2009M)	Comments
Retube & Refeeder (1)	[redacted]	[redacted]	Preliminary Vendor Estimate
Steam Generators (Primary Side Clean)	[redacted]	[redacted]	Internal estimate based on OPEX.
Turbine/Generator Set Upgrades	[redacted]	[redacted]	Preliminary estimate based on known potential scope, e.g. blade replacements
Fuelling Machines	[redacted]	[redacted]	Preliminary estimate pending completion of CCA.
Reactor Components	[redacted]	[redacted]	Life Cycle Management Plan Recommendations
Safety & Environmental. Assessment Upgrades	[redacted]	[redacted]	Based on Pickering B costs
Plant Condition Assessments	[redacted]	[redacted]	Preliminary pending completion of PCAs.
Unit Separation & Construction Island	[redacted]	[redacted]	Based on preliminary islanding report.
Refurbishment Waste & D2O Mgmt	[redacted]	[redacted]	Detailed Waste Mgmt and D2O estimate reports.
Cyclic Outage/IOP Work & Deferred Project	60	60	Completion of periodic inspections during refurb.
Initial Fuel Charge	30	30	Based on OPG internal estimates
Infrastructure (facilities to support Refurbishment as well as post-refurbishment operations)	[redacted]	[redacted]	Includes Project offices, Training and Mock-up Building, Water and Sewer Upgrades, Construction facilities, Warehouses, Parking Lots and Road/Bridge improvements, Security Buildings; as well as OSB Refurbishment, Boiler House, Transformer Upgrades, etc.
Project Mgmt & Programmatic Support	340	205	Includes Supply Chain, Supervision, Oversight, Project Management, and Operations Support
Total Before Risks/Contingencies	[redacted]	[redacted]	
Total Allowances for Risks/ Contingencies	[redacted]	[redacted]	**Note**: $2.1B at 90% Confidence Level. (Approx. $1B at a 50% Confidence Level).
Total	[redacted]	[redacted]	
Overall Total for 4 units (1)	[redacted]		

[redacted]

For the purposes of preparing sensitivity analyses, ranges were applied to the most likely estimates in each line item of the cost estimate.

1.1.3. Contingency and Risks - Refurbishment

Included in the refurbishment estimate is an allowance for uncertainties in project scope, costs and schedule. In addition, allowances are added for known discrete risks.

[redacted] These contingencies are broken out as follows:

- Asymmetry in Cost Estimate Distributions

  This contingency item represents the amount that has to be added to the most likely project estimate to bring it to the expected value (median estimate or 50% probability). This is due to the skewness in cost estimate ranges developed for each scope item towards the higher end of the range. This asymmetry results in the expected value being higher than the most likely estimate.

- Labour/Materials Cost & Schedule

  This item deals with known risks associated with the potential for labour and material costs to be higher than expected in tight markets and is in addition to the skewness built into the cost estimate ranges for cost estimating uncertainty. It is expected that there will be a high demand for qualified workers and the required materials with the current projections of the level of activity in the refurbishment period. Further, this item also reflects concern that the complexity of the project poses a risk to meeting the schedule.

- ISR, EA and other Regulatory Risks

  There is a potential for Integrated Safety Review and Environmental Assessment gap items and other regulatory items to be added to the refurbishment scope due to regulatory uncertainty. There are also allowances in the project estimate for acceptable deviations from the Integrated Safety Review.

- Risk Register Items[redacted]

  Allowances have been included to the overall project estimate to address discrete risks listed in the risk register that are not accounted for in the other risk categories shown above.

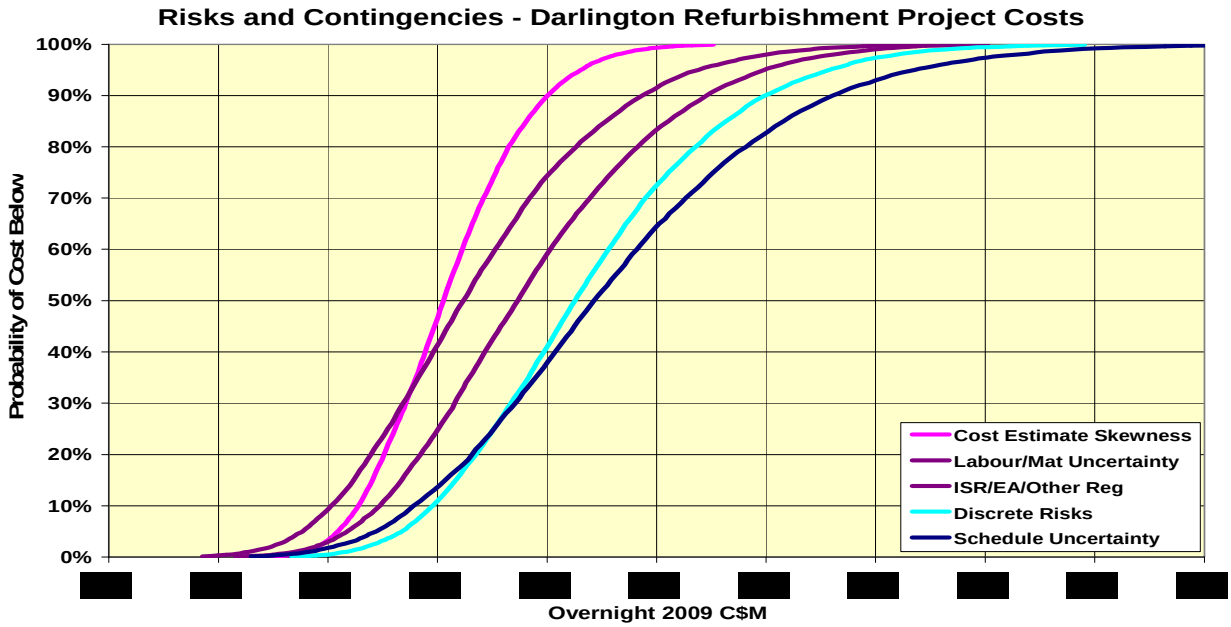
  The estimates for each of these contributors to contingencies and risks at both the 50% confidence level and the 90% confidence level are shown in Table 2.

Table 2: Contingency & Risk Amounts added to the Darlington Project Cost Estimate

	50% Conf. $2009M	90% Conf. $2009M
Asymmetry in Cost Estimate Distributions	[redacted]	[redacted]
Potential Higher Labour/Materials Cost & Schedule Uncertainty	[redacted]	[redacted]
Potential Scope Increase due to ISR, EA Gaps, and Other Regulatory	[redacted]	[redacted]
Discrete Risks	[redacted]	[redacted]
Total Allowance for Contingency & Risks	[redacted]	[redacted]

The resulting distribution of Darlington refurbishment project costs is shown in Figure 1.

Figure 1: Risk and Contingencies – Darlington Refurbishment Project Costs



1.1.4. Refurbishment Reference Schedule

For the Darlington Refurbishment project, the reference schedule was established in 2 steps; the duration of a unit outage was first established followed by the decision on the timing of the outages.

Unit Refurbishment Duration: The duration of the refurbishment outage of the first Darlington unit was originally assessed to be nominally 25 months (breaker open to breaker closed). The project has since reviewed experience from Bruce Power and Pt. Lepreau, and the Retube preliminary technical report. Based on this review, the planning assumptions have been modified. The critical path duration of each unit refurbishment is now 36 months. The key activities and nominal expected durations used to develop the critical path are as follows (estimates may change as the schedule is developed in more detail):

Refurbishment Activity	Duration
• Defuel	3 months
• Vault preparation, isolation, decontamination if required, drain/dry	3 months
• Remove Feeder Pipes	3 months
• Remove Pressure Tubes	8 months
• Calandria Tube removal	4 months
• Replace Pressure Tubes, Calandria Tubes and Feeder Pipes	8 months
• Vault Clean Up	3 months
• Unit Restoration (refill moderator and heat transport system, pressure test, system commissioning)	4 months
Total Duration	**36 months**

Timing of Unit Refurbishment Outages: The Darlington units have predicted end-of-service life dates ranging from Q1 2019 to Q1 2020 assuming 210,000 Effective Full Power Hours (EFPH) for the

lives of the pressure tubes. As shown below, this represents a medium confidence (30 – 70%) estimate. The high confidence estimate (70 – 90%) of the pressure tube life is 185,000 to 190,000 EFPH which corresponds to end-of-service life dates for the Darlington units about two years earlier (see table below). There are currently programs underway to increase the confidence in a pressure tube life of 210,000 EFPH but these are not expected to result in greater clarity around pressure tube life until 2012 or later.

Forecasted Unit Nominal End-of-Service Life Dates

	Pressure tube life	
Unit	210,000 EFPH (30-70 % confidence)	185,000 – 190,000 EFPH (70-90 % confidence)
1	Q1 2019	Q2 2017
2	Q1 2019	Q2 2017
3	Q4 2019	Q1 2018
4	Q1 2020	Q2 2018

Several criteria were used to assess the optimum start dates for a Darlington refurbishment outage, including the life of major components (e.g. pressure tubes and feeders), lead times for key decisions (Environmental Assessment, Integrated Safety Review), lead times for critical path procurement activities (e.g. pressure tube tooling), project preparation and planning, market share implications for OPG and capacity available to the Ontario electricity system. The overall ranking indicated that the optimum start date for the first Darlington refurbishment outage was 2016 based on the medium confidence nominal ends-of-service life dates of the units.

The following is the current reference schedule for refurbishment, with the first unit's refurbishment starting in 2016, refurbishment outage durations of 35 months/unit with a 19 or 16 month overlap between the end of the prior unit and the beginning of the subsequent unit, and a final unit return-to-service date of November, 2023:

Table 3: Reference Schedule Used in the Updated Economic Assessment

Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (months)	Overlap on Previous Unit
1st	**October, 2016**	September, 2019	36	
2nd	February, 2018	January, 2021	36	19
3rd	September, 2019	September, 2022	36	16
4th	January, 2021	**January, 2024**	36	19
		Unit Outage Months	144	
		Refurbishment Window	88	

The refurbishment reference schedule optimizes the value to OPG and the Ontario electricity consumer, considering a range of factors. A key consideration is to minimize the combined sum of idle time and forsaken life. Idle time occurs when a unit is shutdown before the refurbishment outage can begin, because limiting components have reached their ends-of-life, but readiness to refurbish cannot be achieved (e.g. another unit is already under refurbishment; lead time constraints have prevented the acquisition of necessary tooling). Forsaken life occurs when units are shutdown for refurbishment before they reach the limiting component end-of-life, in order to execute the refurbishment. Because the nominal end-of-life dates of the four Darlington units occur within a 1 year span, there is the potential for significant idle time and/or forsaken life which would need to be managed.

1.2. Post-Refurbishment Assumptions

To fully assess the merits of the option to proceed with the refurbishment of the Darlington plant, all future expected costs of operating the facility over its post-refurbishment life, as well as the expected operating performance of the plant and expected unit life must be forecasted.

1.2.1. Unit Life

Since the Darlington units will have been in service for approximately 60 years (not including the time out-of-service for refurbishment) by the end of their post-refurbishment lives, it is considered prudent to utilize conservative assumptions for unit lives for the economic assessment, in order to mitigate the risk that an unforeseen equipment issue could emerge which could bring about an earlier than expected end of post-refurbishment life.

The post-refurbishment life of each unit was assumed to be nominally 30 calendar years. This post-refurbishment calendar life was derived from the current design life of pressure tubes of 24 effective full power years (210,000 effective full power hours) with some recognition that, given the knowledge gained about pressure tube degradation mechanisms, future pressure tubes will likely be designed to achieve longer service lives. Thirty calendar years, with an assumed 87% capability factor translates into a pressure tube life of 25.5 effective full power years (approx. 224,000 effective full power hours).

Sensitivities on unit lives were run at 25 calendar years and 35 calendar years respectively.

1.2.2. Annual Station Operating, Maintenance & Projects Costs

The 2012 data from the approved 2008-2012 business plan was used to derive the expected annual OM&A for the post-refurbishment period. Annual OM&A levels were derived based on forecast changes to programs and were estimated to be nominally the same as the current 2008-2012 Business Plan averages over the post-refurbishment period. These values have been re-verified against the assumptions in the 2009 – 2013 business plans and verified again versus preliminary numbers in the 2009 – 2014 Business Plan.

The post-refurbishment outage costs were developed based on expected work programs and typical outage templates. These were increased during the last 10 years of post-refurbishment life. The outage costs include allowances for periodic 4-unit shutdowns for the Vacuum Building Inspections and Containment Testing.

Expenditures for ongoing sustaining projects of $28M/unit/yr was assumed, which is consistent with the nuclear project portfolio assumptions. This was modified by assuming that, in the first year post-refurbishment, 50% of the “typical’ annual project costs would be incurred, ramping up to 100% by the 5th year.

The following table provides details on the assumptions used for these factors in the analysis.

Table4: Annual OM&A, Outages & Projects Costs Used in the Economic Assessment

Going Forward Cost Item	2008-2012 Bus. Plan Avg. ($M/yr; 2008$)	Post-Refurbishment Averages Median Confidence ($M/yr; 2009$)
Station Base OM&A (1)	290	295
Outages (1)	90	95
Projects (Cap & OM&A) (2,3)	78	100
Annual Direct Costs	458	490

1. Base and Outage post-refurbishment forecasts are very close to the current business plan averages. Excludes Darlington portion of TRF costs which is accounted for in the assessment model.
2. Project forecasts are based on 4/10 of the current Nuclear Portfolio. Darlington specific projects in the last 2 years of the business plan were not all defined. The 3 year projects spending average in the business plan period is $93M.
3. Periodic major projects (e.g. facilities, security) are factored into the long-term projects forecast.

1.2.3. Annual Support and Overhead Costs

Costs associated with direct and allocated support services and overheads must be included when considering the true costs of the continued operation of the Darlington plant. These overhead and support costs are divided into Nuclear and Corporate Support. Examples of nuclear support costs include costs of the Engineering and Modifications organization which are not directly charged to each plant through project work, e.g. chemistry and metallurgy support. Examples of Corporate Support costs include Head Office Finance Support, Human Resources and Real Estate Services. In addition, there are overheads such as pension obligations and insurance which are allocated to Darlington.

Experience shows that a large portion of these costs would not disappear from the company's cost structure if Darlington were to be shut down. Hence, the analysis of Darlington's economics is done including fully allocated support and corporate overhead costs and also including only the portion of those costs which are considered incremental to the operation of Darlington. Table 5 below shows the fully allocated and incremental support and overhead costs which were assumed in the Updated Economic Assessment.

Table 5: Nuclear & Corporate Support Costs Used in the Updated Economic Assessment

Going Forward Cost Item	Fully Allocated M$/Yr, 2009$	Incremental M$/Yr, 2009$
Nuclear Support	180	150
Corporate Support & O/Hs	145	40
Total	325	190

1. Fully Allocated Nuclear & Corporate Support costs are very close to current 2009-2013 business plan averages.
2. Incremental Support & Overhead costs refer to the derived portion of these costs that would not be expended if Darlington were to be shutdown.
3. In other words, of $325 M/yr in allocated support & overhead costs, only $190 M/yr is incremental to Darlington; remaining $135 M/yr will be incurred regardless (in the long term this could likely be reduced).
4. Overheads include costs such as obligations for past service liabilities which will be incurred regardless and are not considered incremental.

1.2.4. Station Performance Assumptions

In developing an estimate of the performance of the Darlington units in the post-refurbishment period, a number of factors were considered including historical performance. Recent capability factor

performance has been excellent, in the 85%-90% range, and recent planned outage performance and forced loss rates (FLR) have also been very good.

Factors considered in forecasting post-refurbishment performance include the following:

- Lifetime performance of the Darlington station has been 83% capability factor; last 10 years' performance has averaged 87% and last 5 years' performance has also averaged 87%.
- As part of the assessment for refurbishment, detailed plant condition assessments (PCAs) will be completed well prior to the decision on refurbishment. These PCAs should identify any major equipment issues which may potentially limit the performance of the plant post-refurbishment.
- Technical knowledge of equipment reliability issues, including component degradation mechanisms in CANDU reactors and the balance of plant, has improved dramatically over last 5 decades of the CANDU program, leading to some confidence that there will be fewer surprises in the future.

These issues were discussed in meetings with senior station personnel and in discussions with the NGD Project Team and the Advisory Committee. The consensus arrived at was to assume a reference annual capacity factor of 87% but to analyze over a broad range as shown in Table 6 below:

Table 6: Performance Assumptions Used in the Updated Economic Assessment

Performance Factor	2008-2012 BP Avg	High Confidence	Medium Confidence	Low Confidence
Gross Capability Factor (%)	91%	82%	**87%**	92%

The 87% capability factor (medium confidence) is equivalent to Darlington's average performance for last 10 years. It is considered conservative given the station's performance of 89.6% over the last 3 years and would put the station in the 4th quartile of INPO plants. The low end performance of 82% reflects the station's since-in-service performance and could result, for example, from a failure to effectively implement the Integrated Aging Management Program (IAMP) and/or an inability to maintain a 3-year outage cycle. It would also allow 20-month outages at year 15 post-refurbishment, if necessary, to replace steam generators. The high end performance of 92% could be achieved if Darlington were to achieve and sustain 1st or 2nd quartile INPO performance, funding levels are maintained, the IAMP is effectively implemented, and Human Performance is maintained.

2.0 Results

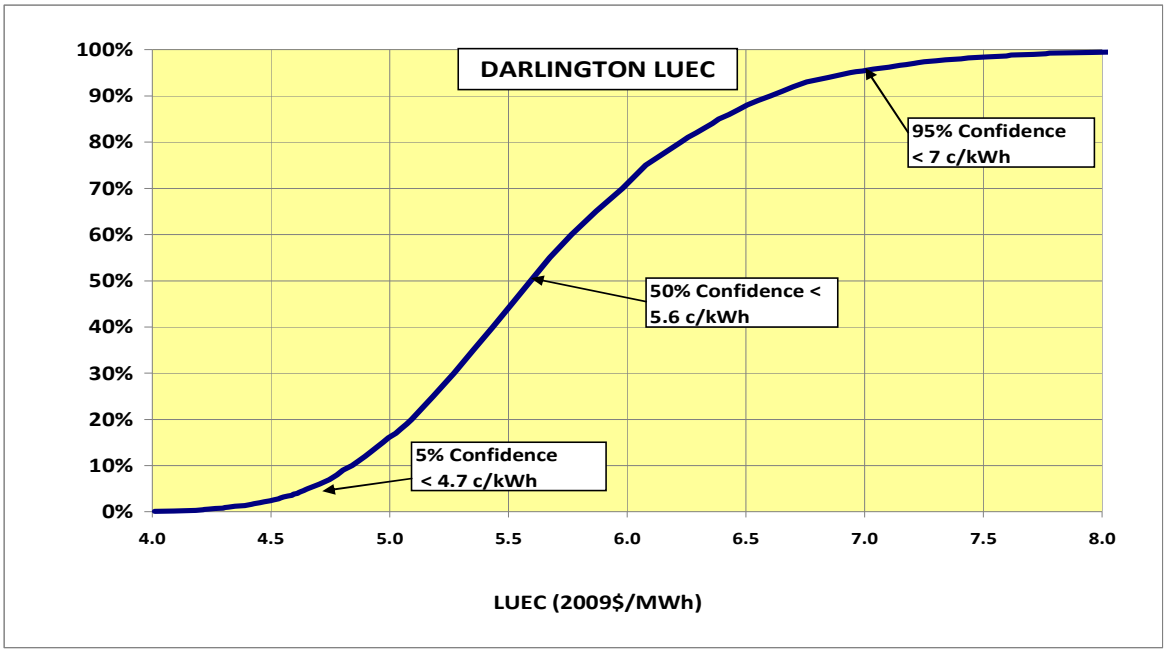
The Levelized Unit Energy Cost (LUEC) was calculated using the above assumptions and alternative scenarios and sensitivity analyses were run on the low/high (pessimistic/optimistic) assumptions in order to assess the sensitivity of the results to the various input variables. These results are presented below.

2.1. Levelized Unit Energy Costs

The updated analysis also indicates 90% confidence that the levelized units energy costs (LUEC) for Darlington Refurbishment will be in the range of 4.7 ¢/kWh to 7 ¢/kWh (2009$) on an incremental basis. Fully allocated, the Darlington LUEC would be approximately 5.3 ¢/kWh to 7.7 ¢/kWh.

[redacted]

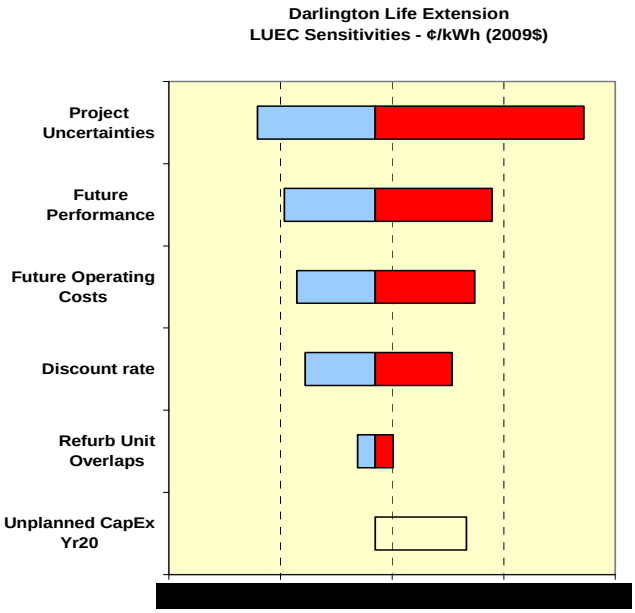
Figure 2: Levelized Unit Energy Cost Confidence Ranges



2.2. Sensitivity of Results to Changes in Input Assumptions

As documented in Section 1, this Updated Economic Assessment includes a large number of assumptions regarding refurbishment costs and durations, going forward operating and sustaining investment costs and operating performance. For each of these factors, ranges were developed and sensitivity analyses were run at the low and high ends of these ranges for each of the key input factors. This analysis shows that the results are most sensitive to assumptions on project costs, future performance (post-refurbishment life and capability factor assumptions), future operating costs (Station Direct, Nuclear & Corporate Support costs), project costs and the discount rate.

Figure 3: Sensitivity Analysis – Darlington LUEC

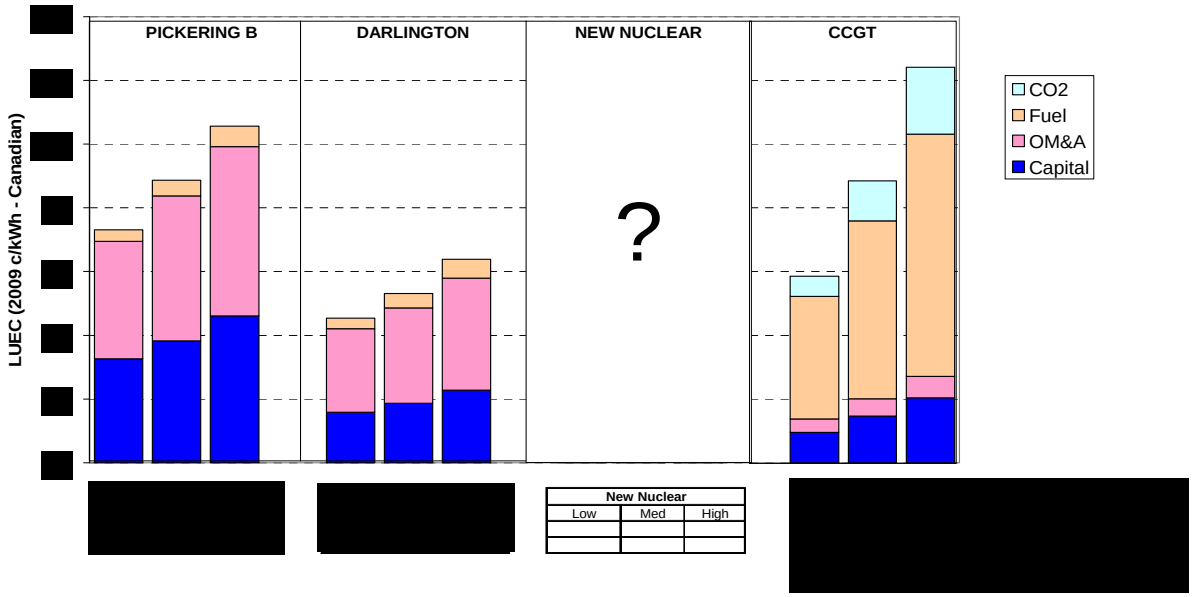


Assumptions	Lower	Base	Upper
Project Uncertainties			
Refurb Cost (2009$)	-15%	[redacted]	20%
Refurb Duration (months)	-6 mths		+12 mths
Future Performance			
ACF (%)	-5%	87%	5%
Life of Refurb Units (yrs)	+5 yrs	30 yrs	-5 yrs
Future Operating Costs			
Base OM&A ($M)	-5%	295	5%
Outage OM&A ($M)	-5%	95	10%
Sustaining Projects ($M)	-20%	100	20%
Nuclear Support ($M)	-5%	150	15%
Corporate Support ($M)	-10%	40	15%
Fuel ($/MWh)	-30%	5	30%
Discount Rate	-1%	7%	+1%
Refurb Unit Overlaps	+4 mths	19/16 mths	-4 mths
Unplanned CapEx Yr20			$1B/unit

2.3. Comparisons to Other Options

A significant input into the decision-making process on the economic viability of the Darlington Refurbishment is a comparison to the LUEC's of other options competing with this project. Figure 5 presents such a comparison.

Figure 5: Levelized Unit Energy Costs for Darlington Refurbishment and Comparators



The conclusion is that the economic viability of Darlington Refurbishment project compares well. It is at a level better than the low end of combined cycle gas turbines (CCGT) for low, median or high gas process and no CO_2 adder. The LUEC for CCGT is highly uncertain due to the continuing volatility in natural gas prices and potential changes to CO_2 regulations.

The costs of New Nuclear remain speculative and this time, thus, a firm comparison to Darlington is not possible. Management believes that the LUEC range for Darlington Refurbishment compares very favourably to New Nuclear, based on known public information of the costs of New Nuclear.

3.0 Conclusions of Economic Assessment

The Levelized Unit Energy Cost (LUEC) for Darlington Refurbishment appears to be very competitive economically with other available generation options, including New Nuclear and Combined Cycle Gas. There is merit to continuing the development of a more detailed scope, cost, and schedule for the project and to commencing definition phase work, including preliminary engineering.

Minister of Energy

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Ontario

JUN 16 2006

Mr. James Hankinson
President and Chief Executive Officer
Ontario Power Generation
700 University Avenue
Toronto, Ontario
M5G 1X6

Dear Mr. Hankinson:

I am writing to you regarding our June 13, 2006 announcement, which outlined the Ontario Government's response to the Supply Mix Report issued by the Ontario Power Authority (OPA). The report, released in December 2005, recommended a plan for supply and demand management options to meet the province's electricity needs to 2025.

The Ontario Government announcement directed the OPA to ensure adequate baseload electricity supply, while maintaining the nuclear generation component of that baseload at today's level of 14,000 MW of installed capacity.

Recognizing that maintaining the current level of nuclear baseload through 2025 would require a combination of refurbishment of existing units and construction of replacement units, and given the long lead times required for licensing approvals of these activities, I am directing OPG to:

a) begin feasibility studies on refurbishing its existing nuclear units. As part of this initiative, OPG is directed to also begin an environmental assessment on the refurbishment of the four existing units at Pickering B, and

b) begin a federal approvals process, including an environmental assessment, for new nuclear units at an existing site.

Staff of the Ministry of Energy will be available should your staff have any questions on this directive.

.../cont'd.

Please accept my best wishes.

Sincerely,

Original signed by:

Dwight Duncan
Minister

Capital Project Listing
Darlington Refubishment - Campus Master Plan
Project Listing (1)

Line No.	Project Name	Project Category	Potential Start Date
	(a)	(b)	(c)
	Projects with anticipated cost >$10M		
1	Training and Mock-up Complex Complex to support Nuclear Refurbishment and Post Refurbishment Operations	Strategic/Value Enhancing	2010
2	Site Infrastructure Upgrades for Domestic Water and Sewage Treatment	Strategic/Value Enhancing	2010
3	Site Infrastructure Upgrades for Electrical	Sustaining	2010
4	Refurbishment of the Operations Support Building	Sustaining	2010
5	Refurbishment of the Auxilliary Steam Boiler	Sustaining	2010
6	Project Offices and Facilities	Strategic/Value Enhancing	2010
7	Retube and Feeder Replacement Support Annex	Strategic/Value Enhancing	2011
8	Site Facilities Maintenance Building	Sustaining	2012
9	Warehousing and Laydown Areaas	Strategic/Value Enhancing	2012
10	Contractor Lunch and Cloakroom Facility	Strategic/Value Enhancing	2011
11	Refuribhsment Security Building	Strategic/Value Enhancing	2010
12	Road and Parking Improvements	Strategic/Value Enhancing	2012
	Projects with anticipated cost <$10M		
13	Road and Parking Upgrades	Strategic/Value Enhancing	2010
14	Heavy Water and Waste Storage Facility	Strategic/Value Enhancing	2011

Note 1: There are no in-service amounts forecast for the bridge or test period.

Ontario Power Authority

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February 8, 2010

Mr. Albert Sweetnam
Executive Vice President
Darlington New Nuclear Project
700 University Avenue, H17 G25
Toronto, Ontario
M5G 1X6

Dear Mr. Sweetnam:

Re: Darlington Environment Impact Statement and License to Prepare the Site – Support for EIS Guidelines Section 07.1– IR #5

This letter is provided by the Ontario Power Authority to respond to the Darlington Joint Review Panel information request on EIS Guidelines Section 7.1 Purpose and Need for the Project – IR#5. The wording of the request is as follows:

"Provide the rationale behind Ontario's Energy Policy decision to build new nuclear units at the Darlington Site."

The Ontario Power Authority ("the OPA") develops integrated Power System plans for Ontario. The OPA was established by the Electricity Restructuring Act, 2004. It is governed by an independent Board of Directors and reports to the Ontario Legislative Assembly through the Minister of Energy and Infrastructure. The OPA is licensed and regulated by the Ontario Energy Board.

The OPA is guided in its interpretation of Ontario Energy Policy by directives from the Ontario Government to the OPA. Of particular relevance to nuclear generation is the "Supply Mix" directive dated June 13, 2006 in which the OPA is directed to:

"Plan for nuclear capacity to meet base-load electricity requirements but limit the installed in-service capacity of nuclear power over the life of the plan to 14,000 MW"

The Supply Mix directive can be found at the following link:
http://www.powerauthority.on.ca/Storage/23/1870_IPSP-June13%2C2006.pdf

It is in Ontario's interest to make decisions as needed that increase the flexibility to respond to changing circumstances. For those supply decisions that have long lead time requirements (such as new nuclear, conservation and hydroelectric generation), the planning and preparation activities need to start long in advance of the potential need for the choice to remain a viable option in the future energy mix.

...../2

Recognizing OPG's decision not to proceed with further refurbishment of Pickering NGS B and the potential for other nuclear units reaching end of their operating life, new nuclear units may be required.

Nuclear is a strategic choice that has been part of a diversified portfolio in Ontario for the last 40 years. Its value increases when generated close to users of the power in a future where carbon free supply commands a premium. The advice to the Ontario Government contained in the OPA Supply Mix Report issued in December 2005 identified the merits of a diversified portfolio of resources, with 50% of long-term energy requirements being met by nuclear generation. (The Supply Mix Report can be found at the following link: http://www.powerauthority.on.ca/Page.asp?PageID=924&SiteNodeID=127). This requirement was further confirmed in the Integrated Power System Plan (IPSP) submitted by the OPA to the Ontario Energy Board in August 2007. The IPSP identified the need for new nuclear generation in Ontario beginning in 2018, in order to maintain the current level of nuclear generation and supply 50% of the Province's energy requirements. The IPSP can be found at the following link: http://www.powerauthority.on.ca/IPSP/Page.asp?PageID=924&SiteNodeID=320

More current assessments of demand, outlook for supply and future options are underway.

New nuclear has a long lead time and some of the preparatory work needs to be started now in order for this to remain as a viable option in the 2020 timeframe. While there are uncertainties around many aspects related to new nuclear, our understanding of the scope of work and costs involved at this stage leads us to support the preparatory work OPG is undertaking.

Yours truly,

Amir Shalaby
Vice President, Power System Planning
Ontario Power Authority

Numbers may not add due to rounding.

Table 1
Rate Base and Return on Rate Base Impact of Darlington Refurbishment Project ($M)
Years Ending December 31, 2011 and 2012

Line No.	Description	Notes	Net Plant Opening Balance	Relative Change in Net Plant	(a)+(b) Closing Balance	((a)+(c))/2 Net Plant Rate Base Amount	Carrying Charges	(d) x (e) Pre-Tax Revenue Requirement	Income Tax	(f)+(g) Revenue Requirement Impact
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
							Note 4		Note 5	
	2011 Plan:									
1	**CWIP in Rate Base**	1	72.9	105.2	178.1	125.5	7.56%	9.5	1.6	11.1
2	**Asset Retirement Cost**	2	565.7	90.6	656.3	611.0	5.58%	34.1	12.3	46.4
3	**Extension to Darlington End-of-Service Life**	3	24.2	24.2	48.5	36.4	7.56%	2.7	0.5	3.2
	2012 Plan:									
4	**CWIP in Rate Base**	1	178.1	255.8	433.9	306.0	7.59%	23.2	3.6	26.8
5	**Asset Retirement Cost**	2	656.3	90.6	746.8	701.6	5.58%	39.1	13.0	52.2
6	**Extension to Darlington End-of-Service Life**	3	48.5	24.2	72.7	60.6	7.59%	4.6	0.7	5.3
7	**Combined Balance**		882.8		1,253.5	1,068.2				
	Test Period Total:									
8	**CWIP in Rate Base** (line 1 + line 4)							32.7	5.2	37.9
9	**Asset Retirement Cost** (line 2 + line 5)							73.2	25.3	98.6
10	**Extension to Darlington End-of-Service Life** (line 3 + line 6)							7.3	1.2	8.5
11	**Total Revenue Requirement Impact**							113.3	31.8	145.1

Notes:

1 CWIP net changes are detailed in Ex. B3-T3-S1 Table 2. Total Rate Base is increased and the lesser of ARC and UNL amount is unchanged. Therefore the rate base financed by the OEB approved capital structure increases by 100% of the change.

2 The ARC increased by $475.2M effective January 1, 2010 per Ex C2-T1-S2 Table 3. The annual depreciation expense impact on ARC for the prescribed facilities of $90.6M is described in Ex. C2-T1-S2 Table 4. As the effective date is January 1, 2010, the 2011 opening balance of accumulated depreciation reflects a full year of depreciation expense. The ARC is always "lesser" than UNL as illustrated in Ex C2-T1-S2 Table 1. Total rate base increases by ARC; Therefore the rate base financed by the OEB's approved capital structure is unchanged. The OEB methodology requires that the accretion rate be used to finance the lesser of ARC and UNL.

3 The total impact on depreciation expense on OPG's prescribed facilities of $114.8M is discussed in Ex F4-T1-S1, Page 6. The depreciation expense impact resulting from the extension of service life is the total depreciation expense of $114.8M less the depreciation expense on ARC of $90.6M described in footnote 2. As the effective date of the extension of service life is January 1, 2010, the 2011 opening balance of accumulated depreciation reflects a full year of depreciation expense. Total Rate Base is increased and the lesser of ARC and UNL amount is unchanged; Therefore the rate base financed by the OEB approved capital structure increases by 100% of the change.

4 Weighted average cost of capital financing OPG's funded rate base and weighted average accretion rate per Ex C1-T1-S1 Table 1 (2012) and Table 2 (2011).

5 Taxes on incremental taxable income calculated by applying: tax rate / (1 - tax rate). Tax rates from Ex. F4-T2-S1 Table 5.

Table 2
Revenue Requirement Impact of Darlington Refurbishment Project ($M)

Line No.	Description	Note or Reference	Test Period Revenue Requirement Impact
			(a)
	PRESCRIBED FACILITIES		
	Return on Rate Base:		
1	**Accretion Rate on Lesser of ARC and UNL**	D2-T2-S1 Table 1, col. (f)	73.2
2	**CWIP in Rate Base Impacts**	D2-T2-S1 Table 1, col. (f)	32.7
3	**Extension to Darlington Service Life Impacts**	D2-T2-S1 Table 1, col. (f)	7.3
4	**Total Return on Rate Base Impact**		113.3
	Depreciation Expense:		
5	**Asset Retirement Costs**	Note 1, C2-T1-S2 Table 4, col. (e)	(181.1)
6	**Extension to Darlington Service Life Impacts**	Note 1, D2-T2-S1 Table 1, col. (b)	(48.5)
7	**Total Depreciation Expense Impact**		(229.6)
	Other Expenses:		
8	**Darlington Refurbishment Project OM&A**	F2-T7-S1 Table 1, line 3, cols. (d), (e)	10.4
9	**Used Fuel Storage and Disposal Variable Expenses**	Note 1, C2-T1-S2 Table 4, col. (e)	8.2
10	**Total Other Expenses**		18.6
	Income Taxes:		
11	**Accretion Rate on Lesser of ARC and UNL**	D2-T2-S1 Table 1, col. (g)	25.3
12	**CWIP in Rate Base Impacts**	D2-T2-S1 Table 1, col. (g)	5.2
13	**Extension to Darlington Service Life Impacts**	D2-T2-S1 Table 1, col. (g)	1.2
14	**Depreciation Expense on Asset Retirement Costs**	Note 1	(62.8)
15	**Used Fuel Storage and Disposal Variable Expenses**	Note 1	2.8
16	**Depreciation Expense on Darlington Service Life**	Note 1	(16.8)
17	**Total Income Tax Impact**		(45.0)
18	**Total Revenue Requirement Impact - Prescribed Facilities**		(142.7)
	(line 4 + line 7 + line 10 + line 17)		
	BRUCE FACILITIES		
19	**Rate Base**		0.0
20	**Depreciation Expense Impact: Asset Retirement Costs**	C2-T1-S2 Table 4, col. (e)	(40.2)
	Other Expenses:		
21	**Accretion**	C2-T1-S2 Table 4, col. (e)	(18.3)
22	**Used Fuel Storage and Disposal Variable Expenses**	C2-T1-S2 Table 4, col. (e)	4.2
23	**Total Other Expenses Impact**		(14.1)
	Income Taxes:		
24	**Impact on Bruce Facilities' Income Tax Calculation**	Note 2, Note 3, Note 4	13.9
25	**Impact on Prescribed Facilities' Income Tax Calculation**	Note 5	(14.0)
26	**Total Income Tax Impact**		(0.1)
27	**Total Revenue Requirement Impact - Bruce Facilities**		(54.4)
	(line 19 + line 20 + line 23 + line 26)		
28	**Total Revenue Requirement Impact of Darlington Refurbishment Project**		(197.1)
	(line 18 + line 27)		

Notes:

1 Amounts impact regulatory income taxes as they represent non-deductible expenses for regulatory tax purposes. Regulatory income taxes are determined using the pre-tax non-deductible expense x tax rate / (1 - tax rate). The tax rate is 25.75%, which is the average of the 2011 and 2012 tax rates as per Ex. F4-T2-S1 Table 5, line 31.

2 Current Income Tax:
Depreciation, Accretion and Used Fuel Storage and Disposal Variable Expenses are not deductible for tax purposes. In determining taxable income for Bruce, the increase in Bruce earnings before tax is reduced by the non-deductible expenses; therefore there is no current tax impact.

3 Future Income Taxes:
The non-deductible expenses represent temporary timing differences. The increase in net revenues resulting from these temporary timing differences will be taxed in the future. In accordance with GAAP, that increase in future tax is recognized in the test period.

4 Tax Rate For Future Income Taxes:
The tax rate applicable to Depreciation Expense is 25.75%, which is the average of the current tax rate for 2011 and 2012 as per Ex. G2-T2-S1 Table 7, Line 34. The tax rate of 25.00% applicable to Other Expenses is the average of the long-term tax rates for 2011 and 2012 as per Ex. G2-T2-S1, Table 7, Line 38.

5 Impact on Prescribed Facilities' Income Tax Calculation:
Changes in Bruce Lease Net Revenues impact regulatory earnings before tax and, therefore, regulatory taxable income of the prescribed facilities, as presented in Ex. F4-T2-S1 Table 5. The impact on prescribed facilities' income taxes is determined as: (line 19 + line 20 + line 23 + line 24) x tax rate / (1- tax rate).
The tax rate is 25.75%, which is the average of the 2011 and 2012 tax rates as per Ex. F4-T2-S1 Table 5, line 31.

Numbers may not add due to rounding.

Table 3
Capital Expenditures Summary - Nuclear Generation Development Projects ($M)

Line No.	Description	2007 Actual	2008 Actual	2009 Actual	2010 Budget	2011 Plan	2012 Plan
		(a)	(b)	(c)	(d)	(e)	(f)
	Darlington Refurbishment						
1	**Darlington Refurbishment Project - Definition Phase**	0.0	0.0	0.0	44.4	42.2	149.2
2	**Darlington Campus Master Plan**	0.0	0.0	1.0	28.6	63.0	106.6
3	**Total Darlington Refurbishment**	0.0	0.0	1.0	72.9	105.2	255.8
4	**Darlington New Nuclear Project**	0.0	0.0	0.0	0.0	0.0	0.0
5	**Total Generation Development Capital**	0.0	0.0	1.0	72.9	105.2	255.8

DARLINGTON REFURBISHMENT CONSTRUCTION WORK IN PROGRESS IN RATE BASE

1.0 PURPOSE

This evidence provides a description of the proposed regulatory treatment of construction work in progress ("CWIP") associated with OPG's Darlington Refurbishment project.

2.0 OVERVIEW

OPG seeks approval to include CWIP in rate base for the Darlington Refurbishment project, effective March 1, 2011. This proposal to include CWIP in rate base for the Darlington Refurbishment project results in rate base being $125.5M higher in 2011 and 306.0M higher in 2012 as shown in Ex. B3-T1-S1 Table 1 and has a test period impact of $37.9on the nuclear revenue requirement. Additional information on this project is provided in Ex. D2-T2-S1.

Section 3 of this exhibit provides the background and context for OPG's proposal to include CWIP in rate base for the Darlington Refurbishment project. Section 4 presents the proposed regulatory treatment and its impact. Section 5 discusses OPG's proposal for performance monitoring and reporting requirements.

This proposal is also supported in a study by Charles River Associates. The Charles River Study provides information on other North American jurisdictions and regulators that have adopted CWIP in rate base and the benefits that these jurisdictions saw flowing from its adoption. It also assesses the common arguments for and against the use of this methodology. The study, which concludes that CWIP in rate base should be adopted in Ontario for large-capital, multi-year projects, is provided as Ex. D4-T1-S1.

3.0 BACKGROUND

On April 3, 2009, the Chair of the OEB issued a statement initiating a consultation process to consider amendments to several existing regulatory constructs with the goal of removing barriers to infrastructure investment in Ontario. In his Statement dated April 3, the Chair indicated:

> The magnitude of current and future utility infrastructure investment has led me to consider how the OEB could create conditions which would foster timely investment by utilities in required infrastructure.

This was followed up with a second Statement from the Chair, a Staff Discussion Paper and stakeholder submissions. On January 15, 2010, the OEB issued EB-2009-0152, a Report of the Board on The Regulatory Treatment of Infrastructure Investment in connection with Rate-regulated Activities of Distributors and Transmitters in Ontario (the "Report"). The Report indicates that the OEB will consider, among other things, applications to include CWIP in rate base on a case-by-case basis, in advance of a project being declared in-service. As concluded in the Report, inclusion of CWIP in rate base is consistent with the Chair's stated objective above and is an important mechanism that is widely used to reduce barriers to investment by utilities[1].

The Report, on page 6, defined CWIP in rate base to be a mechanism that would "…allow CWIP to be included in rate base prior to the asset coming into service, thereby allowing the applicant to recover the carrying cost on the capital investment, typically interest costs on debt and a return on the investment." CWIP is defined in the Report as a temporary holding account that captures the expended costs incurred in the design and construction of facilities that meet general capitalization rules and thresholds.

On page 15 on the Report, the OEB explains how the CWIP in a rate base model would work indicating that it would "…allow utilities to apply to include up to 100 percent of prudently incurred CWIP costs in rate base. This approach allows utilities to recover the interest costs on debt and a return on equity (i.e. the weighted cost of capital) during the construction period. The depreciation or return of investment will continue to be recovered once the project goes into service." OPG is proposing to adopt the CWIP in rate base model described above for its Darlington Refurbishment project.

OPG engaged Charles River Associates to generally consider the question of the inclusion of CWIP in rate base. In response, Charles River has provided a study that describes the other North American jurisdictions and regulators that have adopted CWIP in rate base and the

[1] See Exhibit D4-T1-S1 for a discussion of the inclusion of CWIP in rate base in other jurisdictions.

benefits that these jurisdictions saw or expect from its adoption. It also assesses the common arguments for and against the use of this methodology. The study, which concludes that CWIP in rate base should be adopted in Ontario for large-capital, multi-year projects, is provided as Ex. D4-T1-S1.

4.0 PROPOSED REGULATORY TREATMENT

Inclusion of CWIP in rate base for the Darlington Refurbishment project is warranted since it meets the criteria for qualifying investments specified by the OEB in its Report. The project spans a number of years, has material costs associated with it (i.e., it is capital intensive) and it will form a significant portion of OPG's rate base once placed into service. Moreover, the risks of the project are similar to those noted by the OEB for green energy projects, which include risks related to project delays, public controversy, and the recovery of costs. Additional details on these criteria are provided below.

OPG proposes to include the capital costs of the Darlington Refurbishment project in rate base during the construction period consistent with the methodology approved in the OEB's Report. The test period opening balance would include capital costs from January 1, 2010, the point at which project costs began to be capitalized. Additions to rate base over the test period would be based on OPG's capital expenditure forecast for the Darlington Refurbishment project as provided in Ex. D2-T2-S1. OPG proposes that 100 per cent of the forecast capital in rate base receive the OEB-approved weighted average cost of capital ("WACC") and that any recovery of depreciation on this capital be deferred until the assets come into service. Differences between forecast and actual expenditures for the Darlington Refurbishment project will be recorded in the existing Capacity Refurbishment Variance Account as described in Ex H1-T1-S1 section 6.5. This will ensure that both ratepayers and OPG are protected if actual project spending differs from forecast. As with all variance accounts, any disposition from this account would require a review and approval by the OEB.

As detailed in Ex. D2-T2-S1, the project is currently starting its definition phase. Work addressed within this phase includes detailed engineering and front-end project planning, including the development of the project cost and schedule baseline. The forecast of capital spending on the

project and the specific revenue requirement impacts that flow from this project are explained in the exhibit.

On page 15 of the Report, the OEB indicates that it will also allow utilities to apply to expense prudently incurred pre-commercial costs. The Report goes on to provide examples of these costs, including preliminary surveys, plans and investigations made for the purpose of determining the feasibility of projects. OPG would have incurred some of these costs prior to January 1, 2010 when costs for the project began to be capitalised. To the extent that there are variances between the actual costs for these activities and the costs included in the current payment amounts these differences would also be captured in the existing Capacity Refurbishment Variance Account. OPG's Darlington Refurbishment project has now progressed to the definition phase, and accordingly, essentially all of the costs attributable to the project in the test period will be capitalized.

In section 3.4 of the Report, the OEB sets out a number of factors that it will evaluate within the context of considering a proposal for alternative regulatory mechanisms. These factors include:

- The need for the project
- The public interest benefits of the project
- The overall cost of the project in absolute terms
- The risks or particular challenges associated with the completion of the project
- The cost of the project in proportion to the current rate base of the utility
- The reasons given for not relying on conventional cost recovery mechanisms
- Whether the utility is otherwise obligated to undertake the project

The first four factors above are covered within Exhibit D2-T2-S1 and its associated attachments. The last three are addressed below.

4.1 Costs of the Project in Relation to Current Rate Base

As indicated in Ex. D2-T2-S1, at this preliminary stage the projected cost of the Darlington Refurbishment project is between the "low" bounding case of $6B and the "high" bounding case of $10B (2009 dollars). OPG's nuclear rate base in 2012 is approximately $4.0B as set out in Ex.

B1-T1-S1 Table 2. It is clear that the capital expenditures associated with the Darlington Refurbishment project are significant within the context of OPG's nuclear rate base. Even in comparison to OPG's combined regulated hydroelectric and nuclear rate base of approximately $7.8B, the Darlington Refurbishment project is substantial. Clearly the criterion associated with the project being a significant proportion of rate base has been met.

4.2 Reasons for Inclusion of CWIP in Rate Base

As noted in the OEB's Report, including CWIP in rate base provides two principal benefits. First, it provides a smoothing effect on rates and thereby mitigates the rate shock that might otherwise occur when the new plant is placed into service. Second, it can reduce borrowing costs. Both of these benefits are detailed more fully in Ex. D4-T1-S1. These benefits are also discussed in the Charles River Study. Both of these benefits apply in the case of the Darlington Refurbishment project.

4.2.1 Impact on Rates during Test Period

One of the primary benefits of including CWIP in rate base is that it avoids potential rate shock and provides a smoothing of rates over time (see Ex. D4-T1-S1, section 3.1). Implicitly, this means that rates will increase gradually during the construction period consistent with the amount of expended CWIP capital that is included in rate base. This gradual increase mitigates the sudden shock that is typically associated with a multi-year project being completed and added to rate base as a single, large quantity. Capitalization of the Darlington Refurbishment project began on January 1, 2010, the first unit is scheduled to be removed from service in 2016 and the last unit is scheduled to be returned to service in 2024.

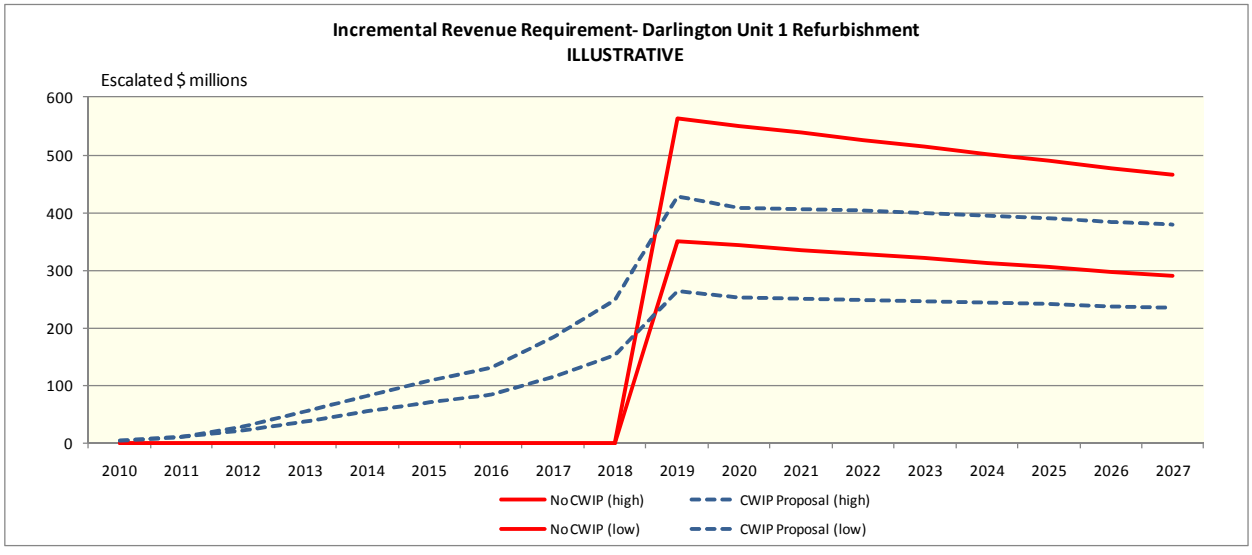
Table 1 in Ex. D2-T2-S2 and the graphs below illustrate the projected rate impact of including CWIP in rates over the 2011/12 test period, and beyond for the Darlington Refurbishment project. The information beyond the current test period is illustrative only, as elements of the project scope, schedule and cost will only be fully defined at the conclusion of the project's definition phase. It is also important to consider when assessing the analysis of rate impacts provided below that this analysis looks solely at the rate impact of the Darlington Refurbishment

project. As with other utilities, OPG would be expected to have numerous other costs pressures during the project period that would also serve to increase rates.

Table 1 indicates that, over the test period, inclusion of CWIP associated with the Darlington Refurbishment project within rate base results in a modest impact of $0.37/MWh on the nuclear payment amount. Further, graphs 1 and 2 below show an illustrative view of the incremental revenue requirement associated with the project in both a situation where conventional regulatory approaches are used and in the situation where CWIP is allowed in rate base in advance of project in-service.

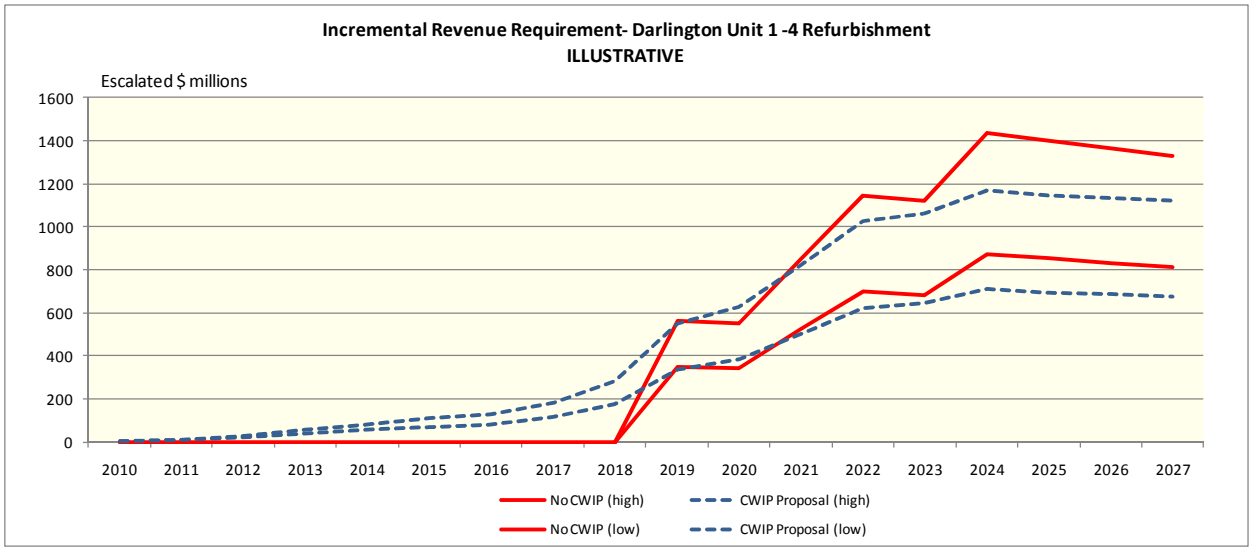
As expected, early recovery of refurbishment costs leads to smaller and more gradual rate increases compared to the rate shock associated with the traditional regulatory approach. Furthermore, there is a lasting benefit of lower rates post in-service date. In the illustrative analysis shown below in Graph 1 (First Darlington Unit), the rate shock associated with the traditional methodology of 2.5 per cent - 4.1 per cent at the in-service date is smoothed to an overall 2.0 per cent - 3.2 per cent rate increase spread over 10 years, with a maximum increase of 0.6 per cent – 1.0 per cent in 2019.

Graph 1
First Darlington Unit



Graph 2 below extends the illustrative analysis to the refurbishment of all four units at Darlington. The traditional regulatory approach leads to four separate rate shocks (2019, 2021, 2022, and 2024) leading to an overall 5.8 per cent - 9.5 per cent rate increase by 2024, the in-service date of the last refurbished unit. The CWIP in rate base proposal smoothes this to an overall 4.9 per cent - 8.4 per cent rate increase, spread over 2010 to 2024, with a maximum annual increase of 1.0 per cent - 1.6 per cent occurring in 2019.

Graph 2
All 4 Darlington Units



All the values shown above are consistent with the project information provided in Ex. D2-T2-S1.

These illustrative graphs demonstrate that inclusion of CWIP in rate base allows the regulator to phase-in the effects of a major capital project. Not only is the rate impact smoothed, but the overall increase is lower as a result of financing charges being recovered as the project is being constructed, as opposed to the typical approach where interest compounds until the project is placed in service.

As the National Regulatory Research Institute has noted: “Sudden jumps in rates for a commodity product produced through large fixed costs with long lives make customers sceptical

of the sellers and the regulators. Methods of pre-approval and cost recovery that give weight to gradualism without distorting economic efficiency deserve regulatory attention."[2] CWIP in rate base mitigates such "jumps in rates" while maintaining the same regulatory oversight of, and utility decision process for, investing in new assets.

4.2.2 Information on Project Financing

OPG has not yet determined the project financing specifics associated with the Darlington Refurbishment project. Regardless of those specifics, the inclusion of CWIP in rate base will serve to reduce borrowing costs for the utility. An entity's ability to access financing will be evaluated based on the risks that they face, including the degree of financial leverage and its standing on a number of standard financial risk metrics (e.g., interest coverage ratios).

In Ex. A2-T3-S1, both of the rating agencies that assess OPG (Standard and Poors and DBRS) rated OPG's long-term credit rating in the low "A" range. Both agencies referenced OPG's nuclear program and Standard and Poors specifically referenced weak cash flow metrics. Clearly, inclusion of CWIP in rate base would help these ratings, and lower overall financing costs. In fact, since no allowance has been made for achieving lower financing costs, it could be said that OPG's illustrative information presented in section 4.2.1 has an added level of conservatism.

Inclusion of CWIP in rate base is seen by financing entities as a mitigating factor when evaluating the risk of a given project, thereby facilitating access to capital at reasonable interest rates. Further, a utility's credit rating, as assessed by rating agencies, can be affected by such considerations. Fitch Ratings notes in a discussion of nuclear plant construction financing: "Like any other large capital program, Fitch assesses the capital requirements of a nuclear construction program relative to the available financial resources to determine the effect on credit quality. Fitch also considers whether regulatory support, non-resource financing, federal loan guarantees or fixed-price construction contracts are available to reduce construction risk. *For*

[2] "Pre-Approval Commitments: When and Under What Conditions Should Regulators Commit Ratepayer Dollars to Utility-Proposed Capital Projects," National Regulatory Research Institute, November 2008.

regulated U.S. utilities, the availability of a cash return on construction work in progress (CWIP) would reduce the construction risk."[3]

In recognition of the general positive benefit created by the inclusion of CWIP in rate base (associated with the easing of project financing costs), OPG has calculated its forecast interest coverage ratios for 2011 and 2012 for both the traditional regulatory approach and for the approach whereby CWIP is included in rate base. The average improvement over the two-year test period is approximately 1.5 per cent under the alternative regulatory approach. Not surprisingly, this percentage will increase over subsequent test periods, as more capital is expended.

4.2.3 Obligation to Undertake the Project

As indicated in Ex. D2-T2-S1, OPG received direction from the Province requiring OPG to undertake feasibility studies on refurbishing its existing nuclear units in 2007. Further, on February 4, 2010, the Province affirmed the November 2009 decision of OPG's Board of Directors to proceed with the definition phase of the project. See Ex. D2-T2-S1 for a full discussion of the project.

4.3 Performance and Reporting Conditions

OPG expects to be before the OEB for several payment amount applications between this application and the ultimate completion of the Darlington Refurbishment project. Accordingly, it will provide regular updates on project scope, schedule and progress, any variances against budget, and a forecast of future expenditures. As part of these applications, OPG will provide information in both its capital exhibits and make annual entries to the Capacity Refurbishment Variance Account, as detailed in Ex. H1-T1-S1 section 6.5, which will account for all capital over or under spend associated with the project. This variance account approach will permit OPG to true up its capital expenses to actual values, as determined by the OEB.

[3] Fitch Ratings, U.S. Nuclear Power: Credit Implications, November 2, 2006. Emphasis added.

Since OPG uses a two-year test period, for years in which it does not file an application for payment amounts, OPG proposes to provide to the OEB an annual monitoring report, indicating project status.

Because of the staged approach to this project (i.e., beginning the definition phase, which is scheduled to last until 2014), OPG expects to be in a position to provide the OEB with a more comprehensive assessment of the project scope, cost and schedule as part of its next application for payment amounts.

Numbers may not add due to rounding.

Table 1
Revenue Requirement and Rate Impact of Inclusion of CWIP in Rate Base ($M)
Years Ending December 31, 2010, 2011 and 2012

Line No.	Prescribed Facility	Gross Plant Opening Balance[1]	Net Change[1]	(a)+(b) Closing Balance[1]	((a)+(c))/2 Gross Plant Rate Base Amount	Carrying Charges[2]	(d) x (e) Pretax Revenue Requirement	Income Tax[3]	(f)+(g) Revenue Requirement Impact
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	2010 Budget:								
1	**Darlington Refurbishment CWIP**	0.0	0.0	0.0	0.0	3.94%	0.0	0.0	0.0
	2011 Plan:								
2	**Darlington Refurbishment CWIP**	72.9	105.2	178.1	125.5	7.56%	9.5	1.6	11.1
	2012 Plan:								
3	**Darlington Refurbishment CWIP**	178.1	255.8	433.9	306.0	7.59%	23.2	3.6	26.8
4	**Total** (line 1 + line 2 + line 3)						32.7	5.2	37.9
5	**Total Nuclear Test Period Production[4] (TWh)**								98.9
6	**Rate Impact ($/MWh)** (line 4 / line 5)								0.38

Notes:

1 From Ex. B3-T3-S1 Table 2.

2 Carrying charges at weighted average cost of capital financing OPG's funded rate base. Ex C1-T1-S1, Table 1 (2012), Table 2 (2011) and Table 3 (2010).

3 Taxes on incremental earnings after interest: Pretax Revenue Requirement x 47% common equity ratio x tax rate / (1 - tax rate). Tax rates from Ex. F4-T2-S1 Table 5.

4 From Ex. E2-T1-S1 Table 1.