CAPITAL EXPENDITURES – REGULATED HYDROELECTRIC

1.0 PURPOSE

This evidence provides an overview of the capital expenditures for OPG's regulated hydroelectric facilities and for Renewable Generation assets that support both the regulated and unregulated business ("Hydro Common") for the historical years (2016-2024), bridge years (2025-2026), and forecast period (2027-2031). Term-over-term explanations are also included in this exhibit.

Consistent with the OEB's letter dated September 17, 2024, issued in EB-2024-0136, OPG has included nine years of historical data for its regulated hydroelectric business below, for the period 2016-2024. As there is no OEB-approved capital project information for 2015 onwards, OPG has only provided term-over-term variance analyses for the following periods: 2017-2021 actuals versus 2022-2026,[1] and 2022-2026[2] versus 2027-2031 (plan).

2.0 OVERVIEW

OPG is planning increased capital investment during the forecast period to address the conditions of aging assets within its regulated hydroelectric fleet. The average age of OPG's regulated hydroelectric stations is approximately 90 years (ranging from 2-127 years).[3] Sustaining regulated hydroelectric assets, maintaining reliable operations, and increasing unit capacity where appropriate support meeting the province's overall net-energy projected growth in demand of 65% by 2050, as discussed in Ex. F1-1-1.

As shown in Chart 1, OPG's capital expenditures in support of its regulated hydroelectric facilities are forecasted to total $4,774.0M for the forecast period: $880.9M, $920.4M, $1,025.0M, $1,001.2M, and $946.6M in 2027, 2028, 2029, 2030, and 2031, respectively. Details are provided in Section 3.0.

[1] 2022-2024 actuals, 2025-2026 forecast.
[2] *Ibid*.
[3] Station specific details are provided in Ex. A1-4-2.

Chart 1 – Regulated Hydroelectric and Hydro Common Capital Expenditures ($M)

Line No.	Category[4]	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan	2027-2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)
	Project Portfolio						
1	**Niagara Region**	44.6	49.4	65.5	71.0	26.0	256.5
2	**Eastern Region**	172.2	195.7	127.4	135.7	143.4	774.4
3	**Western Region**	64.4	87.6	110.5	125.7	162.2	550.5
4	**Total Project Portfolio**	281.2	332.8	303.4	332.3	331.6	1,581.3
5	**Refurbishments**	408.6	486.6	427.1	465.6	405.8	2,193.6
6	**Redevelopments**	156.9	18.1	1.0	0	0	176.0
7	**Sir Adam Beck 1 GS Canal Rehabilitation**	18.3	20.8	134.1	1.5	0	174.7
8	**Expansion Projects**	3.9	6.2	25.9	34.5	28.0	98.4
9	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program**	10.5	54.3	131.9	165.7	179.5	541.9
10	**Minor Fixed Assets**	1.5	1.6	1.6	1.7	1.7	8.0
11	**Total Regulated Hydroelectric Expenditures**	880.9	920.4	1,025.0	1,001.2	946.6	4,774.0
12	**Total Hydro Common Capital Expenditures**	35.9	20.1	16.6	7.9	0	80.4

As a result of these and prior capital expenditures, OPG is requesting that the OEB approve forecasted rate base in-service additions for its regulated hydroelectric facilities of $841.5M in 2027. As discussed in Ex. A1-3-2, the Application proposes to set regulated hydroelectric payment amounts using a price-cap index custom IR framework, inclusive of a custom capital factor designed to recover incremental revenue each year necessary to support incremental capital investments required over the forecast period. The calculation of the custom capital

[4] Totals of allocated and unallocated amounts from Ex. D1-1-1, Table 2.

factor uses the following rate base amounts for 2028-2031: $1,104.7M, $1,115.5M, $938.5M, and $627.1M in 2028, 2029, 2030, and 2031, respectively, as presented in Ex. D1-1-2, Table 4.

Hydro Common projects are discussed in Section 6.0.

3.0 CAPITAL EXPENDITURES

Exhibit D1-1-1, Tables 2, 3, and 4 present the actual and forecasted regulated hydroelectric capital expenditures for the period 2016-2031. These expenditures represent the sum of the following, as categorized in these tables:

- **Portfolio Projects:** Project portfolios are developed and tailored to ensure the safety and reliability of OPG's assets, meet regulatory requirements, sustain or optimize unit/station generation, or address issues of obsolescence. The regulated hydroelectric project portfolio primarily consists of sustaining investments supporting the continued operation and reliability of the hydroelectric generating fleet. Major scopes of work include concrete rehabilitation, electrical and protection and controls upgrades, cranes and lifting devices, hoist and gate upgrades, and building/infrastructure investments. For more information on portfolio projects, refer to Ex. F1-1-1, Section 3.2.3.
- **Non-Portfolio Projects:** Non-portfolio capital expenditures for regulated hydroelectric facilities are organized as either standalone portfolios for significant investment programs covering a number of facilities, or as extraordinary projects for specific facilities, and are managed separately from the capital portfolio budget. The reasons for treating a program/project as non-portfolio include a program's or project's size relative to the overall portfolio whereby both the non-portfolio program/project and the portfolio budgets are more effectively managed separately. The non-portfolio investments over the forecast period include turbine-generator refurbishment program, station redevelopment projects, expansion projects, other special projects, and Minor Fixed Assets ("MFA").
    - **Turbine-Generator Refurbishment Projects:** Turbine-generator refurbishment projects are capital investments aimed at extending the lifespan of turbine-generator equipment. Refurbishment projects may include technological improvements that increase unit capacity. Overhaul projects, often performed in parallel with refurbishment

projects, involve OM&A maintenance to support continued reliable operations of turbine-generator equipment and related systems.

OPG plans to invest $2,193.7M to complete 53 turbine-generator refurbishment projects between 2027-2031, including three unit refurbishment projects at Sir Adam Beck 1 GS, four units at Sir Adam Beck 2 GS, and three units at R.H. Saunders GS. The refurbishment work planned during the forecast period is expected to sustain over 1,500 MW of existing generating capacity as well as add approximately 50 MW of incremental capacity to OPG's regulated hydroelectric fleet. Refer to Ex. F1-1-1, Section 3.2.1 for more information on the turbine-generator refurbishment program.

- **Station Redevelopment Projects:** Redevelopment projects extend operations for stations that are at or near end-of-life. This includes the replacement of a significant portion of the generating station equipment, which may also include the replacement of existing civil infrastructure. The benefits of redevelopment projects include increased capacity, production, reliability, and improved operability. OPG plans to invest $176.0M during the forecast period to complete the redevelopment of stations at or nearing end of life to extend operations. Redevelopment projects are currently being progressed at Matabitchuan GS, Kakabeka GS, Coniston GS, Stinson GS, and Bingham Chute GS. Refer to Ex. F1-1-1, Section 3.2.2 for more information on station redevelopment projects. Project-specific details are provided in Ex. D1-1-2, Section 3.2.2.
- **Expansion Projects:** These projects add generation in the form of new units to existing hydroelectric facilities. Unit additions were recently completed at Sir Adam Beck 1 GS and Ranney Falls GS. OPG is currently planning for a unit addition at Chats Falls GS. Refer to Ex. F1-1-1, Section 3.2.6 for more information on regulated hydroelectric expansion projects.
- **Sir Adam Beck 1 GS Canal Rehabilitation:** This investment aims to restore the structural integrity of the Sir Adam Beck 1 GS power canal, which supplies water from the Welland River and Niagara River to the Sir Adam Beck generating stations. The canal has experienced degradation of the structural integrity of the liner, as well as debris accumulation and vegetation growth over its 100+ years of service. This multi-project effort is expected to restore the integrity of the water conveyance structure

supplying water to Sir Adam Beck 1 GS, Sir Adam Beck 2 GS, and Sir Adam Beck Pump GS. During the forecast period, OPG intends to complete preparatory work to provide the capability to isolate and drain the canal to facilitate future rehabilitation of the canal liner and associated structures. Further information on the allocated projects associated with this rehabilitation is provided in Ex. D1-1-2, Section 3.2.4.

- **Abitibi Canyon GS Concrete and Sluiceway Rehabilitation:** This investment aims to restore the integrity of various structures at Abitibi Canyon GS. Several concrete structures, including the main gravity dam upstream and downstream faces of the dam, have deteriorated since the station originally came into service in 1933, with incidents of surface spalling, scaling, cracking, staining and delamination. In addition, the sluiceway system, including the sluicegates, gains, hoists and superstructure, is experiencing operational issues driven by aging and structural deterioration. During the forecast period, OPG intends to rehabilitate the upstream and downstream faces to extend the life of the structures and mitigate the equipment risks posed by dislodged concrete, as well as rehabilitate the sluiceway system to ensure reliability and availability for operation. Refer to Ex. D1-1-2, Section 3.2.5 for more information on the allocated Tier 1 projects involved in this work.
- **Minor Fixed Assets:** These are capitalized expenditures on portable assets used in the regulated hydroelectric facilities. Examples of MFA include material handling equipment or sophisticated testing equipment. MFA must meet a materiality of $25k per item to be capitalized (see Ex. D4-1-1, Section 2.0 for more information).

Project categories are further subdivided in the tables as follows:

- Allocated projects are those in the planning, execution, or closeout phases (refer to Ex. D2-1-1, Section 3.1) and have an approved Business Case Summary (“BCS”). The approved BCS for these projects can vary from a very preliminary development estimate (e.g., Class 5 estimate) to an Execution BCS (e.g., Class 3 or better estimate).
- Unallocated projects are those in the project identification or initiation phase (as described in Ex. D2-1-1, Section 3.2). Unallocated amounts reflect the difference between the total approved capital budget and the amount of capital allocated to projects in the respective category. The unallocated amount can be positive or negative:

- When positive, the unallocated amount represents the amount of approved capital and reflected in OPG's approved Business Plan that remains available to undertake projects currently at the project identification or initiation phases, until those projects move forward with an approved budget and BCS. Due to the volume of regulated hydroelectric projects projected to be under $10M, OPG has provided the list of unallocated Tier 1 (>$30M) and Tier 2 ($10M-$30M) projects in Ex. D1-1-2, Tables 5a and 5b. OPG expects that during the forecast period some of these projects (or other projects yet to be identified) will move from the project identification and initiation phases into the project planning and execution phase as part of the ongoing portfolio management process (Ex. D2-1-1, Section 3.1).
- When negative, this represents an adjustment as the approved budget is oversubscribed (i.e., there are more projects with approved BCSs than approved funding). OPG manages its project portfolios to maintain annual capital expenditures at the level of approved funding set through the business planning process.

All projects, both allocated and unallocated, have been reviewed and approved to be entered into OPG's business plan in alignment with its asset management and investment planning processes (Ex. D2-1-1, Section 3.2).

Further details on Tier 1 capital projects are provided in Ex. D1-1-2.

4.0 TERM-OVER-TERM CHANGES: 2027-2031 VERSUS 2022-2026 – REGULATED HYDROELECTRIC

During the 2027-2031 period, OPG's forecasted regulated hydroelectric capital expenditures are $4,774.0M, an increase of $1,835.6M from the previous five-year period's expenditures of $2,938.4M between 2022-2026 (2025 and 2026 being forecast). The increase in capital expenditures is mainly due the following:

- An increase for portfolio projects of +$329.9M
- An increase for refurbishment projects of +$1,387.1M
- A decrease for redevelopment projects of +$608.9M
- An increase for expansion projects of +$75.5M

- An increase for the Sir Adam Beck 1 GS Canal Rehabilitation program of +$163.3M
- An increase for the Abitibi Canyon GS Concrete and Sluiceway Rehabilitation program of +$489.7M.

Term-over-term variances between the 2022-2026 and 2027-2031 terms are presented in Ex. D1-1-1, Table 4.

4.1 Portfolio Projects

During the forecast period, regulated hydroelectric capital portfolio project expenditures (both allocated and unallocated) are forecasted to total $1,581.3M, an increase of $329.9M from the previous period's expenditures of $1,251.4M. This increase is comprised of a decrease in expenditures in Niagara Region (-$20.7M) and increases in expenditures in Eastern Region (+$159.4M) and in Western Region (+$191.2M).

Project-specific details are provided in Ex. D1-1-2, Tables 1, 2a and 2b.

Niagara Region

During the forecast period, capital portfolio project expenditures (both allocated and unallocated) in Niagara Region are forecasted to total $256.5M. This is a decrease of $20.7M from the previous period's expenditure of $277.2M in 2022-2026, reflecting a decrease in concrete-related spending compared to the 2022-2026 period (projects #86491 Sir Adam Beck 2 GS Rock Cliff Concrete Rehabilitation and #87951 Sir Adam Beck 2 GS Penstock Concrete Restoration).

Eastern Region

During the forecast period, capital portfolio project expenditures (both allocated and unallocated) in Eastern Region are forecasted to total $774.4M. This is an increase of $159.4M from the previous period's expenditures of $615.0M in 2022-2026. This increase is primarily driven by capital expenditures forecasted under OPG and NYPA's joint works agreement, including Tier 1 project #86595 R.H. Saunders GS: Long Sault Dam Capital Program. In addition, the forecast period sees increases in expenditures relating to crane replacements,

with powerhouse cranes being replaced at a number of stations including Otto Holden GS (project #89152 Otto Holden GS Powerhouse Crane Replacement, Des Joachims GS (project #87530 Des Joachims GS Powerhouse Crane Replacement), and Abitibi Canyon GS (project and #89078 Abitibi Canyn GS Powerhouse Crane Refurbishment/Replacement).

Western Region

During the forecast period, capital portfolio project expenditures (both allocated and unallocated) in Western Region are forecasted to total $550.5M. This is an increase of $191.2M from the previous period's expenditures of $359.2M in 2022-2026. This increase is driven by large investments in concrete rehabilitation, primarily the dam concrete rehabilitation at Aguasabon GS (project #87217 Aguasabon Dam Rehabilitation: Hayes Lake Main Dam) and the rehabilitation of the spillwall at Alexander GS.

4.2 Turbine-Generator Refurbishment Projects

During the forecast period, capital expenditures (both allocated and unallocated) for turbine-generator refurbishment projects are forecasted to total $2,193.7M, an increase of $1,387.1M from the previous period's expenditures of $806.6M. This increase is primarily driven by the progression of the following Sir Adam Beck 2 GS refurbishment projects through the execution phase:

- Project #87357 Sir Adam Beck 2 GS G14 / G13 Refurbishment
- Project #87356, Sir Adam Beck 2 GS G18 / G17 Refurbishment
- Project #87768 Sir Adam Beck 2 GS G20 / G19 Refurbishment

Other significant projects being executed at OPG's largest capacity regulated hydroelectric generating stations include the following:

- Project #86937 R.H. Saunders GS G16 Refurbishment
- Project #86372 Sir Adam Beck 1 GS G6 / G8 Refurbishment

Refer to Ex. D1-1-2, Section 3.2.1 for more information on these projects.

4.3 Station Redevelopment Projects

During the forecast period, capital expenditures (allocated and unallocated) for redevelopment projects are forecasted to total $176.0M, a decrease of $608.9M from the previous period's expenditures of $784.9M. The majority of OPG's regulated hydroelectric redevelopment projects began execution in the 2022-2026 period, including redevelopments of the Kakabeka GS (project #86386 Kakabeka Falls GS Redevelopment), the Coniston GS and Stinson GS (project #82087 Coniston and Stinson GS Redevelopment), and the Matabitchuan GS (project #86387 Matabitchuan GS Redevelopment). The forecast period reflects expenditures related to the continued execution and closeout of these redevelopment projects; no new redevelopment projects are currently planned for the 2027-2031 period. See Ex. D1-1-2, Table 1 for more information.

4.4 Expansion Projects

During the forecast period, capital expenditures for expansion projects are forecasted to total $98.4M, an increase of $75.5M from the previous period's expenditures of $23.0M. In the forecast period, expansion project expenditures are driven entirely by the planned expansion at Chats Falls GS, which, subject to completing the necessary planning, is assumed to commence execution in 2028 and be completed beyond the forecast period. The 2022-2026 period saw fewer expenditures on expansion projects, with projects #84185 Sir Adam Beck G1/G2 Replacement and #80581 Ranney Falls GS Expansion being executed primarily throughout the 2017-2021 term and completing in 2022 and 2023, respectively. See Ex. D1-1-2, Section 3.2.3 for more information on these projects.

4.5 Sir Adam Beck 1 GS Canal Rehabilitation

During the forecast period, capital expenditures for the Sir Adam Beck 1 GS Canal Rehabilitation effort are forecasted to total $174.7M, an increase of $163.3M from the previous period's expenditure of $11.5M. This increase is driven in part by the rehabilitation of the closure structure (project #89252 SAB1 Canal Isolation Preparedness Phase 1, refer to Ex. D1-1-2, Table 1) progressing from early planning and definition in the 2022-2026 period to preparation for execution in the forecast period and beyond.

4.6 Abitibi Canyon Concrete and Sluiceway Rehabilitation Program

During the forecast period, capital expenditures for the Abitibi Canyon Concrete and Sluiceway Rehabilitation program are forecasted to total $541.9M, an increase of $489.7M from the previous period's expenditures of $52.1M. This increase is driven by the larger expenditures forecasted as part of the sluiceway system rehabilitation later in the forecast period, required in order to address operational issues borne from aging and structural deterioration. See Ex. D1-1-2, Section 3.2.5 for more information on these projects.

5.0 TERM-OVER-TERM CHANGES: EXTENDED HISTORICAL YEARS – REGULATED HYDROELECTRIC

Pursuant to the OEB's letter dated September 17, 2024, issued in EB-2024-0136, OPG has included an additional analysis of term-over-term historical data (2017-2021 versus 2022-2026) for its regulated hydroelectric business below.

During the 2022-2026 term, OPG's regulated hydroelectric capital expenditures is forecasted to total $2,938.4M, an increase of $1,741.2M from the 2017-2021 expenditures of $1,197.2M. The increase in capital expenditures is mainly due to the following:

- An increase in expenditures for portfolio projects of $559.4M
- An increase in expenditures for refurbishment projects of $576.6M
- An increase in expenditures for redevelopment projects of $690.4M
- A decrease in expenditures for expansion projects of $139.9M

Term-over-term variances between the 2017-2021 and 2022-2026 terms are presented in Ex. D1-1-1, Table 4.

5.1 Portfolio Projects

During the 2022-2026 term, regulated hydroelectric capital portfolio project expenditures (both allocated and unallocated) are forecasted to total $1,251.4M, an increase of $559.4M from the 2017-2021 period's expenditures of $692.0M. This increase is comprised of increases in expenditures in Niagara Region (+$165.4M), Eastern Region (+$269.5M), and Western Region (+$124.5M).

Niagara Region

Capital portfolio project expenditures (both allocated and unallocated) in Niagara Region are forecasted to total $277.2M during the 2022-2026 term. This is an increase of $165.4M from the 2017-2021 period's expenditures of $111.8M, primarily reflecting increases due to significant concrete rehabilitation efforts at Sir Adam Beck 2 GS's rock cliff and penstocks (as detailed in Section 4.1) as well as investments in electrical equipment and infrastructure.

Eastern Region

Capital portfolio project expenditures in Eastern Region are forecasted to total $615.0M during the 2022-2026 term. This is an increase of $269.5M from the 2017-2021 period's expenditures of $345.5M. This increase is primarily driven by increased concrete rehabilitation work, including the concrete rehabilitation of the Frederick House Lake Dam (project #83194 Frederick House Lake Dam Rehabilitation) as well as the Wanapitei Control Dam (project #86310 Wanapitei Civil Upgrades) and Zone 7 of the Abitibi Canyon downstream face (project #89505 Abitibi Canyon Concrete Rehabilitation Zone 7).

Western Region

Capital portfolio project expenditures in Western Region are forecasted to total $359.2M during the 2022-2026 term. This is an increase of $124.5M from the 2017-2021 period's expenditures of $234.7M. This increase is primarily driven by increased investments in electrical equipment and infrastructure, such as the replacement of transformers at Cameron Falls GS (project #82390 Cameron Falls T1 & T2 Replacement), the replacement of the main switchgear and protections at Alexander GS (project #82378 Alexander GS Station Switchgear, Protections and Controls), and the replacement of a main output transformer at Manitou Falls GS (project #84436 Manitou Falls MOT T1 Replacement).

5.2 Turbine-Generator Refurbishment Projects

Capital expenditures for turbine-generator refurbishment projects are forecasted to total $806.6M during the 2022-2026 term, an increase of $576.6M from the 2017-2021 term's expenditures of $230.0M. This is driven by an increase in turbine-generator refurbishment activity in the 2022-2026 term relative to the previous period of 2017-2021. During the 2022-

2026 period, refurbishment projects executed at OPG's largest capacity regulated hydroelectric generating stations (R.H. Saunders GS, Sir Adam Beck 1 GS, Sir Adam Beck 2 GS) include:

- R.H. Saunders GS Unit G9 (project #83495 R.H. Saunders GS G9 Refurbishment)
- R.H. Saunders GS Unit G12 (project #86587 R.H Saunders GS G12 Refurbishment)
- R.H. Saunders GS Unit G16 (project #86937 R.H. Saunders GS G16 Refurbishment)
- Sir Adam Beck 1 GS Unit G4 (project #86570 Sir Adam Beck 1 GS G4 Refurbishment)
- Sir Adam Beck 1 GS Units G6 and G8 (project #86372 Sir Adam Beck 1 GS G6 / G8 Refurbishment)
- Sir Adam Beck 2 GS Units G20 and G19 (project #87768 Sir Adam Beck 2 GS G20 / G19 Refurbishment)

In comparison, the 2017-2021 period had two refurbishment projects progress through execution at OPG's largest capacity regulated hydroelectric generating stations:

- Project #82777 Sir Adam Beck 1 GS G5 Upgrade
- Project #80649 Sir Adam Beck 1 GS G10 Upgrade (achieved in-service in June 2017)

For more information on these refurbishment projects, refer to Ex. D1-1-2, Section 3.2.1.

5.3 Station Redevelopment Projects

Capital expenditures for redevelopment projects are forecasted to total $784.9M during the 2022-2026 term, an increase of $690.4M from the 2017-2021 term's expenditure of $94.5M. A number of redevelopment projects began execution in the 2022-2026 period, including redevelopments of the Kakabeka GS (project #86386 Kakabeka Falls GS Redevelopment), the Coniston GS and Stinson GS (project #82087 Coniston and Stinson GS Redevelopment), and the Matabitchuan GS (project #86387 Matabitchuan GS Redevelopment). For more information on these projects, refer to Ex. D1-1-2, Section 3.2.2.

5.4 Expansion Projects

Capital expenditures for expansion projects are forecasted to total $23.0M in 2022-2026, a decrease of $139.9M from the 2017-2021 term's expenditures of $162.9M. The bulk of the project scope for expansion projects (including project #84185 Sir Adam Beck 1 GS G1 / G2 Replacement and project #80581 Ranney Falls Expansion) was progressed in the 2017-2021 period. No new expansion projects are forecast to enter execution in the 2022-2026 term. For more information on these projects, refer to Ex. D1-1-2, Section 3.2.3.

6.0 HYDRO COMMON PROJECTS

This section provides term-over-term comparisons of capital expenditures for Hydro Common projects. Capital expenditures for these projects are presented in Ex. D1-1-1, Tables 1-4.

"Hydro Common" refers to projects for assets that support OPG's regulated and unregulated Renewable Generation assets. These capital expenditures investments consist primarily of projects related to information technology, real estate, or other joint-use assets within the hydroelectric portfolio (such as dams or water control structures supporting both regulated and unregulated generating stations). Hydro Common assets form part of the asset service fees charged to the regulated hydroelectric facilities, as discussed in Ex. F3-2-1. Project-specific details for Tier 1 Hydro Common projects are provided in Ex. D1-1-2, Section 6.1.

6.1 Term-over-Term Changes: 2027-2031 vs. 2022-2026 – Hydro Common

During the forecast period, capital expenditures for Hydro Common projects are forecast to total $80.4M. This is very close to the previous period's expenditures of $79.1M in 2022-2026. Capital expenditures in the forecast period are primarily due to the Timmins Building Expansion and Dymond Machine Shop Expansion projects (#87197 and #87329, respectively), which are forecasted to achieve in-service early in this period.

6.2 Term-over-Term Changes: Extended Historical Years – Hydro Common

During the 2022-2026 period, capital expenditures for Hydro Common projects are forecasted to total $79.1M, an increase of $67.8M from the previous period's expenditures of $11.3M in 2017-2021. This increase is primarily driven by the commencement of Tier 1 projects #87197

Timmins Building Expansion and #87329 Dymond Machine Shop Expansion, as well as their progression into execution.

Numbers may not add due to rounding.

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Exhibit D1
Tab 1
Schedule 1
Table 1

Table 1

Capital Expenditures Summary - Regulated Hydroelectric and Hydro Common[1] ($M)

Line No.	Category	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
1	**Total Regulated Hydroelectric Capital**	127.5	147.2	168.0	205.1	289.0	388.0	314.8	371.0	433.0	835.4	984.2
2	**Total Hydro Common Capital[1]**	3.5	0.2	1.1	2.3	3.2	4.5	5.1	10.3	8.6	21.0	34.1

Line No.	Category	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)
3	**Total Regulated Hydroelectric Capital**	880.9	920.4	1,025.0	1,001.2	946.6
4	**Total Hydro Common Capital[1]**	35.9	20.1	16.6	7.9	0.0

Notes:

1 Hydro Common refers to projects for assets that support OPG's regulated and unregulated Renewable Generation assets (see Ex. D1-1-1, Section 6.0). Costs associated with these projects are total project costs, and are charged to the regulated business using the asset service fee methodology described in Ex. F3-2-1.

Numbers may not add due to rounding.

Table 2

Capital Expenditures Summary - Regulated Hydroelectric and Hydro Common ($M)

Line No.	Prescribed Facility Category[1]	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Portfolio Projects (Allocated)											
1	**Niagara Region**	47.6	20.1	21.7	20.0	18.1	31.9	38.5	69.8	53.3	84.0	50.2
2	**Eastern Region**	37.1	45.1	70.6	71.6	68.4	89.8	82.1	108.6	117.5	143.5	140.8
3	**Western Region**	10.9	17.7	20.2	51.3	66.2	79.4	56.3	64.7	74.9	70.9	101.5
4	**Subtotal Portfolio Projects (Allocated)**	95.6	82.9	112.5	142.8	152.7	201.1	176.9	243.1	245.7	298.3	292.5
	Portfolio Projects (Unallocated)											
5	**Niagara Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	(22.1)
6	**Eastern Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	20.4
7	**Western Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	(10.8)
8	**Subtotal Portfolio Projects (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	(12.5)
9	**Subtotal Project Capital (Portfolio)**	95.6	82.9	112.5	142.8	152.7	201.1	176.9	243.1	245.7	305.6	280.0
10	**Refurbishments (Allocated)**	29.7	34.8	18.3	27.0	66.8	83.1	50.9	92.8	106.6	212.1	325.9
11	**Refurbishments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	13.5
12	**Redevelopments (Allocated)**	0.0	0.7	2.1	4.5	25.2	62.0	65.1	27.4	53.4	283.4	355.6
13	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	**Sir Adam Beck 1 GS Canal Rehabilitation[2]**	0.0	2.8	2.5	2.5	4.6	0.1	(0.0)	(0.1)	0.4	6.6	4.6
15	**Expansion Projects[2,3]**	2.0	25.4	31.6	27.2	38.5	40.2	20.6	1.3	0.0	0.0	1.1
16	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program[2]**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	25.2	19.7	2.1
17	**Minor Fixed Assets**	0.2	0.7	1.0	1.1	1.1	1.5	1.3	1.4	1.6	3.2	1.5
18	**Total Regulated Hydroelectric Capital**	127.5	147.2	168.0	205.1	289.0	388.0	314.8	371.0	433.0	835.4	984.2
19	**Total Hydro Common Capital**	3.5	0.2	1.1	2.3	3.2	4.5	5.1	10.3	8.6	21.0	34.1

Line No.	Prescribed Facility Category[1]	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)
	Portfolio Projects (Allocated)					
20	**Niagara Region**	30.4	18.8	17.7	22.3	6.0
21	**Eastern Region**	106.3	89.6	64.5	37.9	34.1
22	**Western Region**	52.6	59.8	20.2	30.6	46.3
23	**Subtotal Portfolio Projects (Allocated)**	189.3	168.2	102.4	90.7	86.4
	Portfolio Projects (Unallocated)					
24	**Niagara Region**	14.2	30.7	47.8	48.7	20.0
25	**Eastern Region**	65.9	106.1	62.9	97.8	109.3
26	**Western Region**	11.9	27.8	90.3	95.1	115.9
27	**Subtotal Portfolio Projects (Unallocated)**	92.0	164.6	201.0	241.6	245.2
28	**Subtotal Project Capital (Portfolio)**	281.2	332.8	303.4	332.3	331.6
29	**Refurbishments (Allocated)**	289.0	299.9	278.2	263.6	117.8
30	**Refurbishments (Unallocated)**	119.6	186.7	148.9	202.0	288.0
31	**Redevelopments (Allocated)**	156.9	18.1	1.0	0.0	0.0
32	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0
33	**Sir Adam Beck 1 GS Canal Rehabilitation[2]**	18.3	20.8	134.1	1.5	0.0
34	**Expansion Projects[2,3]**	3.9	6.2	25.9	34.5	28.0
35	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program[2]**	10.5	54.3	131.9	165.7	179.5
36	**Minor Fixed Assets**	1.5	1.6	1.6	1.7	1.7
37	**Total Regulated Hydroelectric Capital**	880.9	920.4	1,025.0	1,001.2	946.6
38	**Total Hydro Common Capital**	35.9	20.1	16.6	7.9	0.0

Notes:

1 Operating Region descriptions effective 2021 (see Ex. A1-4-2).

2 Includes both allocated and unallocated projects.

3 Expansion projects include the Sir Adam Beck 1 GS G1/G2 Replacement (#84185), Ranney Falls GS Expansion (#80581), and Chats Falls Expansion (#TBD).

Numbers may not add due to rounding.

Table 3
Capital Expenditures Summary - Regulated Hydroelectric Projects and Hydro Common (Allocated) ($M)
By Project Category

Line No.	Project Category	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Regulated Hydroelectric Projects (Allocated)											
1	**Regulatory**	6.6	10.9	2.9	3.2	2.6	14.8	14.3	12.6	8.4	19.4	28.6
2	**Sustaining**	118.7	106.4	129.0	164.9	212.2	264.3	212.1	324.9	366.5	512.5	531.3
3	**Value Enhancing / Strategic**	2.1	29.27	35.1	35.9	73.1	107.5	87.1	32.1	56.5	287.8	361.8
4	**Total Regulated Hydroelectric Capital**	127.3	146.5	167.0	204.0	287.9	386.5	313.5	369.7	431.4	819.7	921.7
	Hydro Common (Allocated)											
5	**Regulatory**	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.1	2.7	2.1	0.0
6	**Sustaining**	3.5	0.2	0.3	0.2	0.6	2.0	2.0	6.3	4.1	15.1	30.2
7	**Value Enhancing / Strategic**	0.0	0.0	0.8	2.1	2.6	2.5	2.5	1.9	1.9	1.5	1.5
8	**Total Hydro Common Capital**	3.5	0.2	1.1	2.3	3.2	4.5	5.1	10.3	8.6	18.7	31.7

		2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan
		(a)	(b)	(c)	(d)	(e)
	Regulated Hydroelectric Projects (Allocated)					
9	**Regulatory**	20.0	34.9	34.2	14.8	14.1
10	**Sustaining**	447.1	461.2	371.5	346.7	192.8
11	**Value Enhancing / Strategic**	163.8	23.3	4.4	0.4	0.0
12	**Total Regulated Hydroelectric Capital**	630.9	519.4	410.1	361.8	206.9
	Hydro Common (Allocated)					
13	**Regulatory**	0.0	0.0	0.0	0.0	0.0
14	**Sustaining**	33.7	19.6	16.6	7.9	0.0
15	**Value Enhancing / Strategic**	0.0	0.0	0.0	0.0	0.0
16	**Total Hydro Common Capital**	33.7	19.6	16.6	7.9	0.0

Numbers may not add due to rounding.

Table 4

Comparison of Capital Expenditures - Regulated Hydroelectric and Hydro Common ($M)

Line No.	Prescribed Facility Category[1]	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Portfolio Projects (Allocated)											
1	**Niagara Region**	47.6	20.1	21.7	20.0	18.1	31.9	38.5	69.8	53.3	84.0	50.2
2	**Eastern Region**	37.1	45.1	70.6	71.6	68.4	89.8	82.1	108.6	117.5	143.5	140.8
3	**Western Region**	10.9	17.7	20.2	51.3	66.2	79.4	56.3	64.7	74.9	70.9	101.5
4	**Subtotal Portfolio Projects (Allocated)**	95.6	82.9	112.5	142.8	152.7	201.1	176.9	243.1	245.7	298.3	292.5
	Portfolio Projects (Unallocated)											
5	**Niagara Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	(22.1)
6	**Eastern Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	20.4
7	**Western Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	(10.8)
8	**Subtotal Portfolio Projects (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	(12.5)
9	**Subtotal Project Capital (Portfolio)**	95.6	82.9	112.5	142.8	152.7	201.1	176.9	243.1	245.7	305.6	280.0
10	**Refurbishments (Allocated)**	29.7	34.8	18.3	27.0	66.8	83.1	50.9	92.8	106.6	212.1	325.9
11	**Refurbishments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	13.5
12	**Redevelopments (Allocated)**		0.7	2.1	4.5	25.2	62.0	65.1	27.4	53.4	283.4	355.6
13	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	**Sir Adam Beck 1 GS Canal Rehabilitation[3]**		2.8	2.5	2.5	4.6	0.1	(0.0)	(0.1)	0.4	6.6	4.6
15	**Expansion Projects[3,4]**	2.0	25.4	31.6	27.2	38.5	40.2	20.6	1.3	0.0	0.0	1.1
16	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program[3]**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	25.2	19.7	2.1
17	**Minor Fixed Assets**	0.2	0.7	1.0	1.1	1.1	1.5	1.3	1.4	1.6	3.2	1.5
18	**Total Regulated Hydroelectric Capital**	127.5	147.2	168.0	205.1	289.0	388.0	314.8	371.0	433.0	835.4	984.2
19	**Total Hydro Common Capital[1]**	3.5	0.2	1.1	2.3	3.2	4.5	5.1	10.3	8.6	21.0	34.1

Line No.	Prescribed Facility Category[1]	2017-2021 Actual	(c)-(a) Change	2022-2026 Actuals & Budget	(e)-(c) Change	2027-2031 Plan
		(a)	(b)	(c)	(d)	(e)
	Portfolio Projects (Allocated)					
20	**Niagara Region**	111.8	184.0	295.8	(200.7)	95.1
21	**Eastern Region**	345.5	247.0	592.5	(260.1)	332.4
22	**Western Region**	234.7	133.6	368.3	(158.9)	209.5
23	**Subtotal Portfolio Projects (Allocated)**	692.0	564.6	1,256.6	(619.7)	636.9
	Portfolio Projects (Unallocated)					
24	**Niagara Region**	0.0	(18.6)	(18.6)	180.0	161.4
25	**Eastern Region**	0.0	22.5	22.5	419.5	442.0
26	**Western Region**	0.0	(9.1)	(9.1)	350.1	341.0
27	**Subtotal Portfolio Projects (Unallocated)**	0.0	(5.2)	(5.2)	949.6	944.4
28	**Subtotal Project Capital (Portfolio)**	692.0	559.4	1,251.4	329.9	1,581.3
29	**Refurbishments (Allocated)**	230.0	558.3	788.3	460.2	1,248.5
30	**Refurbishments (Unallocated)**	0.0	18.3	18.3	926.9	945.2
31	**Redevelopments (Allocated)**	94.5	690.4	784.9	(608.9)	176.0
32	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0
33	**Sir Adam Beck 1 GS Canal Rehabilitation[3]**	12.4	(1.0)	11.5	163.3	174.7
34	**Expansion Projects[3,4]**	162.9	(139.9)	23.0	75.5	98.4
35	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program[3]**	0.0	52.1	52.1	489.7	541.9
36	**Minor Fixed Assets**	5.4	3.6	9.0	(1.0)	8.0
37	**Total Regulated Hydroelectric Capital**	1,197.2	1,741.2	2,938.4	1,835.6	4,774.0
38	**Total Hydro Common Capital[1]**	11.3	67.8	79.1	1.4	80.4

Notes: Refer to Notes described in Table 2

CAPITAL PROJECTS – REGULATED HYDROELECTRIC OPERATIONS

1.0 PURPOSE

This evidence provides a project listing and the business case summaries ("BCS") that support the capital expenditures and the in-service amounts for OPG's regulated hydroelectric facilities and for Renewable Generation ("RG") assets that support both the regulated and unregulated facilities ("Hydro Common") during the 2027-2031 forecast period. These capital expenditures reflect the capital budgets presented in Ex. D1-1-1. Hydro Common assets form part of the asset service fees charged to the regulated hydroelectric facilities, as discussed in Ex. F3-2-1. Consistent with the OEB's letter dated September 17, 2024, issued in EB-2024-0136, OPG has included nine years of historical data in this evidence, for the period 2016-2024.

This evidence provides project-specific summaries of major capital projects (Tier 1 projects) with either expenditures during the forecast period, or in-service amounts in either the bridge years (2025-2026) or forecast period, as well as completed projects since 2016 (as of the time of the 2025-2031 business plan). Consistent with Ex. D1-1-1, this exhibit also divides the discussions for new projects between those that fulfill portfolio investment objectives and the non-portfolio projects (turbine-generator refurbishment projects, station redevelopment projects, station expansion projects, rehabilitation of the Sir Adam Beck 1 GS canal, and rehabilitation of the Abitibi Canyon concrete and sluiceway system). The evidence also divides the discussions between those projects that are in the Development or Definition phases, and those that are in or beyond the Execution phase. Section 4.1 provides in-service amount variance explanations.

Hydro Common projects are discussed in Section 6.0.

2.0 CAPITAL PROJECTS LISTING – REGULATED HYDROELECTRIC

The following tiered reporting structure, consistent with the OEB's filing requirements issued in EB-2024-0136, has been used to present the evidence for all allocated capital projects that have budgeted expenditures in the forecast period or in-service amounts during the bridge

years or forecast period, or have been completed since 2016. The accompanying tables setting out the project listing details include a column indicating eligibility for the Capacity Refurbishment Variance Account ("CRVA").[1]

The federal government has proposed a 15% refundable Clean Electricity investment tax credit ("CEITC") for certain clean electricity investments, including hydroelectric systems, that could be available to OPG. At the time of filing, no legislation implementing this credit is in place and the CEITCs are not reflected in OPG's 2025-2031 Business Plan. OPG will account for such credits as a reduction in the capital costs of the underlying projects. As discussed elsewhere in the evidence, the Application proposes to return to customers the revenue requirement of the CEITCs through a series of variance accounts, including the CRVA. The CEITCs are discussed further in Ex. F4-2-1, Section 3.6.1.

Tier 1:

This tier comprises individual projects with a total cost of $30M or more. For these projects, summary level information is provided in Ex. D1-1-2, Table 1, and BCSs[2] are provided in Attachment 1. There are 40 regulated hydroelectric Tier 1 projects. Further information on Tier 1 projects is provided in Section 3.0 below.

All Tier 1 projects listed in Ex. D1-1-2, Table 1, with six exceptions, have a final in-service date before or during the forecast period. The final in-service amounts for all projects are provided in the above table, along with the forecast in-service amounts for the forecast period. The six exceptions and their forecasted final in-service dates are as follows:

- #86595 R.H. Saunders GS: Long Sault Dam Capital Program – 2033
- #87217 Aguasabon Dam Rehabilitation: Hayes Lake Main Dam – 2033
- #87357 Sir Adam Beck 2 GS G14 / G13 Refurbishment – 2032
- #87362 Sir Adam Beck 2 GS 230 kV Conductor Replacements – 2039
- #87575 R.H. Saunders GS: Long Sault Dam Downstream Concrete Rehabilitation – 2038

[1] The hydroelectric CRVA is discussed in Ex. H1-1-1, Section 5.6.1.

[2] BCS amounts generally reflect point estimates. For projects in early definition stage, the BCS estimate may be based on a range, or no estimate may be provided. In these instances the current estimate of the total project cost is provided in Ex. D1-1-2, Table 1.

- #89354 Otto Holden GS Refurbish Stop Log Sluice Piers – 2036

In addition to Total Project Cost and In-Service Amounts, Ex. D1-1-2, Table 1 includes Total Cost per First Execution BCS (if available).[3]

Tier 2:
This tier comprises individual projects with a total cost of more than $10M but less than $30M, for which summary level information is provided in Ex. D1-1-2, Tables 2a and 2b. There are 81 regulated hydroelectric Tier 2 projects.

Tier 3:
This tier comprises individual projects with a total cost of less than $10M, for which aggregated information is provided Ex. D1-1-2, Table 3. There are 627 regulated hydroelectric Tier 3 projects. OPG's regulated hydroelectric business typically has a relatively high number of smaller capital portfolio projects given the number of individual stations in the fleet.

Unallocated Projects:
There are a further 78 projects in the unallocated category (as defined in Ex. D1-1-1), which are currently projects in the project identification or project initiation phases, with a total cost of more than $10M. As discussed in Ex. F1-1-1, Section 3.2.3.4, with the introduction of five-year rate terms, RG has established an unallocated capital project portfolio to provide funding in the Business Plan for potential projects expected to start in the future but are not yet fully scoped or approved. These projects are presented in Ex. D1-1-2, Tables 5a and 5b. OPG expects that during the forecast period, some of these projects (or other projects yet to be identified) will move from the project identification and initiation phases into the project definition or execution phase as part of the ongoing portfolio management process (Ex. D2-1-1, Section 3.1). As identified in Ex. D1-1-2, Table 5a, preliminary forecasts indicate that 33 of these projects will have a total project cost greater than $30M.

[3] The project total cost figure is the estimate contained in the most recent, approved BCS available at the time OPG's evidence was developed. That estimate can increase or decrease as the project is refined through planning. The planned in-service cost during the forecast period is based on the information supporting OPG's 2025-2031 Business Plan and may reflect a more recent forecast than the estimate included in the BCS.

3.0 PROJECT-SPECIFIC INFORMATION – TIER 1 REGULATED HYDROELECTRIC PROJECTS

Exhibit D2-1-1, Section 3.2, provides details on OPG's asset management and investment planning process that identifies the need for new projects, assesses project alternatives and then prioritizes the selected projects to move forward. As stated in that evidence, the identification of new projects involves a rigorous process that considers, among others, asset condition, equipment reliability, and security and safety needs to identify the need for project funding. Exhibit D2-1-1, Attachment 1 also provides a more detailed description of the project life cycle and management, along with a chart setting out the Association for the Advancement of Cost Engineering International ("AACE") Estimate Class and Accuracy Ranges.

The information for Tier 1 projects has been divided into five categories:

1. Tier 1 Portfolio Projects

   The regulated hydroelectric project portfolio primarily consists of sustaining investments to ensure ongoing equipment reliability, with major scopes of work including electrical upgrades, protection and controls, cranes, and building/infrastructure investments. For more information on portfolio projects, refer to Ex. F1-1-1, Section 3.2.3.

2. Tier 1 Non-Portfolio Projects

   Non-Portfolio Projects for the regulated hydroelectric business are key investments that are non-routine in nature and managed as standalone portfolios. These projects include investments in turbine-generator unit refurbishment projects, station redevelopment projects, expansion projects and other special projects.

   - Tier 1 Turbine-Generator Refurbishment Projects

   Turbine-generator refurbishment projects are capital investments aimed at extending the lifespan of the equipment. Refurbishment projects may also include technological improvements that increase megawatt ("MW") capacity. Refer to Ex. F1-1-1, Section 3.2.1 for more information on the turbine-generator refurbishment program.

- Tier 1 Station Redevelopment Projects

Station redevelopment projects include the replacement of generating station equipment as well as the replacement of civil infrastructure to extend operations for stations near or at end of life. In some scenarios, redevelopments may add incremental generating capacity through technology improvements and/or optimization of water utilization. Refer to Ex. F1-1-1, Section 3.2.2 for more information on the redevelopment program.

- Tier 1 Expansion Projects

The purpose of these projects is to add generating capacity, in the form of new units, to existing regulated hydroelectric facilities. Refer to Ex. F1-1-1, Section 3.2.6 for more information on regulated hydroelectric expansion projects.

- Sir Adam Beck 1 GS Canal Rehabilitation

These projects aim to restore the structural integrity of the Sir Adam Beck 1 GS power canal, which has experienced canal wall deterioration, debris accumulation and weed growth over its 100+ years of service. This multi-project effort is expected to reclaim flow capacity to the Sir Adam Beck 1 GS, Sir Adam Beck 2 GS, and Sir Adam Beck Pump Generating Station. Refer to Section 3.2.4 of this exhibit for more information on the allocated projects associated with this work.

- Abitibi Canyon GS Concrete and Sluiceway Rehabilitation

These high-priority projects aim to restore the integrity of various structures at Abitibi Canyon GS, constructed in 1933. Several concrete structures, including the main gravity dam upstream and downstream faces, have deteriorated over time due to conditions including erosion from water seepage and freeze-thaw cycles. In addition, the sluiceway system, including the sluice gates, gains, hoists and superstructure, is experiencing operational issues driven by aging and declining conditions. This multi-project effort aims to rehabilitate the upstream and downstream faces to extend the life of the structures and eliminate the risks of dislodged concrete, as well as rehabilitate the sluiceway system to ensure reliability and availability for operation. Refer to Section

3.2.5 of this exhibit for more information on the allocated Tier 1 projects associated with this work.

Consistent with the OEB's directive in EB-2016-0152 that OPG file the costs for each major capital project based on the first execution business case,[4] the information for Tier 1 projects has been further divided into two sub-categories:

Tier 1 Projects at Planning, Development, or Definition Phase

These are projects that have an approved development or definition phase BCS but for which execution has not been approved. Projects in the development and definition phases undergo a review of alternatives, delivery strategy, and/or baseline scope, and are considered to be at a planning stage. Projects at this stage are still in the process of refining their scope and completing their conceptual, preliminary, and detailed designs. As a result, there may be changes in key project assumptions around cost and schedule that will be refined as the project progresses through the gated process described in Ex. D2-1-1. For this reason, the total project cost estimate associated with these projects can vary from actual costs as depicted in each project's AACE estimate class and corresponding accuracy range.

Tier 1 Projects at, or beyond, the Execution Phase

These are projects that have an approved Execution BCS, reflecting the approval to move forward with construction and commissioning of the work. At this phase, subject to a past practice discussed below with respect to partial Execution business cases, detailed engineering, procurement for long lead items, and detailed construction/installation planning have typically been completed and therefore the total project cost estimate has a higher level of definition and accuracy than projects in the earlier phases. Projects in execution phases are still subject to known and unknown risks; this uncertainty can result in cost and schedule variances as described in each project's AACE estimate class and corresponding accuracy range.

[4] Decision and Order, EB-2016-0152, December 28, 2017, p. 22.

A number of projects with approved execution BCSs have been progressed and completed, with the corresponding assets placed in service. These projects are discussed alongside execution phase projects currently in progress.

Exhibit D1-1-2, Table 1 includes 20 regulated hydroelectric Tier 1 projects that have been approved for execution since 2016 (the remainder are in the Planning, Development, or Definition phases). There are five Tier 1 projects for which total actual or forecasted project cost variances currently exceed 10% as compared to the total project cost estimate detailed in each project's first Execution business case. Of those five projects, two have been completed, or are expected to be completed, with a total project cost within the Class 3 estimate accuracy range (within -20% to +30% of the Class 3 Estimate) defined in their first Execution Business Case, with the remaining three having been completed, or are expected to be completed, with a total project cost outside of the Class 3 estimate accuracy range.

In addition to scope changes, project cost variances have occurred primarily as a result of:

- **As-found conditions differing from expectations:** Under certain circumstances, site conditions may not be able to be fully assessed without more invasive procedures such as demolition or turbine-generating unit disassembly, which typically begin in a project’s execution phase. This can present a risk to cost and schedule certainty, as adverse site conditions discovered during demolition, installation, or construction activities may result in scope changes, schedule changes, and cost increases to the project. Challenges with as-found site conditions have arisen in several concrete rehabilitation projects, where the full extent of degradation was not capable of being determined until concrete demolition activities commenced.
- **Estimate uncertainty in previously utilized partial execution releases:** Prior to 2020, some regulated hydroelectric projects processed their first Execution business case to authorize partial release of funds – these “Partial” Execution business cases were typically based on lower estimating accuracy than present-day requirements, resulting in these projects being more likely to experience larger cost variances as the cost estimates, schedules, and designs were not yet finalized. “Partial” Execution business cases, typically

utilized for the procurement of long-lead items,[5] often detailed a Class 4 total cost estimate and/or a life cycle estimate that was premature for what would be considered an Execution business case using the current project management standards and governance. Projects utilizing a "Partial" Execution business case later advanced to a subsequent "Full" Execution business case once estimates were refined with further inputs aligned with what would be expected under the current governance.

As discussed in EB-2023-0336, in the second half of 2020, OPG integrated major project execution groups from across the Nuclear and Renewable Generation business units into the Enterprise Projects Organization, which facilitated the implementation of standardized project management tools across the company. Currently, projects generally utilize a Definition business case to seek funding to procure long lead items, per OPG's latest project management standards and governance. Engineering design is generally funded via Development and Definition business cases. This ensures that the first Execution business case presents a refined, Class 3 Estimate. "Partial" Execution business cases are now only utilized for specific regulated hydroelectric projects on a limited case-by-case basis.

BCSs for all Tier 1 projects, addressing project need, alternatives considered, assessment of key risks, projected cash flows and projected total cost, and project cost variances (if applicable), are provided in Attachment 1.

3.1 Tier 1 Portfolio Projects

Thirteen regulated hydroelectric Tier 1 projects listed in Ex. D1-1-2, Table 1 are Portfolio Projects. The discussion of these projects is organized by region as well as by their stage in the project life cycle.

3.1.1 Niagara Region Portfolio Projects

Three of the 13 Tier 1 portfolio projects are executed in the Niagara Region.

[5] EB-2023-0336, Ex. L-H-Staff-07 and Ex. L-H-CCC-03.

Portfolio Projects at Planning, Development, or Definition Phase

There are two Niagara Region projects at the Planning, Development, or Definition phase.

Project #86364 Sir Adam Beck 1 GS Station Service Upgrade. The objective of this project is to replace the equipment within the alternating current station service system at the Sir Adam Beck 1 GS to extend its service life by approximately 30 years. The existing station service transformers contain obsolete, oil-immersed load tap changers that can no longer be diagnosed to determine their risk of failure and resultant damage to the transformers. The fused disconnect assembly has experienced failures in its draw-out mechanism, resulting in disconnect switches being locked from operation and equipment isolation being performed via alternate means. This obsolete equipment, combined with a lack of redundancy and arc-resistance in the original system design, presents operational challenges as well as a high risk of alternating current station component failure and subsequent forced generating unit outages at the Sir Adam Beck 1 GS. This project will replace the station service electrical equipment, including the switchgear, transformers, motorized disconnects, distribution panels, and station lighting and cabling, with modern equivalents. This work is expected to reduce ongoing maintenance requirements for the station service, while improving station operability and reliability. The total estimated project cost is $33.4M. with a forecast in-service amount of $31.8M fully during the forecast period. The planned final in-service is January 2030.

Project #87362 Sir Adam Beck 2 GS 230 kV Conductor Replacements. The objective of this project is to replace the conductors, insulators, overhead shield wires and required high-voltage tower structural members for seven of eight circuits remaining that connect the Sir Adam Beck 2 GS main output transformers to Hydro One's 230 kV transmission system. The eighth circuit, line T15 connecting to transformer T15, was replaced in 2023 under pilot project #84989 Sir Adam Beck 2 GS T15 230 kV Tower Insulators as a separate investment to address the required need while assessing the extent of the work required for the remaining circuits.

The conductors are over 60 years old, and a 2019 assessment of the system indicated that the transmission shield wires are in poor condition, and that the replacement of tower structural elements, as well as all insulator hardware and polymeric type insulators, are necessary.

Should this equipment fail, one or more units at the Sir Adam Beck 2 GS could experience a forced outage, disrupting generation. The total estimated project cost is $35.9M. The total forecast in-service amount is $29.8M, with $9.6M during the forecast period. The planned final in-service is in 2039.

Portfolio Projects at, or beyond, the Execution Phase

There is one Niagara Region project at, or beyond, the Execution phase.

Project #80583 Sir Adam Beck PGS Reservoir Refurbishment. This project refurbished the storage reservoir for the Sir Adam Beck Pump GS. The reservoir is surrounded by a dike consisting of natural clay material in its core which connects to the reservoir floor to prevent water seepage. The bedrock underneath the dike contained open, continuous joints that could cause water to seep out from the reservoir, particularly in areas with the largest water depths and strongest downward pressures, risking the formation of sinkholes capable of causing the dike to breach. The project was undertaken to minimize the risk of water seepage and other risks by lining critical areas of the reservoir with clay, constructing a grout curtain in the bedrock foundation of the dike, and re-grading the reservoir floor in specified locations to remove any depressions. The project was completed with a total cost and in-service amount of $48.7M, $9.5M less than its Class 2 Full Execution BCS cost estimate of $58.2M. The project was placed in service in April 2017. All amounts associated with this project were reviewed as part of EB-2023-0336.[6]

3.1.2 Eastern Region Portfolio Projects

Seven of 13 Tier 1 portfolio projects are executed in the Eastern Region.

Portfolio Projects at Planning, Development, or Definition Phase

Four of seven Eastern Region projects are at the Planning, Development, or Definition phase.

Project #86595 R.H. Saunders GS: Long Sault Dam Capital Program. The objective of this project is to remediate the mechanical, civil, and electrical systems and structures at the Long

[6] EB-2023-0336, Ex. H1-1-1, Attachment 4 and Table 7b.

Sault Dam. The dam, located on the St. Lawrence River in the U.S. state of New York, serves as a spillway that supports both the R.H. Saunders GS and the St. Lawrence Franklin D. Roosevelt GS, the latter being operated by New York Power Authority ("NYPA"). The Long Sault Dam and this project's scope of work are managed by NYPA, with OPG and NYPA sharing equally in the costs required to operate and maintain assets within the St. Lawrence River management system (as described in Ex. A1-4-2, Section 2.1). The total estimated project cost to OPG, or net project cost, is forecasted to be $88.0M. The total forecast in-service amount is $74.8M, with $45.3M during the forecast period. The planned final in-service is in 2033.

Project #87142 R.H. Saunders GS: Massena Canal Dam. The objective of this project is to demolish the Alcoa Powerhouse and construct an earthen dam for the Massena Power Canal in its place. The Alcoa Powerhouse, located in the U.S. state of New York, was originally constructed in 1902 and decommissioned in 1958 following the construction of the St. Lawrence Franklin D. Roosevelt GS in New York and the R.H. Saunders GS in Ontario. The powerhouse remained as a water-retaining structure for the Massena Power Canal, but its advanced age and deteriorated state present a hazard to site inspection and maintenance activities. Rebuilding this structure is expected to mitigate environmental and public safety risks associated with the existing powerhouse.

The Alcoa Powerhouse and this project's scope of work are managed by NYPA, with OPG and NYPA sharing equally in the costs required to operate and maintain assets within the St. Lawrence River management system (as described in Ex. A1-4-2, Section 2.1). The total estimated project cost to OPG, or net project cost, is $47.3M with a forecast in-service amount of $39.1M fully during the forecast period. The planned final in-service for this is in December 2029.

Project #87575 R.H. Saunders GS: Long Sault Dam Downstream Concrete Rehabilitation. The objective of this project is to refurbish the downstream concrete spillway of the Long Sault Dam sluiceway structure to extend the long-term integrity of the asset. The concrete structure, consisting of 29 sluices, is over 65 years old, with signs of significant

deterioration including areas of exposed rebar at the tailrace water elevation level. The Long Sault Dam and this project's scope of work are managed by NYPA, with OPG and NYPA sharing equally in the costs required to operate and maintain assets within the St. Lawrence River management system (as described in Ex. A1-4-2, Section 2.1). The length of this project is estimated to be at least 15 years due to the number of sluices as well as a requirement to ensure that the facility remains operational for dam safety. The total estimated project cost to OPG, or net project cost, is $38.4M. The total forecast in-service amount is $32.6M, with $20.2M during the forecast period. The planned final in-service is in 2038.

Project #89354 Otto Holden GS Refurbish Stop Log Sluice Piers. The objective of this project is to rehabilitate areas of deterioration in the upstream nose piers, stop log gains, and downstream pier surfaces to ensure the continued structural integrity of the stop log structure and supports at the Otto Holden GS. These structures have experienced deteriorating concrete caused by long-term freezing and thawing, coupled with Alkali-Aggregate Reaction ("AAR", refer to Ex. F1-1-1, Section 3.2.3). Continued concrete deterioration would reduce the structural integrity of the stop log structure and cause future challenges with removing and installing stop logs**,** potentially resulting in the facility not meeting dam safety criteria for flow control. The total estimated project cost is $108.0M. The total forecast in-service amount is $91.8M, with $51.3M during the forecast period. The planned final in-service is in 2036.

<u>Portfolio Projects at, or beyond, the Execution Phase</u>

Three of seven Eastern Region projects are at, or beyond, the Execution phase.

Project #83194 Frederick House Lake Dam Rehabilitation. This project rehabilitated the Frederick House Lake Dam in order to restore operational reliability and structural integrity. The dam, which was originally constructed in 1938, exhibited signs of deterioration: concrete cracking and deterioration had exposed reinforcing steel at certain locations on the piers, the existing sluice gains and steel gates had experienced deformation and corrosion, and there was excessive leakage around the gains at most sluiceways. Had the structure been allowed to deteriorate further, the sluice gains would have become compromised, potentially leading to an uncontrolled release of water. This project is expected to extend the dam's design life by

up to approximately 50 years. The total Execution BCS-estimated project cost is $90.0M. The total forecast in-service amount is $79.9M, with $44.6M during the 2025-2026 bridge period. The planned final in-service is December 2025. OPG is treating this project as CRVA-eligible.

Project #84907 Otter Project Camp. This project installed a construction camp near the Abitibi Canyon GS to provide housing and accommodation for up to 115 tradespeople and contractors supporting projects at the Abitibi Canyon GS and Otter Rapids GS. Prior to the construction of this camp, neither the Abitibi Canyon GS nor Otter Rapids GS were near locations with sufficient accommodations for workers. This resulted in extended worker commutes, increasing safety risks during Northern Ontario's inclement weather conditions. The construction camp is expected to reduce travel time for workers, reduce travel-related safety risks, and increase resource availability to meet project requirements. Over the 2024 to 2033 period, workers on site will support major works in the form of turbine-generator refurbishments and sluice gate replacements at the Otter Rapids GS and unit refurbishments and dam repairs at the Abitibi Canyon GS. The camp has a mobile design and can potentially support other locations beyond these two stations after 2033. The project is expected to be completed at a total cost of $39.5M, consistent with its Class 3 estimate of $39.5M in the Execution BCS. This project was placed in service in July 2024, with a total in-service amount of $39.0M ($0.4M in the 2025-2026 bridge period).

Project #84494 Chenaux Limerick Island Superstructure Gate Hoist. This project implemented improvements to the motorized sluice gates at the Limerick Island Control Dam, which supports the Chenaux GS. Modifications included the replacement of the previous screw hoists with wire rope hoists, as well as the installation of a heated hoist house atop a new superstructure.

The original screw hoists were designed in the late 1940s, and until 2010 the gates were operated fewer than 20 times per year, on average. In recent years, changes in system demand and addition of new intermittent generating sources have resulted in the gates now being operated as much as 200 times each year, contributing to additional wear and sluice gate failures. The installation of wire rope hoists is expected to support more frequent and

reliable sluice gate operation. The addition of a new hoist house and sluiceway superstructure is expected to address severe environmental conditions affecting the reliable operation of the sluice gates by protecting the hoists and associated controls, gearboxes and motors. This project is expected to be completed at a total cost of $32.7M, on budget compared to its Class 3 estimate of $32.7M in the Execution BCS. The project achieved final in-service in November 2023, with an in-service amount of $28.8M. OPG is treating this project as CRVA-eligible.

3.1.3 Western Region Portfolio Projects

Three of 13 Tier 1 portfolio projects are in the Western Region.

Portfolio Projects at Planning, Development, or Definition Phase

There are two Western Region projects are at the Planning, Development, or Definition phase.

Project #83833 Silver Falls GS Surge Tank Replacement. The purpose of this project is to replace the existing surge tank with a new tank to support the station's water conveyance system. The original surge tank was built in 1958 and is nearing the end of its service life with damaged insulation, wall thickness loss, and internal corrosion; any further degradation of the tank is expected to lead to increased outage frequency and duration. As the surge tank is in a provincial park with public access, the project will also address the potential safety risk should the surge tank fail, or deteriorated material fall from the above-grade tank structure. The new tank is expected to have a design life exceeding 50 years. The total estimated project cost is $40.7M with a forecast in-service amount of $38.8M fully during the forecast period. The planned final in-service is December 2028. OPG is treating this project as CRVA-eligible.

Project #87217 Aguasabon Dam Rehabilitation: Hayes Lake Main Dam. The objective of this project is to remediate the concrete structures at Hayes Lake Dam, which is expected to extend the useful life of the dam, reduce the risk of failure, and mitigate risks to the safety and reliability of operations in the area. Hayes Lake serves as a 680-hectare head pond for the Aguasabon GS. The Hayes Lake Dam, originally constructed in 1948, is exhibiting signs of deterioration, including concrete expansion and active leakage throughout the main dam body. The total estimated project cost is $116.5M. The total forecast in-service amount is $110M,

with $70M during the forecast period. The planned final in-service is in December 2033. OPG is treating this project as CRVA-eligible.

Portfolio Projects at, or beyond, the Execution Phase

There is one Western Region project at, or beyond, the Execution phase.

Project #84901 Northwestern Operations Work Centre Building. The objective of this project is to construct a new work centre and control room for over 160 staff in the Northwestern Operations group ("NWO") within the Western Region. The current work centre, which consists of a 17,800 square foot administration building, lacks sufficient capacity for current and future NWO staffing levels. The current facility reached its maximum capacity in 2018, necessitating the leasing of 21,900 square feet of additional, separate space by 2023 to house production support, engineering personnel, and additional staff supporting the Western Region's increased refurbishment program. The work centre was previously expanded both in 2001 and 2005; lot size limitations prevent any such further expansion.

The current work centre presents several significant health and safety risks to personnel. Yard drainage issues have resulted in heaving, sinkholes and pooling of water that when frozen presents a slip, trip or fall hazard. The facility's heating, ventilation and air conditioning system is aging, undersized and incapable of meeting internal temperature or air circulation requirements. In addition, the septic system servicing the building is both aging and at capacity given the historical building expansions.

The new work centre will consolidate the staff from the current work centre and leased facility into a single 45,000 square foot, two-floor administration building. The administration building's first floor will provide a work centre for NWO operations and maintenance personnel; the second floor will provide workspace for engineering personnel, production support staff, and management. The total estimated project cost is $44.4M with a forecast in-service amount of $39.9M fully during the forecast period. The planned final in-service is in August 2027.

3.2 Non-Portfolio Projects

Non-Portfolio Projects are identified and managed separately from the Portfolio Projects due to their extraordinary nature, as discussed in Ex. D1-1-1. Twenty-seven Tier 1 Non-Portfolio Projects are listed in Ex. D1-1-2, Table 1. The discussion of each category of these projects is presented by their stage in the project life cycle.

3.2.1 Tier 1 Turbine-Generator Refurbishment Projects

Nineteen Tier 1 projects listed in Ex. D1-1-2, Table 1 are to perform turbine-generator refurbishments across the regulated hydroelectric fleet. See Ex. F1-1-1, Section 3.2.1 for more details on OPG's regulated hydroelectric refurbishment program. OPG is treating all of these projects as CRVA-eligible.

Turbine-Generator Refurbishment Projects at Planning, Development, or Definition Phase

Ten of 19 Tier 1 refurbishment projects are at the Planning, Development, or Definition phase.

Project #82391 Alexander GS G1 Capital Refurbishment. The objective of this project is to refurbish Alexander GS Unit G1, including replacing the runner, exciter, governor, and embedded parts. This unit was originally commissioned in 1930, with its runner last replaced in 1956. There are signs of cavitation damage to the runner blades, and the exciter is now obsolete and no longer supported by the original equipment manufacturer. Issues with the exciter have contributed to this unit experiencing a forced outage in each of 2023 and 2024, and Units G4 and G5 have experienced several forced outages between 2019 and 2024 relating to exciter issues. This refurbishment is required to manage the risks associated with the unit's aging equipment and declining asset condition, and is expected to sustain 12.6 MW of existing generating capacity. The total estimated project cost is $45.9M with a forecast in-service amount of $42.0M fully during the forecast period. The planned final in-service is in September 2030.

Project #83148 Abitibi Canyon GS G1 Capital Upgrade. The objective of this project is to refurbish Abitibi Canyon GS Unit G1, including re-insulating the rotor poles, replacing the rotor spider and replacing the runner. In 2022, Unit G1 was taken out of service for over a year due

to its runner suffering extensive damage after contacting the unit's discharge ring – the unit was placed back in service in 2023. In addition, Unit G1's other turbine components are original to the unit (placed in service in 1933), and the discharge ring, headcover, shift ring and wicket gates are at end of life, all of which are being replaced as part of this project. The refurbishment is expected to return Unit G1 to a state of long-term reliability and sustain 69.5 MW of existing generating capacity. The total estimated project cost is $54.7M with a forecast in-service amount of $46.8M fully during the forecast period. The planned final in-service is in January 2031.

Project #87768 Sir Adam Beck 2 GS G20 / G19 Refurbishment. The objective of this project is to refurbish Sir Adam Beck 2 Units G20 and G19. Recent condition assessments confirm that sustaining unit reliability will be challenged due to normal wear and aging, and there is a lack of readily available spare parts as the Original Equipment Manufacturer ("OEM") no longer manufactures or supports the existing parts; this has led to prolonged outages required for repairs. Units G20 and G19 are being refurbished together due to being closely connected electrically – the units share a common transformer bank, high-voltage line, high-voltage disconnect and medium voltage isolated phase bus, as well as protection and controls equipment. Completing this project is expected to promote the long-term reliability of both units, modernize critical components, and, in addition to sustaining 187.4 MW of existing generating capacity, increase it by an estimated 3 MW.

As Units G20 and G19 will be the first pair of units refurbished under the RG Programmatic Collaboration Agreement ("RG PCA") secured with the OEM (GE Renewable Energy Canada Inc.), this project will complete the engineering design and front-end planning elements that will be applicable to all subsequent projects within the Sir Adam Beck 2 GS refurbishment program. The total estimated project cost is $377.5M with a forecast in-service amount of $353.0M fully during the forecast period. The planned final in-service is in February 2029.

Details of the RG PCAs are provided in Ex. F1-1-1, Section 3.2.1.

Project #86372 Sir Adam Beck 1 GS G6 / G8 Refurbishment. The objective of this project is to refurbish Sir Adam Beck 1 GS Units G6 and G8, which includes the replacement of major turbine components, the generator rotor, the exciter, and the governor. Unit G8 has experienced reliability issues, including a forced outage from thrust bearing cooling line leaks. Despite targeted interventions and outages to resolve reliability issues, the underlying risks associated with wear, aging equipment and limited availability of OEM-supported spare parts persist. In addition, Units G6 and G8 share the same floating rim design as Units G4 and G5, which developed operating restrictions due to high generator rotor vibration – this necessitates a timely refurbishment to proactively mitigate the risk of Units G6 and G8 developing similar operating issues. Completing this project is expected to promote the long-term reliability of both units, modernize critical components, and, in addition to sustaining 106.2 MW of existing generating capacity, increase it by an estimated 10 MW.

Units G6 and G8 will be refurbished under the RG PCA secured with the OEM (GE Renewable Energy Canada Inc.); upfront engineering design and front-end planning elements are included in project #86570, Sir Adam Beck 1 GS G4 Refurbishment (the first Sir Adam Beck 1 GS unit to be refurbished under the RG PCA with the OEM). The total estimated project cost is $232.3M with a forecast in-service amount of $226.2M fully during the forecast period. The planned final in-service is in April 2030.

Details of the RG PCAs are provided in Ex. F1-1-1, Section 3.2.1.

Project #86792 Alexander GS G2 Capital Refurbishment. The objective of this project is to perform a refurbishment of Alexander GS Unit G2, including replacing the runner, exciter, governor, and embedded parts. This unit was originally commissioned in 1930, with its runner last replaced in 1964. There are signs of cavitation damage to the runner blades, and the exciter is now obsolete and is no longer supported by the OEM. Issues with similar exciters in Units G1, G4, and G5 have contributed to the units experiencing several sudden and forced outages between 2019 and 2024. This refurbishment project is required to manage the risks associated with the unit’s aging equipment and declining equipment conditions and is expected to sustain 12.6 MW of existing generating capacity. The total estimated project cost is $49.7M

with a forecast in-service amount of $43.5M fully during the forecast period. The planned final in-service is in August 2027.

Project #86793 Alexander GS G3 Capital Refurbishment. The objective of this project is to perform a refurbishment of Alexander GS Unit G3, including replacing the runner, exciter, governor and embedded parts, as well as refurbishing the generator. This unit was originally commissioned in 1931, with its runner last replaced in 1963. There are signs of cavitation damage to the runner blades, and the exciter is now obsolete and is no longer supported by the OEM. Issues with similar exciters in Units G1, G4, and G5 have contributed to the units experiencing several sudden and forced outages between 2019 and 2024. This refurbishment effort is required to manage the risks associated with the unit's aging equipment and declining equipment conditions and is expected to sustain 12.6 MW of existing generating capacity. The total estimated project cost is $43.6M. The total forecast in-service amount is $41.5M, with $40.0M during the forecast period. The planned final in-service is in December 2031.

Project #86860 Manitou Falls GS G3 Capital Refurbishment. The objective of this project is to refurbish Manitou Falls Unit G3, including a stator component replacement and rotor rim re-shrink, as well as updates to machine monitoring. During a maintenance outage in 2021, the Manitou Falls GS Unit G3 was discovered to have an eccentric rotor, collapsed stator windings, and core damage. A temporary solution was implemented to restore the unit to operation and mitigate the risk of further stator collapse in the near term, but a complete replacement of the stator component is required, along with a rotor re-shrink, to ensure reliable long-term operation and mitigate the risk of failure. This refurbishment is expected to sustain 14.9 MW of existing generating capacity. The total estimated project cost is $53.2M with a forecast in-service amount of $48.0M fully during the forecast period. The planned final in-service is in May 2029.

Project #86937 R.H. Saunders GS G16 Capital Refurbishment. The objective of this project is to refurbish Unit G16 at the R.H. Saunders GS, including replacing the turbine discharge ring, installing a new thrust bearing, installing new servomotors, upgrading electrical and mechanical auxiliary systems, re-wedging the generator stator, and rehabilitating the generator

field poles. This project will also include the installation of a new runner, which is being procured under project #83104 R.H. Saunders GS Runner Replacement (refer to Ex. D1-1-2, Table 2b). Like all units at the R.H. Saunders GS, Unit G16 is impacted by concrete deterioration from AAR (refer to Ex. F1-1-1, Section 3.2.3), which has contributed to structural damage, discharge ring deformation, reduced generating unit clearances and shifting of embedded components throughout the unit. This refurbishment is a necessary step to re-establish critical component clearances, restore the integrity of the unit, and ensure continued reliability. In addition to sustaining 61.7 MW of existing generating capacity, this work is expected to increase unit capacity by an estimated 4.5 MW. The total estimated project cost is $49.3M with a forecast in-service amount of $38.7M fully during the forecast period. The planned final in-service is in February 2028.

Project #87356 Sir Adam Beck 2 GS G18 / G17 Refurbishment. The objective of this project is to refurbish Sir Adam Beck 2 Units G18 and G17. Unit G17 has experienced challenges in reliability due to axial vibration issues that have rendered the unit unable to operate on automatic generation control. Despite targeted interventions and outages to resolve reliability issues, the underlying risks associated with wear, aging equipment, and limited availability of OEM-supported spare parts persist. Project work includes the replacement of major components within the turbine, generator, and electrical/mechanical systems, as well as the replacement of the governor and protection and control systems. Units G17 and G18 are being refurbished together due to being closely connected electrically – the units share a common transformer bank, high-voltage line, high-voltage disconnect, and medium-voltage isolated phase bus, as well as protection and controls equipment. Completing this project is expected to promote the long-term reliability of both units, modernize critical components, and in addition to sustaining 187.4 MW of existing generating capacity, increase it by an estimated 3 MW.

Units G17 and G18 will be refurbished under the RG PCA secured with the OEM (GE Renewable Energy Canada Inc.); upfront engineering design and front-end planning elements are included in project #87768, Sir Adam Beck 2 GS G20 / G19 Refurbishment (the first Sir Adam Beck 2 GS units to be refurbished under the RG PCA with the OEM). The total estimated

project cost is $361.1M with a forecast in-service amount of $344.2M fully during the forecast period. The planned final in-service is in November 2030.

Details of the RG PCAs are provided in Ex. F1-1-1, Section 3.2.1.

Project #87357 Sir Adam Beck 2 GS G14 / G13 Refurbishment. The objective of this project is to refurbish Sir Adam Beck 2 Units G13 and G14. Stator core winding and pilot exciter issues have been identified on Unit G14, and both units face operating risks associated with wear, aging equipment, and a limited availability of OEM-supported spare parts. Project work includes the replacement of major components within the turbine, generator, and electrical/mechanical systems, as well as the replacement of the governor and protection and control systems. Units G13 and G14 are being refurbished together due to being closely connected electrically – the units share a common transformer bank, high-voltage line, high-voltage disconnect, and medium-voltage isolated phase bus, as well as protection and controls equipment. Completing this project is expected to promote the long-term reliability of both units, modernize critical components, and in addition to sustaining 187.4 MW of existing generating capacity, increase it by an estimated 3 MW.

Units G13 and G14 will be refurbished under the RG PCA secured with the OEM (GE Renewable Energy Canada Inc.); upfront engineering design and front-planning elements are included in project #87768, Sir Adam Beck 2 GS G20 / G19 Refurbishment (the first Sir Adam Beck 2 GS units to be refurbished under the RG PCA with the OEM). The total estimated project cost is $375.6M. The total forecast in-service amount is 360.8M; there are no in-service amounts during the forecast period. The planned final in-service is in July 2032.

Details of the RG PCAs are provided in Ex. F1-1-1, Section 3.2.1.

<u>Turbine-Generator Refurbishment Projects at, or beyond, the Execution Phase</u>

Nine of 19 Tier 1 refurbishment projects are at, or beyond, the Execution phase.

Project #80649 Sir Adam Beck 1 GS G10 Major Overhaul and Upgrade. As part of this project, OPG completed various major upgrades to Unit G10 at the Sir Adam Beck 1 GS, such as rewinding the generator stator and rotor, replacing the associated electrical equipment, and overhauling the turbine. These changes increased unit capacity from 45.9 MW to 55.0 MW. The project achieved final in-service in 2017 with a total cost of $30.8M and a total in-service amount of $30.2M. The total cost represented an increase of $3.8M from the Class 3 Estimate of $27.0M in the First Execution BCS, which is within the Class 3 estimate accuracy range. The cost variance was mainly due to higher-than-expected contractor cost to perform the work, delays in the original equipment manufacturer manufacturing and testing of the generator coil, and scope added to the turbine overhaul for a new head cover and bottom ring based on lessons learned from the Sir Adam Beck 1 Unit G9 upgrade. All amounts associated with this project were reviewed as part of EB-2023-0336.[7]

Project #80851 DeCew Falls 2 GS G2 Overhaul and Upgrade. The project installed a new generator and turbine shaft at DeCew Falls 2 GS Unit G2. Downstream electrical equipment and protections were also upgraded to accommodate output from the new unit. This work restored the unit's capacity to 72.0 MW, which had previously been derated to 63.0 MW between 2013 and 2019 to mitigate the risk of generator failure due to vibrations. The project was completed at total cost of $35.5M, which is $2.6M less than its Class 3 Estimate of $38.1M. The project achieved final in-service in July 2019, with a total in-service amount of $34.9M. All amounts associated with this project were reviewed as part of EB-2023-0336.[8]

Project #82542 Otter Rapids GS G1 Capital Upgrade. The objective of this project is to refurbish Otter Rapids GS Unit G1, including refurbishing the discharge ring, re-insulating the field poles, replacing the thrust bearing pads with new polytetrafluoroethylene pads and installing a new runner. Unit G1 currently experiences high vibrations as well as cavitation damage to the current runner and discharge ring. This refurbishment is expected to promote long-term reliability and, in addition to sustaining 45.6 MW of existing generating capacity, increase it by an estimated 5 MW. The total estimated project cost is $40.7M. The total forecast

[7] EB-2023-0336, Ex. H1-1-1, Attachment 4 and Table 7b.
[8] *Ibid*.

in-service amount is $40.7M, with $34.0M in the 2025-206 bridge period and $1.8M during the forecast period. The planned final in-service is in December 2026.

Project #82543 Otter Rapids GS G2 Refurbishment. The objective of this project is to refurbish Otter Rapids GS Unit G2, including refurbishing the discharge ring, re-insulating the field poles, replacing the thrust bearing pads with new polytetrafluoroethylene pads and installing a new runner. Unit G2 currently experiences high vibrations as well as cavitation damage to the current runner and discharge ring. This refurbishment is expected to promote long-term reliability and, in addition to sustaining 45.6 MW of existing generating capacity, increase it by an estimated 5.8 MW.

The total project cost is estimated to be $78.1M, an increase of $35.0M from the Class 3 Estimate of $43.1M detailed in the first Execution Business Case, which was a Partial Execution BCS that was issued in 2020 to facilitate site preparation works for the full Otter Rapids GS refurbishment program and that preceded detailed design and full construction pricing estimates. The Full Execution BCS, which included construction and material estimates supported by contractor pricing, resulted in a Class 3 Estimate of $51.8M. This cost variance of $26.2M to the Full Execution BCS is driven in part by the identification of cracks in high stress areas of the stay vanes during non-destructive examination, the full extent of which was uncovered once the unit had been fully disassembled. In addition, larger-than-anticipated gaps were identified between the upper and lower transitions where the new modification components would transition to the scroll case. These discoveries necessitated additional welding and grinding to resolve the cracks, as well as the installation of backing material to fill the transition gaps. The total forecast in-service amount is $70.1M, with $62.3M in the 2025-206 bridge period and no in-service during the forecast period. The planned final in service is in December 2025.

Project #82777 Sir Adam Beck 1 G5 Upgrade. Prior to this project, Unit G5 at the Sir Adam Beck 1 GS was operating under a derate to 49 MW (relative to its maximum continuous rating of 53.1 MW) to manage the risk of generator failure due to vibrations. At the time of the EB-2013-0321 application, this project was at the initiation phase. However, as discussed in EB-

2023-0336, the primary purpose of the first Partial Execution BCS was to release funds to support the purchase of long lead equipment and provided a Class 4 Estimate that was premature for an Execution BCS.[9] The project was completed at a total cost of $44.7M with a total in-service amount of $43.4M, with a final in-service date of September 2021. All amounts associated with this project were reviewed as part of EB-2023-0336.[10]

Project #83155 Abitibi Canyon GS G2 Capital Upgrade and Head Gate Replacement. This project refurbished Abitibi Canyon GS Unit G2, including replacing the unit's windings and rotor spider, as well as re-insulating the rotor poles. Unit G2 last underwent a major overhaul in 1992 and more recently displayed multiple signs of fatigue and high vibrations, with cracks developing at the rotor hub and the unit's stator windings at end of life. This project also replaced the unit's head gate and mechanical hoist system, which were original to the unit (originally placed in service in 1933) and in poor condition, demonstrating signs of corrosion. This project enables sustaining 69.5 MW of existing generating capacity.

The total project cost is $30.1M, an increase of $2.6M from the Class 3 Estimate of $27.5M detailed in the first Execution BCS. The increase in the total project forecast cost is within the accuracy range of a Class 3 estimate. The cost variance of $2.6M was driven by the discovery of poor equipment conditions upon disassembly. Turbine components including the discharge ring, headcover and shift ring were unexpectedly found to be at end of life, with cracks and casting defects that were difficult to repair. As a result, OPG decided to replace these turbine components as opposed to refurbishing them. This project achieved final in-service in March 2022, with a total in-service amount of $29.5M.

Project #83495 R.H. Saunders GS G9 Capital Refurbishment. This project refurbished Unit G9 at the R.H. Saunders GS, including replacing the turbine discharge ring, replacing the servomotor, re-insulating the field poles and replacing the thrust bearing pads with new polytetrafluoroethylene pads. This project also installed a new runner, procured under project #83104 R.H. Saunders Runner Replacement (refer to Ex. D1-1-2, Table 2b).

[9] EB-2023-0336, Ex. L-H-CCC-03.
[10] EB-2023-0336, Ex. H1-1-1, Attachment 4 and Table 7b.

Unit G9 was nearing the end of its service life, with severe runner cavitation damage and reduced ring unit clearances. Like all units at the R.H. Saunders GS, Unit G9 was impacted by concrete deterioration from AAR (refer to Ex. F1-1-1, Section 3.2.3 for more information), which has contributed to structural damage, discharge ring deformation, reduced generating unit clearances, and shifting of embedded components throughout the unit. This refurbishment was a necessary step to re-establish critical component clearances, restore the integrity of Unit G9, and ensure continued reliability. This project enables sustaining 64.6 MW of existing generating capacity.

The total project cost is estimated to be $42.7M. This represents an increase of $25.5M from the Class 4 Estimate of $17.2M provided in the first Partial Execution BCS, which preceded the completion of detailed design and released funds primarily for the design and procurement of long lead equipment. The Full Execution BCS, which included refined construction and material estimates and confirmed contractor pricing, detailed a Class 3 Estimate of $24.8M. The project achieved final in-service in August 2025, with the total in-service amount of $38.4M fully in the 2025-2026 bridge period.

The $17.9M cost variance from the Full Execution BCS is primarily attributable to the following:

- The project experienced longer-than-planned durations for unit refurbishment activities, many of which were first-of-a-kind at the R.H. Saunders GS. Execution activities, including stay ring machining, the removal and replacement of the discharge ring, the removal of the turbine outer head cover, and the alignment of the new pivot ring, took more time to complete than anticipated. Delays were driven in part by as-found conditions, with complexities exacerbated by greater-than-anticipated challenges from AAR impacting concrete-embedded components at the facility. These issues led to additional refurbishment scope not anticipated during project planning.
- Project completion was further delayed by a thrust bearing failure that occurred during commissioning in October 2024. The thrust bearing failure resulted in damage to the polytetrafluoroethylene bearing. To resolve this issue, OPG procured a replacement Babbitt bearing and disassembled, repaired, and commissioned the unit.

Project #86570 Sir Adam Beck 1 GS G4 Refurbishment. The objective of this project is to refurbish Sir Adam Beck 1 GS Unit G4, which includes the replacement of major turbine components, the generator rotor, the exciter, and the governor. In addition, this project will upgrade the programmable logic controller and protection and control systems. Despite a maximum continuous rating of 53.1 MW, Unit G4 is currently restricted to a must-run status at 48 MW that also prevents starts and stops on the unit. This restriction is due to high vibrations at the generator bearing that are lowest at 48 MW. Critical components, including the runner, generator rotor, and excitation system, have either reached or are nearing end of life, with performance issues due to wear and aging. This work is expected to modernize the generating unit, promote long-term reliability, and, in addition to sustaining 53.1 MW of existing generating capacity, increase it by an estimated 2 MW.

As Unit G4 will be the first unit refurbished under the RG PCA secured with the OEM (GE Renewable Energy Canada Inc.) for the Sir Adam Beck 1 GS refurbishments, this project will manage the engineering design and front-end planning elements that will be applicable to all subsequent projects within the Sir Adam Beck 1 GS refurbishment program. The total estimated project cost is $109.1M with a forecast in-service amount of $96.7M fully during the forecast period. The planned final in-service is in June 2027.

Details of the RG PCAs are provided in Ex. F1-1-1, Section 3.2.1.

Project #86587 R.H. Saunders GS G12 Capital Refurbishment. The objective of this project is to refurbish Unit G12 at the R.H. Saunders GS, including installing new servomotors, replacing the turbine discharge ring, re-wedging the generator stator, re-shrinking the generator rotor and rehabilitating the generator field poles. This project will also include the installation of a new runner, which is being procured under project #83104 R.H. Saunders Runner Replacement (refer to Ex. D1-1-2, Table 2b).

Unit G12 experienced a thrust bearing wipe in June 2024. Like all units at the R.H. Saunders GS, Unit G12 experiences AAR (refer to Ex. F1-1-1, Section 3.2.3), which has contributed to structural damage, concrete deterioration and shifting of embedded components throughout

the unit. This refurbishment is a necessary step to re-establish critical component clearances, restore the integrity of Unit G12, and ensure continued reliability. This work is expected to sustain 66.2 MW of existing generating capacity. The total estimated project cost is $30.4M with a total forecast in-service amount of $26.9M fully in the 2025-206 bridge period. The planned final in-service is June 2026.

3.2.2 Tier 1 Station Redevelopment Projects

Four Tier 1 projects listed in Ex. D1-1-2, Table 1 are to perform station redevelopments. OPG is treating all of these projects as CRVA-eligible.

Station Redevelopment Projects at Planning, Development, or Definition Phase

There are no Tier 1 redevelopment projects that are at the Planning, Development, or Definition phase.

Station Redevelopment Projects at, or beyond, the Execution Phase

All four Tier 1 redevelopment projects are at, or beyond, the Execution phase.

Project #82087 Coniston GS / Stinson GS Redevelopment. The objective of this project is to redevelop the Coniston GS and the Stinson GS to extend their life by approximately 80 years each. This project is expected to increase the combined capacity of Coniston GS and Stinson GS from approximately 8.0 MW to an estimated 12.0 MW.

Coniston GS, originally built in 1905, is nearing the end of its service life. Coniston Unit G1 was removed from service in 2013 following a penstock collapse, Unit G2 was shut down in 2019 after the penstock steel was deemed too thin for continued safe operation, and Unit G3 was temporarily taken out of service in 2024 following major wicket gate failures. In the absence of a redevelopment project, this station would be permanently shut down. The Stinson GS, originally built in 1925, is also nearing the end of its expected life as it experiences significant equipment issues, including failed wicket gates, cracked downstream shift rings, cracked distributor rings, as well as a recent failure of the Babbitt and generator guide bearings.

In the absence of the redevelopment project, this station is estimated to be permanently shut down within approximately five years.

The Coniston GS and Stinson GS redevelopments have a number of synergies that made it favourable to combine them into one project. Both stations operate on the Wanapitei River and are in close proximity to one another, with a driving distance of approximately 14 km between the two. The sites have similar characteristics, including flow and head, allowing for the ability to match the design flows of the stations to optimize river operations as well as the ability to procure identical mechanical and electrical equipment for both stations at the same time. Combining these redevelopments into one project also enables project management efficiencies.

Both redevelopments are expected to have similar scopes of work. The scope involves the demolition of the existing station powerhouses down to their foundations, remediation of portions of the existing foundations, the removal of the existing Coniston GS intake and penstocks, the installation of two new turbine generator units per station, as well as new balance of plant mechanical and electrical systems.

The total estimated project cost is $178.0M. The total forecast in-service amount is $176.4M, with $130.5M during the 2025-2026 bridge period and $45.9M in the forecast period. The planned final in-service is in April 2027.

Project #82089 Calabogie GS Redevelopment. This project designed, constructed, and commissioned a new hydroelectric generating station in place of the original Calabogie GS. The original station was in service from its construction in 1917 until 2018, when it was critically damaged by a tornado. Through this project, the original powerhouse and intake structure were demolished, and the existing forebay concrete was remediated. The redeveloped station has a capacity of 10.7 MW, an increase of 5.7 MW from the original station capacity. The redevelopment is estimated to extend the life of the facility by approximately 90 years.

This project was completed at a total cost of $167.2M,[11] which is an increase of $30.7M from the Class 3 estimate of $136.5M detailed in the first Execution BCS. The total cost of $167.2M is within the Class 3 estimate accuracy range presented in the first Execution BCS. The project was placed in service in October 2023, with a total in-service amount of $165.6M.

The cost variance of $29.2M is primarily attributable to the following:

- Civil construction challenges were experienced during project execution, including delays to drilling, blasting, and structural works, as well as discovery of subsurface conditions.
- Higher than estimated costs related to the installation of the turbine generators as a result of the prime contractor needing to change subcontractors.
- The project incurred higher-than-estimated project management and engineering costs, driven in part by changes in scope and the extended project schedule.

OPG recovered a total of $7.7M in cost from the contractor, including $3.8M of liquidated damages settled in relation to schedule delays incurred by the contractor, as well as $3.9M in cost disincentives. These recoveries have been applied to the final project cost and in-service amount.

Project #86386 Kakabeka Falls GS Redevelopment. The objective of this project is to redevelop the Kakabeka Falls GS to extend the life of the facility by an additional 90 years. This project is also expected to increase the capacity of the station by an estimated 3.0 MW to approximately 27.4 MW.

At 119 years old, Kakabeka Falls GS is the second-oldest station in OPG's regulated hydroelectric fleet. After over a century of operation, this 24.4 MW station requires significant investment to continue operating safely and effectively. Critical station components, including the surge tank facility, turbine generators, penstock and turbine inlet valves, and penstocks, are reaching the end of their safe operating lifespans.

[11] The total cost is net of cost disincentives and recoveries for damages applied to the project contractor.

Kakabeka Falls GS utilizes an over 100-year-old surge tank facility to provide surge protection for the 2-kilometer-long aqueduct during station load rejections. In the event of a load rejection or station trip, water is discharged through the existing surge overflow pipe over a 50-meter-high cliff, which has historically contributed to cliff and shoreline erosion and can potentially impact fish spawning areas downstream of the station. A failure of the facility could result in an uncontrolled release of water, posting a significant risk to the public and the environment.

The existing turbine generators are nearing the end of their service life, as they were placed in service over 100 years ago. The turbine inlet valves are also approximately 100 years old, with no spare parts available due to obsolescence; any necessary repairs require custom-designed parts. In addition, there is material loss and pitting in all four penstocks, along with localized deformations and leaks.

As part of the project scope, OPG will remove the station's four original turbine generators and associated balance of plant equipment, replace the surge tank building and penstocks, and install two new turbine generator units in a newly constructed building upstream of the existing station. The project will also remove the existing surge overflow pipe and install a new design solution to discharge water through the existing powerhouse into the tailrace area, reducing public safety risks and mitigating environmental impacts. The total estimated project cost is $519.0M. The total forecast in-service amount is $511.0M, with $23.9M during the 2025-2026 bridge period and $487.1M in the forecast period. The planned final in-service is in May 2028.

Project #86387 Matabitchuan GS Redevelopment. The objective of this project is to redevelop the Matabitchuan GS to extend the life of the facility by approximately 90 years. The project is also expected to provide the station with an increase in total generating capacity of an estimated 4.5 MW, for a total of approximately 12.0 MW.

Matabitchuan GS, originally a 7.5 MW station, was first placed in service in 1910 and is now nearing the end of its service life. The powerhouse building's concrete structure is experiencing ongoing differential settlement and concrete deterioration, the bifurcated penstock sections inside the powerhouse show signs of leakage, and the turbine generator units are experiencing

ongoing alignment issues. The generator units no longer provide optimal performance due to extensive wear and deterioration. This project will demolish the existing powerhouse, remove the existing turbine generator units, and construct a new powerhouse foundation, substructure, and superstructure with two new turbine generator units. The total estimated project cost is $190.0M. The total forecast in-service amount is $187.6M, with $4.2M during the 2025-2026 bridge period and $183.4M in the forecast period. The planned final in-service date is in August 2028.

3.2.3 Tier 1 Expansion Projects

Two Tier 1 projects listed in Ex. D1-1-2, Table 1 are categorized as Expansion projects. OPG is treating all of these projects as CRVA-eligible.

Expansion Projects at Planning, Development, or Definition Phase

There are no Expansion projects in the Planning, Development, or Definition phase.

Expansion Projects at, or beyond, the Execution Phase

There are two Expansion projects at, or beyond, the Execution phase.

Project #80581 Ranney Falls GS Expansion Project. The project installed a new 10 MW G3 unit at the Ranney Falls GS, replacing the existing 0.8 MW unit in the second powerhouse that had reached the end of life. The project was completed with a total capital cost and an in-service amount of $74.5M, $2.8M less than its Class 2 Estimate of $77.3M (unchanged from the information presented in EB-2023-0336). Although the project experienced a schedule delay from the generator sustaining damage during final commissioning in 2020, resulting in the final in-service taking place in June 2022, cost impacts were limited as the contractor was financially responsible for all additional work to repair and reassemble the unit. Of the total in-service amount for the project, $53.7M was reviewed as part of EB-2023-0336.[12]

[12] EB-2023-0336, Ex. H1-1-1, Attachment 4 and Table 7b.

Project #84185 Sir Adam Beck 1 GS G1/G2 Replacement. This project replaced the obsolete and previously decommissioned 25Hz G1 and G2 units at the Sir Adam Beck I GS with two new 60Hz units. For each unit, OPG installed a new generator, exciter, transformer, and protection and controls systems, replaced the scroll cases, refurbished the head gates, and replaced the turbine components. The new units have a maximum continuous rating of 57.5 MW each, compared to 40.0 MW for each of the decommissioned units. The project was placed in service in October 2022 with a total cost of $122.8M, which is an increase of $7.0M from the Class 2 Estimate of $115.8M detailed in the first Execution BCS (unchanged from the information presented in EB-2023-0336). The total in-service amount was $112.9M. A superseding budget was established to account for supply chain delays for key components manufactured overseas as a result of the COVID-19 pandemic, as well as replacement of the scroll cases for both units upon discovery of significant deterioration beyond repair. Of the total in-service amount for the project, $11.6M was reviewed as part of EB-2023-0336.[13]

3.2.4 New Tier 1 Sir Adam Beck 1 GS Canal Rehabilitation Projects

One Tier 1 project listed in Ex. D1-1-2, Table 1 concerns the rehabilitation of the Sir Adam Beck 1 GS canal. OPG is treating all of these projects as CRVA-eligible.

Sir Adam Beck 1 GS Canal Rehabilitation Projects at Planning, Development, or Definition Phase

There is one Sir Adam Beck 1 Canal Rehabilitation project at the Planning, Development, or Definition phase.

Project #89252 SAB1 Canal Isolation Preparedness Phase 1. The 13.7-kilometer Sir Adam Beck 1 GS power canal, which supplies water from the Welland River and Niagara River to the Sir Adam Beck generating complex (Sir Adam Beck 1 GS, Sir Adam Beck 2 GS, Sir Adam Beck Pump Generating Station), has exceeded 100 years of service and last underwent a capital refurbishment in 1965. Deterioration of the canal walls, localized collapsed areas, debris accumulation, and weed growth are contributing factors to reduced flow to the Sir Adam Beck generating complex. OPG plans to repair and raise the canal liner to mitigate future

[13] EB-2023-0336, Ex. H1-1-1, Attachment 4 and Table 7b.

deterioration, clear vegetation and stabilize slopes along the canal lands, remove debris that collected at the bottom of the canal, replace the Montrose gate, and repair the closure structure and replace the stop logs.

This is the first of three anticipated projects to rehabilitate the Sir Adam Beck 1 GS power canal. This project concerns the canal closure structure, which was constructed in 1964, for the purpose of ensuring dewatering capability of the Sir Adam Beck 1 GS canal downstream of the Montrose Gate and supporting the Sir Adam Beck 1 GS canal rehabilitation efforts undertaken during this period. In addition to structural deterioration, the closure structure has accumulated debris and rubble along the base of the canal walls, which can obstruct the installation of the stop logs. Failure to properly install the stop logs could hinder the dewatering of the canal, which may be required for future canal maintenance and rehabilitation efforts. Additionally, the Ministry of Transportation may require the canal to be dewatered in the event maintenance and repairs need to be performed on the Highway 420 culvert.

The objective of this project is to rehabilitate the closure structure to ensure its long-term structural integrity and operability. In addition, this project will include the provision of 16 sectional gates for the closure structure that can also be utilized with the Sir Adam Beck 2 GS tunnel outlets. The total estimated project cost is $65.0M with a forecast in-service amount of $65.0M fully during the forecast period. The planned final in-service is in December 2029.

Sir Adam Beck 1 GS Canal Rehabilitation Projects at, or beyond, the Execution Phase

There are no Sir Adam Beck 1 canal rehabilitation projects that are at, or beyond, the Execution phase.

3.2.5 Abitibi Canyon GS Concrete and Sluiceway Rehabilitation

One Tier 1 project listed in Ex. D1-1-2, Table 1 concerns the rehabilitation of the Abitibi Canyon GS concrete structures and sluiceway system. OPG is treating all of these projects as CRVA-eligible.

Abitibi Canyon GS Concrete and Sluiceway Rehabilitation Projects at Planning, Development, or Definition Phase

There are no Abitibi Canyon GS concrete and sluiceway rehabilitation projects that are at the Planning, Development, or Definition phase.

Abitibi Canyon GS Concrete and Sluiceway Rehabilitation Projects at, or beyond, the Execution Phase

There is one Abitibi Canyon GS concrete and sluiceway rehabilitation project that is at, or beyond, the Execution phase.

Project #89505 Abitibi Canyon GS Concrete Rehabilitation – Zone 7. The objective of this project is to repair and rehabilitate a segment of the downstream face of the main gravity structures to eliminate the risks of falling concrete debris and extend the life of the concrete wall surfaces. Abitibi Canyon GS has experienced a gradual deterioration of its dam concrete structure surfaces since its commissioning in 1933. All exposed downstream faces now show signs of advanced surface scaling, spalling, cracking, staining, efflorescence and delamination, with concrete debris dislodged by these processes posing a potential hazard to the powerhouse equipment and operating staff on the transformer deck roof.

The downstream face has been organized into seven zones, with Zone 3 and a portion of Zone 4 managed by predecessor project #87192 Abitibi Canyon Dam Downstream Concrete (refer to Ex. D1-1-2, Table 2b). A portion of the west gravity wall, labelled Zone 7, was initially included in the scope of work of project #87192 but was separated into a distinct project to facilitate expedited rehabilitation given the extensive degradation discovered during concrete demolition in project #87192. The total estimated project cost is $35.6M. The total forecast in-service amount is $26.4M, with $25.0M during the 2025-2026 bridge period. The planned final in-service is in April 2026.

4.0 CAPITAL PROJECT IN-SERVICE INFORMATION – REGULATED HYDROELECTRIC

OPG's actual and forecast regulated hydroelectric in-service capital additions for the period 2016-2031 are summarized in Ex. D1-1-2, Table 4. In addition to annual information, as per the OEB's filing requirements issued in EB-2024-0136, Ex. D1-1-2, Table 4 summarizes capital in-service additions for each of the forecast period (2027-2031) and the two previous periods (2022-2026 and 2016-2020) to support a term-over-term analysis of the in-service additions, below.

The forecast in-service amounts in the bridge years (2025-2026) and forecast period (2027-2031) represent a combination of the following:

- Projected in-service amounts for specific allocated Tier 1, 2, and 3 projects as presented in Ex. D1-1-2, Tables 1-3, and
- A supplemental in-service amount forecasting in-service declarations for unallocated projects that can be expected in the bridge years and forecast period. The supplemental in-service amount assumes currently unallocated projects will eventually become allocated projects with an approved BCS. Supplemental in-service forecasts are based on an initial estimate of total project costs based on work of a similar nature.

The timing of in-service project-specific forecast amounts could change as completed work packages for specific projects may be deemed ready for service earlier or later than forecasted.

Numerous factors can affect both the amount of an in-service declaration and its timing. In-service amounts can vary relative to forecast year-over-year, driven by changes in the level of capital expenditures and the timing of project installations which are frequently tied to specific unit or station outages. Also, if a project that is forecast for completion in a particular year is delayed by even a month or two such that it carries into the following year, it has an impact on actual in-service amounts for both years. Resolution of final project acceptance issues may also shift in-service timing.

The amount of the in-service declaration can also be directly affected by project cancellation decisions. After a project is cancelled, alternative replacement projects may be pursued; when alternative replacement projects are pursued, the in-service date may ultimately be at an earlier or later date than the cancelled project.

OPG is requesting that the OEB approve forecasted rate base in-service additions for its regulated hydroelectric facilities of $841.5M in 2027. As discussed in Ex. A1-3-2, the Application proposes to set regulated hydroelectric payment amounts using a price-cap index custom IR framework, inclusive of a custom capital factor designed to recover incremental revenue each year necessary to support incremental capital investments required over the forecast period. The calculation of the custom capital factor uses the following rate base amounts for 2028-2031: $1,104.7M, $1,115.5M, $938.5M, and $627.1M in 2028, 2029, 2030, and 2031 respectively, as presented in Ex. D1-1-2, Table 4.

OPG's planned total capital in-service additions for the regulated hydroelectric facilities are $4,627.3M over the 2027-2031 period, which represents an increase of $2,535.7M from 2022-2026 in-service additions of $2,091.5M (2025 and 2026 being forecast). The total increase in in-service additions is mainly comprised of the following:

- An increase for portfolio projects of +$583.3M
- An increase for refurbishment projects of +$1,437.6M
- An increase for redevelopment projects of +$369.3M
- A decrease for expansion projects of +$123.6M
- An increase for the Sir Adam Beck 1 GS Canal Rehabilitation program of +$190.0M
- An increase for the Abitibi Canyon GS Concrete and Sluiceway Rehabilitation program of +$80.1M

Term-over-term variances between the forecast period (2027-2031) and the previous period (2022-2026) are presented in Ex. D1-1-2, Table 4 and are explained below.

4.1 Portfolio Projects

During the forecast period, in-service additions for portfolio projects (both allocated and unallocated) are forecasted to total $1,666.6M, an increase of $583.3M from the previous period's in-service additions of $1,083.4M. This term-over-term change consists of increases in in-service additions for Niagara Region (+$41.1M), Eastern Region (+$208.8M), and Western Region (+$333.4M).

Niagara Region

During the forecast period, in-service additions (both allocated and unallocated) for portfolio projects in Niagara Region are forecasted to total $303.3M. This is an increase of $41.1M from the previous period's in-service additions of $262.2M in 2022-2026. This increase is driven primarily by a significant increase in in-service additions for crane and lifting device projects, including the replacement of the headworks and powerhouse cranes at Sir Adam Beck Pump GS and Sir Adam Beck 2 GS, respectively. For more information on this work, see projects #86920 Sir Adam Beck Pump GS Headworks Crane Replacement and #89025 Sir Adam Beck 2 GS Powerhouse Crane Replacement in Ex. D1-1-2, Table 2b.

Eastern Region

During the forecast period, in-service additions (both allocated and unallocated) for portfolio projects in Eastern Region are forecasted to total $739.0M. This is an increase of $208.8M from the previous period's in-service additions of $530.2M in 2022-2026. This increase is driven in part by in-service additions forecasted for projects under OPG and NYPA's joint works agreement, including Tier 1 projects #86595 R.H. Saunders GS: Long Sault Dam Capital Program, project #87142 R.H. Saunders GS: Massena Canal Dam and project #87575 R.H. Saunders GS: Long Sault Dam Downstream Concrete Rehabilitation. See Section 3.1.2 for more information on these projects.

Western Region

During the forecast period, in-service additions (both allocated and unallocated) for portfolio projects in Western Region are forecasted to total $624.3M. This is an increase of $333.4M from the previous period's in-service additions of $291.0M in 2022-2026. This increase is

driven by large concrete rehabilitation undertakings in the region, including a dam rehabilitation at Aguasabon GS (project #87217 Aguasabon Dam Rehabilitation: Hayes Lake Main Dam, see Section 3.1.3 for more information), spillwall rehabilitation at Alexander GS and water conveyance system upgrade at Aguasabon GS.

4.2 Turbine-Generator Refurbishment Projects

During the forecast period, in-service additions (both allocated and unallocated) for turbine-generator refurbishment projects are forecasted to total $1,914.3M, an increase of $1,437.6M from 2022-2026 in-service additions of $476.7M. This increase is driven in part by an increase in turbine-generator refurbishment activity in the forecast period. As discussed in Ex. F1-1-1, Section 3.2.1, during the forecast period, 53 units are planned to have their refurbishment projects completed and placed in service. Some of the largest in-service additions will take place under the following projects:

- Project #86937 R.H. Saunders GS G16 Refurbishment
- Project #87768 Sir Adam Beck 2 GS G20 / G19 Refurbishment
- Project #87356 Sir Adam Beck 2 GS G18 / G17 Refurbishment
- Project #86372 Sir Adam Beck 1 GS G6 / G8 Refurbishment

Fewer refurbishment projects were completed (or are forecasted to be completed) during the 2022-2026 period, with OPG's largest generating stations seeing the following completed:

- Project #83495 R.H. Saunders GS G9 Refurbishment
- Project #86587 R.H Saunders GS G12 Refurbishment

See Section 3.2.1 for more information on these refurbishment projects.

4.3 Station Redevelopment Projects

During the forecast period, in-service additions for station redevelopment projects are forecast to total $716.9M, an increase of $369.3M from 2022-2026 in-service additions of $347.6M. This reflects the completion of the redevelopment projects initiated in the previous period, primarily at Kakabeka Falls GS (project #86386 Kakabeka Falls GS Redevelopment) and

Matabitchuan GS (project #86387 Matabitchuan GS Redevelopment). See Section 3.2.2 for more information on these redevelopment projects.

4.4 Expansion Projects

There are no in-service additions in the forecast period, a decrease of $123.6M from the previous period's in-service additions of $123.6M. Project #84185 Sir Adam Beck 1 GS G1 / G2 Replacement and project #80581 Ranney Falls Expansion Project were placed in service in the previous period. Refer to Section 3.2.3 for more information on both projects.

4.5 Sir Adam Beck 1 GS Canal Rehabilitation

During the forecast period, in-service additions (both allocated and unallocated) for the Sir Adam Beck 1 GS Canal Rehabilitation program are forecasted to total $190.0M, an increase of $190.0M from the previous period when there were no in-service additions for such projects.

4.6 Abitibi Canyon GS Concrete and Sluiceway Rehabilitation

During the forecast period, in-service additions (both allocated and unallocated) for the Abitibi Canyon GS Concrete and Sluiceway Rehabilitation program are forecasted to total $131.4M, an increase of $80.1M from the previous period's in-service additions of $51.3M. This increase is driven by the in-service additions forecasted as part of the sluiceway system rehabilitation later in the forecast period.

5.0 CAPITAL PROJECT IN-SERVICE INFORMATION: EXTENDED HISTORICAL YEARS – REGULATED HYDROELECTRIC

Pursuant to the OEB's letter dated September 17, 2024, issued in EB-2024-0136, the Application includes an additional analysis of term-over-term historical data (2017-2021 vs. 2022-2026) for OPG's regulated hydroelectric business below.

During the 2022-2026 period, OPG's capital in-service additions for the regulated hydroelectric facilities total $2,091.5M (2025 and 2026 being forecast), an increase of $1,149.5M from the previous five-year period's in-service additions of $942.0M between 2017-2021. The increase in capital in-service additions is mainly due to the following:

- An increase for portfolio projects of +$373.8M
- An increase for refurbishment projects of +$315.3M
- An increase for redevelopment projects of +$347.6M
- An increase for expansion projects of +$58.2M
- An increase for the Abitibi Canyon GS Concrete and Sluiceway Rehabilitation program of +$51.3M

5.1 Portfolio Projects

In-service additions for portfolio projects are forecasted to total $1,083.4M in the 2022-2026 term, an increase of $373.8M from the 2017-2021 previous term's in-service additions of $709.6M. This term-over-term change reflects increases in in-service additions for Niagara Region (+$120.5M), Eastern Region (+$185.6M), and Western Region (+$67.7M).

Niagara Region

In-service additions (both allocated and unallocated) for portfolio projects in Niagara Region are forecasted to total $262.2M in the 2022-2026 period. This is an increase of $120.5M from the 2017-2021 period's in-service additions of $141.7M. This increase is driven in part by several significant concrete rehabilitation investments in the region, including the rehabilitation of the concrete on the Sir Adam Beck 2 GS rock cliff (project #86491 Sir Adam Beck 2 GS Rock Cliff Concrete Rehab) and the rehabilitation of penstock concrete at Sir Adam Beck 2 GS (project #87951 Sir Adam Beck 2 Penstock Concrete Restoration). Other contributing factors include increased in-service additions from investments in electrical equipment and infrastructure, including the upgrade of the DC service system at Sir Adam Beck 2 GS (project #80812 Sir Adam Beck 2 GS Battery Banks and DC System Upgrade). Refer to Ex. D1-1-2, Table 2a for more information on these projects.

Eastern Region

In-service additions (both allocated and unallocated) for portfolio projects in Eastern Region are forecasted to total $530.2M in the 2022-2026 period. This is an increase of $185.6M from the 2017-2021 period's in-service additions of $344.6M. This increase is driven in part by large undertakings in concrete rehabilitation, notably the rehabilitation of the Frederick House Lake

Dam (project #83194 Frederick House Lake Dam Rehabilitation, see Section 3.1.2 for more information on this project). Other notable in-service additions come from the remediation of the Wanapitei control dam (project #86310 Wanapitei Civil Upgrades) and the mitigation of AAR-induced concrete expansion (refer to Ex. F1-1-1, Section 3.2.3) by rehabilitating impacted powerhouse structural components at R.H. Saunders GS (project #89543 R.H. Saunders GS Concrete Rehabilitation). See Ex. D1-1-2, Table 2b for more information on these projects.

Western Region

In-service additions (both allocated and unallocated) for portfolio projects in Western Region are forecasted to total $291.0M in the 2022-2026 term. This is an increase of $67.7M from the 2017-2021 period's in-service additions of $223.3M. This increase is driven in part by large in-service additions from electrical infrastructure replacements at Alexander GS (project #82378 Alexander GS Station Switchgear, Protections and Controls Replacement) and Cameron Falls GS (project #82390 Cameron Falls GS T1 and T2 Replacement). See Ex. D1-1-2, Table 2a for more information on these projects. Western Region is also seeing greater investment in cranes and lifting devices in the 2022-2026 period, with powerhouse crane replacements at Manitou Falls GS, Cameron Falls GS, Alexander GS and Pine Portage GS.

5.2 Turbine-Generator Refurbishment Projects

In-service additions (both allocated and unallocated) for turbine-generator refurbishment projects are forecasted to total $476.7M in the 2022-2026 period, an increase of $315.3M from the 2017-2021 period's in-service additions of $161.4M. This increase in refurbishment-related in-service additions is driven by an increase in turbine-generator refurbishment activity in the 2022-2026 period relative to 2017-2021.

5.3 Station Redevelopment Projects

In-service additions for redevelopment projects are forecasted to total $347.6M in the 2022-2026 period, an increase of $347.6M from the previous period's in-service additions of $0.0M. This change is driven by placing in service the redeveloped Calabogie GS (project #82089 Calabogie GS Redevelopment) as well as the planned partial in-service of the Coniston GS and Stinson GS redevelopment (project #82087 Coniston GS / Stinson GS Redevelopment).

See Section 3.2.2 for more information on these projects. No redevelopment projects were completed during the 2017-2021 period.

5.4 Expansion Projects

In-service additions for expansion projects are forecasted to total $123.6M in the 2022-2026 period, an increase of $58.2M from the 2017-2021 period's in-service additions of $65.4M. This increase is driven by the completion of the installation of new units G1 and G2 at Sir Adam Beck 1 GS (project #84185 Sir Adam Beck 1 GS G1 / G2 Replacement). During the 2017-2021 period, $11.7M was placed in service on the same project, along with $53.7M from the completion of the installation of Unit G3 at Ranney Falls GS (project #80581 Ranney Falls Expansion). Refer to Section 3.2.3 for more information on both projects.

5.5 Abitibi Canyon GS Concrete and Sluiceway Rehabilitation

In-service additions for the Abitibi Canyon GS Concrete and Sluiceway Rehabilitation program are forecasted to total $51.3M in the 2022-2026 period, an increase of $51.3M from the 2017-2021 period's in-service additions of $0.0M. The capital program began in 2023 with the execution of project #87192 Abitibi Canyon Dam Downstream; refer to Ex. D1-1-2, Table 2b for more information on this project.

6.0 CAPITAL PROJECT LISTING – HYDRO COMMON

This section details allocated Tier 1 Hydro Common projects (as described in Ex. D1-1-1, Section 6.0) and outlines a term-over-term comparison of their in-service additions. In-service additions for Hydro Common projects are presented in Ex. D1-1-2, Table 4. Amounts described in this exhibit represent total project costs and in-service amounts; the costs for these joint use projects are charged to the regulated hydroelectric facilities through the use of asset service fees in accordance with the methodology described in Ex. F3-2-1.

6.1 Hydro Common Projects

There are two Tier 1 Hydro Common projects listed in Ex. D1-1-2, Table 1. The discussion of these projects is presented by their stage in the project life cycle.

Hydro Common Projects at Planning, Development or Definition Phase

There are two Hydro Common projects at the Planning, Development or Definition phase.

Project #87197 Timmins Building Expansion. This project will renovate and expand the Timmins Service Centre to accommodate 70 additional workstations, along with support areas including washrooms and meeting rooms. The original centre, a 16,254 square foot facility with approximately 100 workstations, is currently operating at full capacity with no space to accommodate additional staff. Three office trailers have been added on the Timmins site to support 20 additional workstations; these trailers are now at full capacity as well. This project will construct an addition of approximately 12,000 square feet to the Timmins Service Centre, supporting OPG's increased hydroelectric project portfolio, within the Western Region, by accommodating additional necessary project, production, and support staff. This project will also renovate the existing building and upgrade windows, doors, heating and ventilation, electrical distribution equipment and mechanical equipment. The total estimated project cost is $35.1M. The planned final in-service is in December 2028, with an in-service amount during the forecast period of $30.9M.

Project #87329 Dymond Machine Shop Expansion. The objective of this project is to expand OPG's Dymond Machine Shop, which provides machining, fabrication, and welding services to the Renewable Generation facilities. The project will construct a 23,320 square foot addition to the building, install a 60-tonne overhead crane to support new equipment installation and shop maintenance, install a 10-tonne overhead crane to support welding, cutting and fabrication operations, install a new boring mill, and replace the existing shop lathe. The existing lathe, which is no longer able to meet required machining tolerances, has reached the end of its life and has since been taken out of service; this project will replace the lathe with a new, five-axis large turn mill computer numerical control lathe to machine wicket gates and turbine generator shafts. The existing boring mill is not large enough to accommodate headcovers or bottom rings from larger vertical turbine generating units within OPG's hydroelectric fleet, necessitating the addition of a larger, more advanced mill to manage these components. This project is necessary to prepare the Dymond Machine Shop for supporting OPG's turbine-generator overhaul and refurbishment programs, reducing the risk of schedule

delays due to reliance on OEMs and external machining shops. The total estimated project cost is $44.3M. The planned final in-service is in December 2027, with an in-service amount during the forecast period of $40.4M.

Hydro Common Projects at, or beyond, the Execution Phase

There are no Hydro Common projects at, or beyond, the Execution phase.

6.2 Term-over-Term Comparison: 2027-2031 vs. 2022-2026 – Hydro Common

During the 2027-2031 forecast period, in-service additions for Hydro Common assets are forecasted to total $109.4M. This is an increase of $76.3M from the previous period's in-service additions of $33.1M in 2022-2026 and is primarily driven by Tier 1 projects #87197 Timmins Building Expansion and #87329 Dymond Machine Shop Expansion, which are forecasted to achieve final in-service early in the forecast period.

6.3 Term-over-Term Comparison: Extended Historical Years – Hydro Common

During the 2022-2026 period, in-service additions for Hydro Common assets are forecasted to total $33.1M, an increase of $20.2M from the previous period's in-service additions of $12.9M in 2017-2021. This increase is primarily driven by the implementation of information technology investments, including the standardization of OPG's supervisory control and data acquisition system and the development of a fleet-wide inflow forecasting system.

LIST OF ATTACHMENTS

Attachment 1: Business Case Summaries and Supporting Information

Note: Business Case Summaries included in Attachment 1 are marked “Confidential” or “Internal Use Only”, however, OPG has determined them to be non-confidential either in their entirety or with redactions as indicated.

Attachment 1

1.0 Business Case Summaries

Provided below is a list of projects with a total project cost (actual or forecast) of $30M or greater. The business case summaries ("BCS") and any applicable Project Over-Variance Approvals ("POVA") for the projects listed are attached. This list of releases can also be found in Ex. D1-1-2, Table 6.

Tab	Facility	Business Case Summary (BCS) Title	Project Number	BCS Approval Date	BCS Status
1	Ranney Falls	Ranney Falls Expansion Project	80581	Mar-17	Full Release Execution
2	Sir Adam Beck Pump Generating Station	Sir Adam Beck Pump GS - Reservoir Refurbishment	80583	Aug-15	Full Release Execution
3	Sir Adam Beck 1	Sir Adam Beck I GS - G10 Major Overhaul & Upgrade	80649	Aug-16	Superseding Execution
4	DeCew Falls 2	G2 Overhaul & Upgrade	80851	Apr-16	Full Release Execution
5	Coniston/ Stinson	Coniston/Stinson GS Redevelopment	82087	Nov-24	Full Release Execution
6	Calabogie	Calabogie GS - Redevelopment	82089	Oct-22	Superseding Execution
7	Alexander	G1 Capital Refurb	82391	Apr-23	Full Release Development
8	Otter Rapids	Otter G1 Capital Upgrade	82542	Nov-24	Full Release Execution
9	Otter Rapids	Otter G2 Capital Upgrade	82543	Jul-25	Superseding Execution
10	Sir Adam Beck 1	Sir Adam Beck 1 GS - Unit G5 Upgrade	82777	Sep-21	Superseding Execution
11	Abitibi Canyon	ABI - G1 Capital Upgrades	83148	Mar-25	Full Release Execution
12	Abitibi Canyon	Abitibi - G2 Capital Upgrades/HG	83155	Dec-19	Full Release Execution
13	Abitibi Canyon	Abitibi - G2 Capital Upgrades/HG	83155	Aug-24	Over-Variance Execution

Tab	Facility	Business Case Summary (BCS) Title	Project Number	BCS Approval Date	BCS Status
14	Frederick House	Frederick House Lake Dam Upgrades	83194	May-23	Full Release Execution
15	R.H. Saunders	SAU - G9 Capital Refurbishment	83495	Aug-24	Superseding Execution
16	Silver Falls	Surge Tank Replacement	83833	Mar-21	Full Release Development
17	Sir Adam Beck 1	SAB G1/G2 Replacement	84185	Oct-20	Full Release Execution
18	Sir Adam Beck 1	SAB G1/G2 Replacement	84185	Oct-20	Over-Variance Execution
19	Chenaux	CHE - Limerick Isl. Spr Structure Sluice Gate Hoist	84494	Dec-20	Full Release Execution
20	Northwest Operations	NWO Work Centre Building	84901	Jul-25	Full Release Execution
21	Otter Rapids	Otter Project Camp	84907	Apr-23	Full Release Execution
22	Sir Adam Beck 1	SAB1 Station Service Upgrade	86364	Jul-23	Full Release Definition
23	Sir Adam Beck 1	BK1 G6 G8 Refurbishment	86372	May-25	Full Release Definition
24	Kakabeka Falls	Kakabeka Falls GS	86386	Nov-24	Full Release Execution
25	Matabitchuan	Matabitchuan GS	86387	Mar-25	Full Release Execution
26	Sir Adam Beck 1	BK1 G4 Refurbishment	86570	Dec-24	Full Release Execution
27	R.H. Saunders	SAU - G12 Capital Refurbishment	86587	May-24	Full Release Execution
28	R.H. Saunders	SAU – Long Sault Dam Capital Program (JW)(NYPA)	86595	Mar-23	Full Release Development
29	Alexander	G2 Capital Refurb	86792	May-25	Superseding Development
30	Alexander	G3 Capital Refurb	86793	Jun-23	Full Release Development

Tab	Facility	Business Case Summary (BCS) Title	Project Number	BCS Approval Date	BCS Status
31	Manitou Falls	MAN G3 Capital Refurb	86860	Dec-24	Full Release Development
32	R.H. Saunders	SAU - G16 Capital Refurbishment	86937	Nov-24	Full Release Definition
33	R.H. Saunders	SAU - Massena Canal Dam (JW)(NYPA)(CAP)	87142	Mar-23	Full Release Definition
34	Timmins	Timmins Building Expansion	87197	Sep-24	Full Release Development
35	Aguasabon	Aguasabon Dam Rehab. Hayes Lake Main Dam	87217	Aug-23	Full Release Development
36	Dymond	Dymond Shop Machine Expansion	87329	Apr-25	Superseding Development
37	Sir Adam Beck 2	BK2 G18 G17 Refurbishment	87356	May-25	Full Release Development
38	Sir Adam Beck 2	BK2 G14 G13 Refurbishment	87357	May-25	Full Release Development
39	Sir Adam Beck 2	BK2 230kV Conductor Replacement	87362	Mar-25	Full Release Development
40	R.H. Saunders	SAU - Long Sault Dam Downstream Concrete JW NYPA	87575	Jun-24	Full Release Development
41	Sir Adam Beck 2	BK2 G20/G19 Refurbishment	87768	Dec-24	Full Release Definition
42	Sir Adam Beck 1	SAB1 Canal Isolation Preparedness Phase 1 (SAB1 CIP1)	89252	Jul-25	Full Release Definition
43	Otto Holden	OTO - Refurbish Stop Log Sluice Piers	89354	Oct-24	Partial Release Definition
44	Abitibi Canyon	Abitibi Canyon Concrete Repair Zone 7	89505	Apr-25	Full Release Execution

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Type 3 Business Case Summary

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

Executive Summary and Recommendations

Project Information			
Project #:	COR80581 (HDEV 0024)	**Document #:**	QC10-22260-0001
Project Title:	Ranney Falls G3 Project		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Business Development Initiative
Phase:	Execution	**Release:**	Full
Facility:	Ranney Falls Generating Station (GS)	**Target In-Service or Completion Date:**	December 31, 2019

Project Overview

We recommend the release of $71.2M, including $7.4M of contingency.
This approval brings the total released for the Project to $77.3M, including definition phase of $6.1M plus execution phase of $71.2M.

The estimated cost of the Execution Phase of the Ranney Falls G3 Project is $74.2M. The Definition Phase cost to date is $3.1M and the Definition Phase release was for $6.1M. We recommend the approval of an incremental release of $71.2M for project execution. The cost estimate is an AACE (Association for the Advancement of Cost Engineering) Class 2 quality estimate, with a 94% confidence level. It includes fixed price contracts with the civil contractor, gates contractor, and Water-to-Wire (W2W) contractor and other costs estimated on the basis of experience with previous OPG hydroelectric development projects.

This release will fund the following scope of work:

- Construction, testing and turnover to Central Operations (CO) of the new 10 MW G3 single unit generating station (GS)
- Transmission connection with Hydro One - point of connection is at site
- Owner's Engineer and other OPG direct costs
- Interest during Construction (IDC)

Problem Statement/Business Need:

The Ranney Falls G3 Project is being undertaken to construct, test and turnover to CO a new 10 MW single unit hydroelectric generating station at OPG's Ranney Falls G3 site. Key drivers of the Project include:
:

- Replaces the existing G3 unit (0.8 MW) that reached end of life in June 2014 and preserves the site for an additional 90 years.
- Offers the opportunity for a reasonable financial return. Project costs are lower than recent renewable procurement price offers on a ¢/kWh basis.
- Utilizes excess water running through existing OPG and Parks Canada water control infrastructure on the Trent River.
- Installing a new spillway integrated with the new G3 powerhouse provides asset protection at the Ranney Falls Generating Station (GS) site and enhances public safety in Campbellford.
- Distribution system connection has been secured and no new distribution line is needed.
- Addition of a clean, renewable source of generation to OPG's capacity and revenue base.
- OPG and area Indigenous communities have discussed capacity building and contracting and construction employment opportunities.
- Project is specifically noted in the Province's proposed Long Term Energy Plan (LTEP); highlights hydroelectric expansions at existing sites as a cost-effective and green way of leveraging provincial assets while avoiding the need for new near-term procurement in Southern and Central Ontario.
- Consistent with OPG's strategic plan and is included in OPG's 2017-19 business plan.
- Provides an opportunity to enhance OPG's long-term relationship with Parks Canada and the Trent Hills Municipality.

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

Type 3 Business Case Summary

Project #: COR80581 (HDEV 0024)
Project Title: Ranney Falls G3 Project, <Full> <Execution> Release
Document #: QC10-22260-0001

Project Overview

Summary of Preferred Alternative:

The Ranney Falls G3 Project is being undertaken to construct a new 10 MW single G3 unit in a new powerhouse adjacent to the existing G1 and G2 powerhouse at the Ranney Falls GS site, with an expected in-service date of December 31, 2019. The proposed new G3 unit is replacing the existing 0.8 MW G3 unit that reached end of life in June 2014. The design life of the new asset will be 90 years and the forecast annual incremental generation is 33.1 GWh for an average year, based upon the available 61 years of hydraulic data.

The Project takes advantage of available flows in the Trent River to generate green power. Water is diverted down the Trent Canal from the Trent River by the Parks Canada Dam #10, located 1.4 km upstream of the existing Ranney Falls GS, which was acquired by Ontario Hydro in 1922. The Project is one of the few opportunities in Ontario that has reserved capacity on the Hydro One distribution system. It also has the least environmental impact, as no inundation is required to build the new unit. This Project will result in investment, contracting, employment and training opportunities for the local Trent Hills Municipality economy. Currently, the Project is expected to provide an economic injection of about $25M to the local Campbellford area.

Financial evaluation determined that the Ranney Falls G3 Project compares favourably to other waterpower developments being procured in the province considering enhanced asset protection and public safety at the site. The Power Purchase Agreement (PPA) equivalent price for the Project is 15.9¢/kWh. The Independent Electricity System Operator's Large Renewable Procurement (LRP) I program in March 2016 resulted in a weighted average price of 17.6¢/kWh for the four successful hydroelectric proponents. The Levelized Unit Energy Cost (LUEC) for the Project is 11.7¢/kWh, which is close to the regulated rate that OPG receives for its CO regulated hydroelectric assets.

A Design Bid Build (DBB) contracting approach was selected for the Ranney Falls G3 Project to create more competition between contractors for the relatively small sized project and to avoid mark ups by a general contractor when hiring subcontractors. The detailed design was completed during the Definition Phase to enable OPG to request fixed prices from prequalified suppliers and contractors. In addition, the design was optimized through physical model testing by a Ryerson University team. After a competitive Request for Proposals (RFP) process, GDB Constructeurs was chosen as the contractor to construct the project civil works during Phase One of the execution of the Project. Andritz Hydro Canada Inc. was chosen as the contractor to supply, install, and commission the W2W equipment in Phase Two of the execution of the Project. Gates for the Project are being supplied by Canmec Industriel Inc. OPG is "Owner-only" in both phases of the Project, with GDB and Andritz acting as the "Constructor" in Phases One and Two, respectively. Each of the contracts is based on OPG's Engineering, Procurement and Construction (EPC) template, with a fixed price to limit the risk of cost overruns on the Project.

History of BCS releases and project cost estimates:

In December 2011, the partial release of $6.1M was approved to initiate key Definition Phase activities and ready the Project for execution. Work included detailed engineering, design of critical long-lead time equipment (i.e. turbine/generator), project construction planning and permit application activities.

Key activities completed during the Definition Phase of the project included:

- negotiating the EPC agreements with the civil contractor (GDB), gates contractor (Canmec) and W2W contractor (Andritz)
- Completing an extensive geotechnical investigation at the site
- Completing engineering design (approximately 100%)
- Obtaining the federal environmental assessment approval and key permits, including extensive communication with several Federal and Provincial agencies and area First Nations
- Obtaining the Transport Canada approval and key permits
- Completing the Permit To Take Water exemption process
- Securing the 10 MW capacity on the distribution grid and executing the Hydro One Cost Connection Recovery Agreement (CCRA)

Key Assumptions and Risks:

The Project faces execution risks common to new hydroelectric projects, including discovery of unknown adverse geotechnical conditions, resourcing and contractor interface management.

Type 3 Business Case Summary

Project #: COR80581 (HDEV 0024)
Project Title: Ranney Falls G3 Project, <Full> <Execution> Release
Document #: QC10-22260-0001

Project Cash Flows, NPV, and OAR Approval Amount

M$	LTD	2016	2017	2018	2019	2020	Future	Total
Currently Released	6.1							6.1
Requested Now	-		39.2	22.5	9.1	0.4		71.2
Future Required	-							
Total Project Cost	6.1		39.2	22.5	9.1	0.4		77.3
Ongoing Costs	-							
Grand Total	6.1		39.2	22.5	9.1	0.4		77.3

Estimate Class:	Class 2	**Estimate at Completion:**	$77.3M
NPV:	N/A	**OAR Approval Amount:**	$77.3M

Additional Information on Project Cash Flows (optional):

Approvals

	Signature	Comments	Date
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Carlo Crozzoli SVP, Corporate Business Development & Strategy			Feb 3/17.
Mike Martelli President, Renewable Generation & Power Marketing			6 Feb 17
I concur with the business decision as documented in this BCS.			
Finance Approval: Ken Hartwick SVP Finance, Strategy, Risk & CFO per OPG-STD-0076			March 14, 2017
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Jeffrey Lyash President & Chief Executive Officer per OAR 1.3			March 14, 2017

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Type 3 Business Case Summary

Project #: COR80581 (HDEV 0024)
Project Title: Ranney Falls G3 Project, <Full> <Execution> Release

Document #: QC10-22260-0001

Business Case Summary

Part A: Business Need

The Ranney Falls G3 Project is being undertaken to construct, test and turnover to CO a new 10 MW single G3 unit at the Ranney GS site. The new hydroelectric unit replaces the existing 0.8 MW G3 unit that reached end of life in June 2014. The expected in-service date is December 31, 2019. The asset life will be 90 years and the forecast annual incremental energy production of the generation station is 33.1 GWh. The Project takes advantage of flows diverted down the Ranney canal from the Trent River by the Parks Canada Control Dam #10, which was constructed by the crown in 1882. The head (approximately 14.37 m) and flow available at the proposed site provide an opportunity to develop a renewable energy resource and meet OPG's objective of maintaining and expanding its hydroelectric asset base, while utilizing the existing infrastructure of OPG and Parks Canada. The existing Ranney Falls G1 and G2 that were built in 1922 are approaching end of life within the next 15 to 20 years. Execution of the Ranney Falls G3 Project preserves the Ranney Falls GS site for an additional 90 years.

The Trent Canal is sensitive to Ranney GS operations because it is a run-of-the-river station with a very small storage capacity (3 m^3/s-day), with no spilling capacity. The Trent-Severn Waterway (TSW) owned and operated control dam is 1.4 km upstream of the station. Therefore, timely diversion of the flow away from Ranney GS is important in emergency shutdown situations. However, there are inevitable delays associated with mobilizing the TSW staff to manually operate TSW Dam #10 to divert the flow. A major issue with the status quo is that CO will continue to be exposed to the risk of flooding the residential areas along the Trent Canal leading to Ranney GS. This risk is credible as an overtopping event occurred in the past. Although TSW is responsible for operating the control dam when the station is down for any reason, including the outages imposed by Hydro One, the reputation of OPG is associated with any delay or failure to perform this critical operation in a timely manner. Including the new spillway as an integrated part of the new powerhouse is a major enhancement to asset protection and public safety for the newly developed Ranney GS site. The new spillway will allow for passing the flow from the new unit and also from any of the two existing units (G1 and G2) at the site.

The Ranney Falls Generating Station is included in OPG's regulated hydroelectric assets and the Ranney Falls G3 Project is expected to receive a regulated rate that reflects cost recovery and a return on capital. OPG will prepare comprehensive evidence to demonstrate that project costs were prudently incurred and their recovery is consistent with applicable regulatory principles. The Ranney Falls G3 Project measures up well against other hydroelectric developments being procured in the province. When evaluated at a 70% debt ratio (higher leverage than the deemed debt ratio allows for a more accurate comparison with LRP I hydroelectric projects), the PPA equivalent price is 15.9¢/kWh, well below the 17.6¢/kWh weighted average price of the successful LRP I proponents. The LUEC for the Project is 11.7¢/kWh, which is close to the regulated rate of 10.7¢/kWh that OPG receives for its CO regulated hydroelectric assets.

Part B: Preferred Alternative: Construct the Ranney Falls G3 Generating Station

Description of Preferred Alternative

Proceed with the Execution Phase of the Ranney Falls G3 Project to have the selected DBB contractors construct, test and turnover to CO, the new G3 10 MW unit. In this alternative, a 10 MW unit is recommended to be installed in a new, smaller powerhouse, next to the existing main powerhouse. The existing forebay structure will also need to be expanded. This alternative does not require a penstock because the expanded forebay will feed the flow directly to the new unit. In addition, the existing tailrace must be expanded to handle the additional discharge from the new unit and spillway as illustrated in the figure below.

The end of life 0.8 MW unit in the "Pup" powerhouse will be mothballed and its penstock will be partially removed and capped to make space for the new powerhouse. The superstructure of the "Pup" powerhouse itself will be left in place for heritage and cultural purposes. A new spillway will be integrated with the new powerhouse to provide asset protection for the existing and new facilities and mitigates the current public safety and reputational risks. The spillway can pass 172 m^3/s outside the navigation season and 120 m^3/s during navigation season, which is the combined flow of all (existing and new) generating units.

Pros:

- The new station takes advantage of unused flows diverted down the Trent River by the Trent Canal.
- Extensive geotechnical investigation completed to help alleviate the geotechnical risk at the site.
- The development meets OPG's stated objective of maintaining assets by replacing the G3 unit that reached end of life, and expanding its hydroelectric asset base utilizing the existing infrastructure.
- The Project preserves the Ranney Falls GS site for an additional 90 years.
- The Project is also identified in the of the proposed Province's Long Term Energy Plan.
- The new station will provide an additional source of income for OPG.

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Part B: Preferred Alternative: Construct the Ranney Falls G3 Generating Station

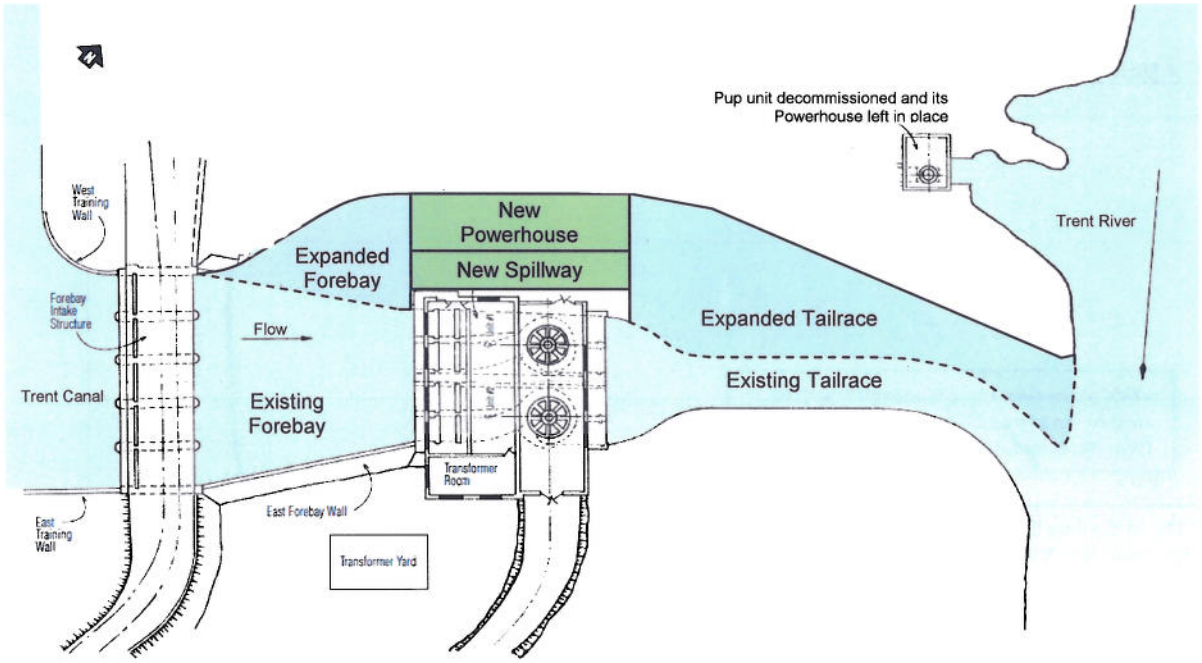
Description of Preferred Alternative

- The Project will result in investment, contracting, employment and training opportunities for Trent Hills Municipality communities. The Project will build on and strengthen OPG's relationship with these communities and Parks Canada.

Cons:

- Like other new construction projects in Ontario, the Ranney Falls G3 Project will face several risks to meeting cost and schedule targets, particularly the labour productivity, potential discovery of adverse geotechnical issues, and contractor interface management. Although extensive geotechnical investigation was completed at this site, the risk is still possible.

Proposed Ranney Falls G3 Project Layout



Deliverables:	Associated Milestones (if any):	Target Date:
Mobilize to site	• Ready the site to start excavation activities	April 2017
Excavate for expanded forebay, spillway, intake, powerhouse and the expanded tailrace canal		October 2017
Concrete work for the forebay wall, intake, spillway, and powerhouse and gate installations		April 2018
Civil work complete		October 2018
Install mechanical and electrical equipment	• Turbine/Generator installed	August 2019
Commission the new Ranney Falls G3 10 MW unit	• Unit In-service	December 31, 2019

Part C: Other Alternatives

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

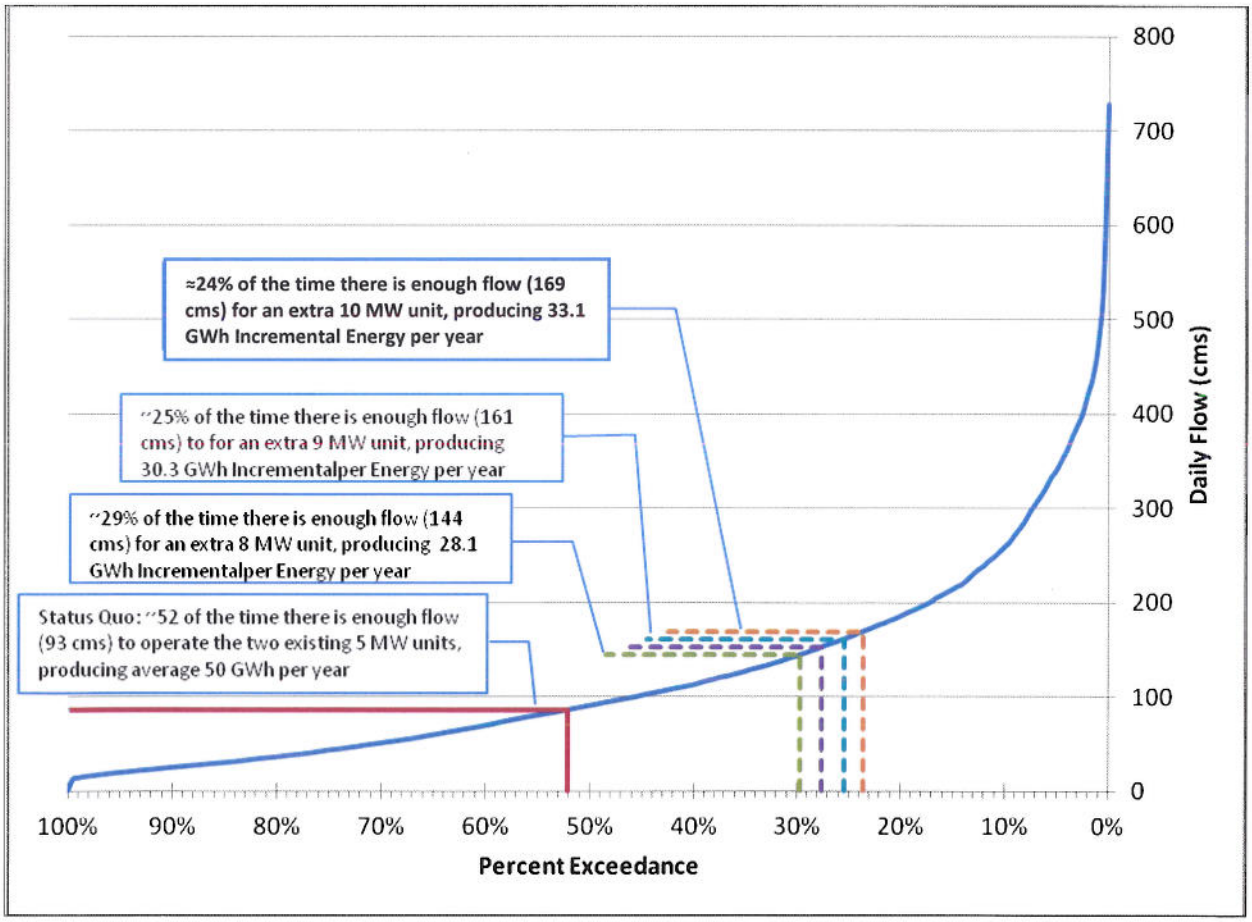
Alternative 2: Base Case – Cancel the Project

Alternative 2: Base Case – Cancel the Project

The "status quo" alternative is not recommended because it represents a lost opportunity in expanding OPG's hydroelectric generation portfolio. It continues to expose OPG to the risk of damage to the site assets and flooding the residential areas along the Trent Canal leading to Ranney GS. With this "status quo" alternative, the Ranney GS is left with a reduced total station capacity of 10.3 MW and average annual energy production by G1 and G2 combined is about 50 GWh. This "status quo" alternative underutilizes the available flow during the non-navigation period (between the long weekends of Thanksgiving in October to Victoria Day in May), which if economically utilized could produce on average an additional 33.1 GWh of electricity in a typical water year. The figure below shows the percentage of available flow spilling at the site for different new unit sizes.

[Type a quote from the document or the summary of an interesting point. You can position the text box anywhere in the document. Use the Text Box Tools tab to change the formatting of the pull quote text box.]

Comparison of Unit Size and Incremental Energy



Pros:

- None.

Cons:

- Lost revenue opportunity with unused flows diverted down the Trent River.
- Continued exposure to flooding risk as the new spillway would not be constructed.
- OPG's relationship with the Municipality of Trent Hills and the community at large will be negatively impacted, as there will be lost project employment and business opportunities.
- The Ranney Falls GS site may not be preserved for OPG generation beyond the expected end of life for the G1 and G2 units (estimated to be within the next 15 to 20 years).

Type 3 Business Case Summary

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

M$	LTD	2016	2017	2018	2019	2020	Future	Total
Currently Released	6.1							6.1
Requested Now	-		39.2	22.5	9.1	0.4		71.2
Future Required	-							
Total Project Cost	6.1		39.2	22.5	9.1	0.4		77.3
Ongoing Costs	-							
Grand Total	6.1		39.2	22.5	9.1	0.4		77.3

Estimate Class:	Class 2	**Estimate at Completion:**	$77.3M
NPV:	N/A	**OAR Approval Amount:**	$77.3M

Additional Information on Project Cash Flows (optional):
See Appendices A and C for further information on Project Cash Flows and Financial Assumptions.

Part E: Financial Evaluation

M$	Execute Project	Cancel Project			
Project Cost	77.3	3.1			
NPV	N/A	-3.1			
Equivalent PPA (¢/kWh)	15.9	N/A			
LUEC (¢/kWh)	11.7	N/A			

Summary of Financial Model Key Assumptions or Key Findings:

Once in service, the Ranney Falls G3 Project is expected to receive a regulated rate that reflects cost recovery of all prudent and reasonable costs, plus a return on capital based on a deemed 55/45 debt/equity capital structure. The Ranney Falls G3 Project measures up well against other hydroelectric developments being procured in the province. When evaluated at a 70% debt ratio (higher leverage than the deemed debt ratio allows for a more accurate comparison with LRP I hydroelectric projects), the PPA equivalent price is 15.9¢/kWh, well below the 17.6¢/kWh weighted average price of the successful LRP I proponents. The LUEC for the Project is 11.7¢/kWh, which is close to the regulated rate that OPG receives for its CO Operations regulated hydroelectric assets.

See Appendix C for additional detail on the financial evaluation and results.

Part F: Qualitative Factors

1. Sustainable Energy Development

The Project meets OPG's stated objective of expanding its hydroelectric asset by constructing 10 MW of emission-free generation. Given the increase in intermittent generation in Ontario, such as wind, additional emission-free generation is extremely valuable. Hydroelectric generation is the most environmentally sustainable form of generation that accomplishes this task. The Project is also identified as a key component to the Province's hydroelectric strategy in the proposed LTEP.

2. Stakeholder Relations

There is broad support for the Project among the Municipality of Trent Hills, Parks Canada, local First Nations and the community at large. The Project will provide employment, training and business opportunities to local stakeholders in the region. Approval of the Project ensures the continued engagement and support of Parks Canada and Trent Hills municipality.

3. Economic Benefits to Central Ontario

A significant portion of the total project expenditure will occur in Central Ontario, resulting in benefits to the local and regional economy. These benefits will include, but not be limited to, contracting opportunities for local businesses, along with training and employment opportunities. The Project will also result in indirect benefits to local businesses due to the increased activity in the area.

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Part F: Qualitative Factors

4. Health and Safety Performance

Safety program/performance was a significant factor in the contractor evaluation process. GDB and Andritz will develop and implement comprehensive site specific safety plans for construction safety, public safety and security. GDB, Canmec and Andritz have demonstrated its commitment and ability to work safely through their participation in previous OPG projects.

5. Project Management Reputation

Successful completion of the Project within budget and on time will enhance OPG's project management reputation with the Provincial Government and regulators and enhance the probability of obtaining future development opportunities.

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	There is a risk that the actual project cost exceeds the approved budget.	The project budget was reviewed and updated with confirmed fixed prices from DBB Contractors. Contingency is included in the cost estimate.	Medium	Low
Scope	There is a risk that the project scope increases in the Execution Phase leading to unexpected costs and schedule delays	The Project completed 100% of the design during the Definition Phase and WSP (the project designer) is a leading hydroelectric engineering firm. Contingency is included in the cost estimate for any residual risk.	Low	Low
Schedule	There is a risk that abnormal weather (in excess of 1 in 20 years), Force Majeure events or critical equipment delivery delays will impact the project schedule.	The Project is carrying contingency to address this risk should it occur. The DBB Contractors have experience working on hydro projects in Ontario and managing adverse weather conditions. The project schedule also has some flexibility built into it and it is possible to recover schedule by increasing the amount of winter work conducted. The fixed price contracts include milestone related payments and liquidated damages for schedule delay.	Low	Low
Resources	There is a risk of a shortage of skilled construction labour for the project.	The construction site is close to a number of centers that are able to supply construction labour.	Low	Low
Quality/ Performance	There is a risk that execution productivity is impacted by interface coordination between the DBB contractors.	The DBB contractors are experienced in performing similar work. The DBB contracts identify interfaces and the contractors are preparing an integrated schedule for the Project. OPG has included contingency in its estimate to cover any residual risk.	Medium	Medium
Technical	There is a risk that unexpected subsurface conditions are discovered during construction, leading to additional costs and/or schedule delays.	A comprehensive geotechnical site investigation was undertaken as part of the Conceptual and Definition phases and led to the creation of a Geotechnical Baseline Report (GBR). The GBR was used to inform engineering/design decisions and the Civil Work contract negotiations. OPG will retain ownership of the risk of unknown adverse geotechnical conditions discovered during construction and hold contingency to address it, if required. The Civil Work	Medium	Medium

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
		contractor will retain ownership of risks related to the design/construction assumptions and dewatering. The Civil Work contractor will conduct the remediation for any geotechnical issues encountered.		

Project Risks will be managed as follows:

1. Risk management will be an agenda item at regular project meetings.
2. New or emerging risks will be identified and included along with the status of existing risks in monthly reports.
3. The project risk register will be maintained throughout the course of the Project.
4. The Project Director will report project risk status through the project reporting processes.
5. Project contingency will be managed through the change control process and supported by a contingency log. A re-assessment of the adequacy of the contingency will be part of the risk monitoring and control processes.

Additional Risk Analysis:

See Appendix E for a summary of the additional risk analysis and results.

Part H: Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Comprehensive PIR	December 31, 2019	December 2020

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
Target In-Service Dates	December 31, 2019	December 31, 2019	Compared with contract completion date and approved changes	RG&PM Project Execution
Actual turbine/ generator output	Output guaranteed in contract	Output guaranteed in contract	Actual turbine/ generator output will be compared to the output guaranteed in the contract	External performance testing consultant
Actual Cost	$77.3M	$77.3M	Cost compared with approved release	OPG Finance

Part I: Definitions and Acronyms

AACE – Association for the Advancement of Cost Engineering
ACF – Annual Capacity Factor
CCA – Capital Cost Allowance
CCRA – Connection Cost Recovery Agreement
CO – Central Operations
DBB – Design Bid Build
EPC – Engineering, Procurement and Construction
GBR – Geotechnical Baseline Report
GS – Generating Station
GWh – Gigawatt hour
IDC – Interest during Construction
kWh – kilowatt-hour
LRP – Large Renewable Procurement
LTEP – Long Term Energy Plan
LUEC – Levelized Energy Cost

Type 3 Business Case Summary

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Part I: Definitions and Acronyms
m^3/s – cubic meters per second
m^3/s – cubic meters per second-day
MW – Megawatt
OM&A – Operating, Maintenance and Administration
PIR - Post Implementation Review
PPA - Power Purchase Agreement
RFP – Request for Proposal
TSW – Trent-Severn Waterway
W2W – Water-to-Wire
WACC – Weighted Average Cost of Capital

Type 3 Business Case Summary

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Type 3 Business Case Summary

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For Internal Project Cost Control

Type 3 Business Case Summary

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Appendix A: Summary of Estimate									
Project Number:	COR80581 (HDEV 0024)								
Project Title:	Ranney Falls G3 Project								
M$	LTD	2016	2017	2018	2019	2020	Future	Total	%
Definition Phase (not including IDC)	3.0			-	-	-		3.0	3.9%
OPG Project Management	-		0.7	0.7	0.6	0.3		2.3	3.0%
Commercial	-		0.15	0.31	-	-		0.5	0.7%
Engineering & Contract Management (Owner's Engineer)	-		0.3	0.4	0.5	0.1		1.3	1.7%
Operations Interface	-		0.12	0.07	0.11	-		0.3	0.4%
Environment	-		0.17	0.07	0.08	-		0.3	0.4%
DBB Allowance	-		0.5	-	-	-		0.5	0.7%
Civil Work Contract (GDB)	-		22.0	12.1	-	-		34.1	44.1%
Gates Contract (Canmec)	-		5.7	1.6	-	-		7.3	9.4%
Water-to-Wire Contract (Andritz)	-		6.0	2.0	5.5	-		13.5	17.4%
Hydro One Connection	-		0.8	-	-	-		0.8	1.0%
EPSCA	-		0.2	0.2	-	-		0.4	0.5%
Interest during Construction	0.1		0.9	2.9	1.7	-		5.6	7.2%
Subtotal	3.1		37.6	20.3	8.5	0.4		69.9	90.4%
Contingency	-		4.6	2.2	0.6	-		7.4	9.6%
Total	3.1		42.2	22.5	9.1	0.4		77.3	100%

Notes			
Project Start Date	Mar-2017	**Total Definition cost** (excludes unspent contingency for Nuclear)	$3.1M
Target In-Service (or AFS) Date	Dec-2019	**Contingency included in this BCS** (Nuclear only)	N/A
Target Completion Date	Dec-2019	**Total contingency released plus contingency in this BCS** (Nuclear only)	N/A
Escalation Rate	2.00%; 0.00% on fixed price contracts	**Total released plus this BCS without contingency** (Nuclear only)	N/A
Interest Rate	4.83%	**Total released plus this BCS with contingency** (Nuclear only)	N/A
Removal Costs	N/A	**Estimate at Completion** (includes only spent contingency for Nuclear)	$77.3M

Type 3 Business Case Summary

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Prepared by:		Approved by:	
Iskander Boulos		Paul Burroughs	
Iskander Boulos	Date	Paul Burroughs	Date
Project Manager	2017-01-~~XX~~	Director	2017-01-~~XX~~
Project Execution		Project Execution	
Renewable Generation & Power Marketing		Renewable Generation & Power Marketing	

Type 3 Business Case Summary

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

Comparison of Total Project Estimates

Phase	Release In M$	Approval Date	Total Project Estimate in M$ (by year including contingency)						Future	Total Project Estimate
			LTD	2016	2017	2018	2019	2020		
Definition Phase	$6.1	Dec-2011	3.1							$48.7
Full Release Execution Phase	$71.2	Mar-2017	3.1		42.2	22.5	9.1	0.4		$77.3

Project Variance Analysis

Choose an item.	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management					
OPG Engineering (including Design)					
OPG Procured Materials					
OPG Other					
Design Contract(s)					
Construction Contract(s)					
EPC Contract(s)					
Consultants					
Other Contracts/Costs					
Interest					
Subtotal					
Contingency					
Total					

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Appendix C: Financial Evaluation Assumptions

Key assumptions used in the financial model of the Project are:

Once in service, the Project is expected to receive a regulated rate that reflects OPG's revenue requirements at that time according to O. Reg. 53/05, as it refurbishes and expands capacity.

Key assumptions used in the financial model of the Project are:

Project Cost:

1. The total project cost is $77.3M.
2. The project cost includes $0.2M of cost escalation, $7.4M of contingency, and $5.6M of interest during construction (IDC).
3. $54.9M of the project cost consists of fixed price construction contracts (Civil Work, W2W, and Gates) which do not receive annual escalation.

Financial:

1. Weighted Average Cost of Capital (WACC) used for LRP I PPA price comparison based on 70/30 debt/equity capital structure, 4.83% cost of debt, 9.33% return on equity, and a tax rate of 25%.
2. PPA equivalent price is based on a 40-year contract term, with 20% of the price escalating at 2.00%/year once the unit goes into service.
3. WACC used for LUEC price is based on a 55/45 deemed debt/equity capital structure, 4.83% cost of debt, 9.33% return on equity, and a tax rate of 25%.
4. LUEC price is based on a 90-year asset life, with 100% of the price escalating at 2.00%/year once the unit goes into service.
5. The IDC rate is 4.83%.
6. General cost escalation during the construction and operating periods is 2.00%/year. Fixed price construction contracts do not escalate.
7. The tax rate is 25% and taxes have been calculated on a stand-alone basis.

Project Life:

1. The asset life is 90 years from the expected in-service date of December 31, 2019.

Energy Production:

1. The 10MW unit is expected to generate an incremental 33.1GWh annually (37.8% Annual Capacity Factor (ACF)) for an average year based upon the available 61 years of hydraulic data.

Operating Cost:

1. The incremental annual OM&A cost associated with the new unit is $50k/year (2016$).
2. The financial forecast includes $300k (2016$) in project specific OM&A, occurring on a 25-year cycle.
3. The Gross Revenue Charge (GRC) is $40/MWh, with escalation beginning in 2020. There is no 10-year GRC holiday on the TSW system.
4. The financial forecast includes $3.3M (2016$) in sustaining capital for turbine-generator overhauls, occurring on a 25-year cycle.

Other:

1. The full project cost is allocated to Capital Cost Allowance (CCA) class 43.2 (50%).

Appendix D: References

1. Ranney Falls G3 Project – Project Charter (Document Number QC10-00120-0003 R000, July 2010)
2. Ranney Falls G3 Project – Project Execution Plan, Definition Phase (Document Number QC10-COR80581-PEP-0000 R000, August 2015)
3. Ranney Falls G3 Project – Project Execution Plan, Execution Phase (Document Number QC10-PLAN-00121.1-0001

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R000, February 2017)
4. Ranney Falls G3 Project – Project Definition Rating Index Report, Stage 3 (December 12, 2016)
5. Ranney Falls G3 Project – Business Case Summary, Definition Phase (Document Number QC10-HDEV0024-BCS R000, December 2011)

Appendix E: Quantitative Risk Assessment Results

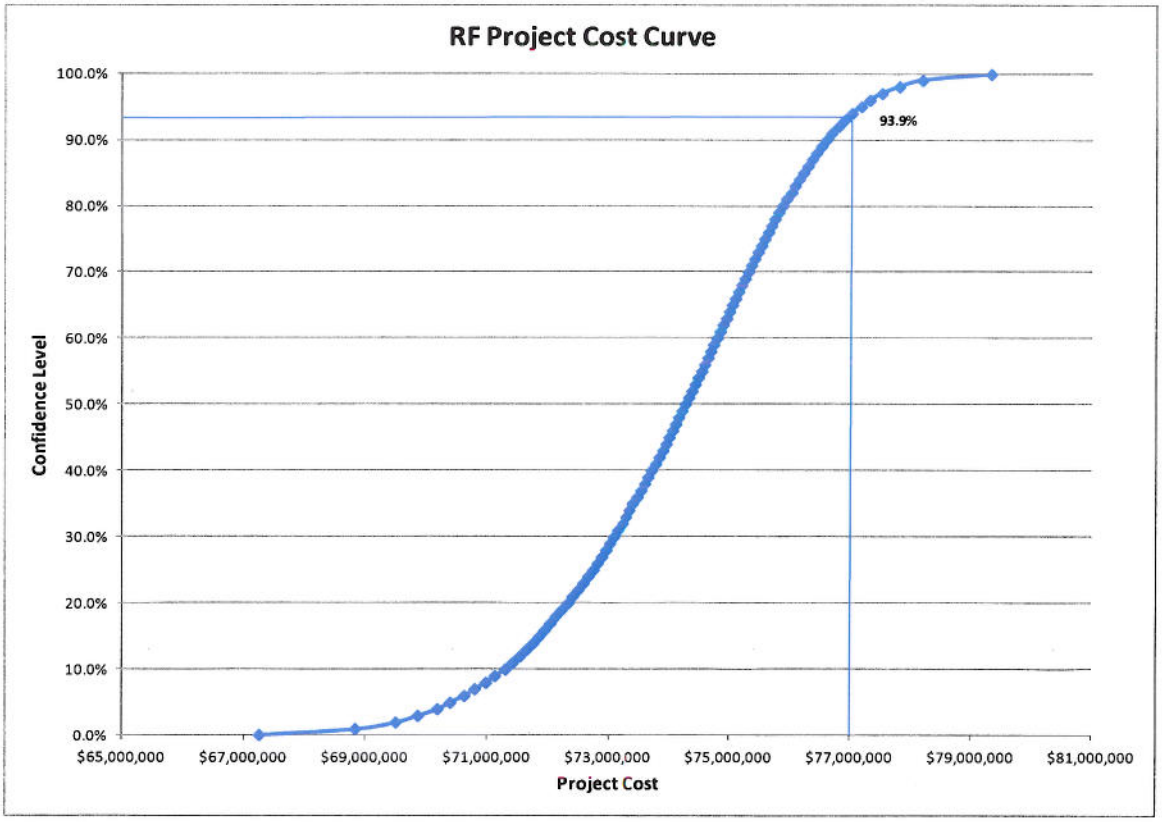
The Ranney Falls G3 Project overall cost estimate includes a Project contingency of $7.4M, which is held by OPG.

The Project completed a quantitative risk assessment to calculate this contingency. The overall cost estimate, including contingency, is expected to be sufficient to cover project costs and risks at a 94% confidence level. The following areas of uncertainty and risk were included in the assessment:

1. Cost Estimate Uncertainty – The Project team provided best case, worst case and most likely estimates for the Owner's, construction work packages, and construction management and engineering consultant costs. This analysis took into account any estimate uncertainty and the likely range that each cost item would fall in.
2. Discrete Project Risks – The Project team developed a detailed register of Execution phase risks through a series of meetings. Likelihood of occurrence and three point estimates for Financial and Schedule Impact were estimated for each of these risks. The Financial Impact of each risk was included in the contingency calculation, while the Schedule Impact was used to conduct a Monte Carlo analysis of the schedule.
3. Schedule Uncertainty – A high-level critical path schedule was created for the purposes of the schedule analysis. The Project team estimated the best case, worst case and most likely durations for each of the high-level schedule tasks. The Schedule Impacts of the discrete risks were then mapped directly to the schedule tasks. A simulation of the project schedule was then conducted using Primavera Pertmaster software to develop probability curves for likely in-service dates for the Project. Potential delays were input into the project cost model using a project run rate calculated by the Project Manager.

   A project cost model was developed in Microsoft Excel 2007, based on the model developed for the Lower Mattagami River Project, New Post Creek Project and Mattagami Lake Generating Station Project. The software @Risk 6 was used to conduct the Monte Carlo Simulation used to develop the project cost distribution curve. The model also takes into account variability related to Interest during Construction and Escalation. The cost probability curve is illustrated below:

Ranney Falls G3 Project – Quantitative Risk Assessment Results



Appendix F

RANNEY FALLS G3 PROJECT RESOLUTION

RESOLUTION OF THE BOARD OF DIRECTORS
OF
ONTARIO POWER GENERATION INC.

Re: Approval of Ranney Falls G3 Generating Station Project

WHEREAS:

A. Ontario Power Generation Inc. ("**OPG**") is finalizing its plans to construct and operate a new 10 MW hydroelectric generating station in Campbellford, in the Municipality of Trent Hills, Northumberland County. The new station is an expansion to OPG's existing hydroelectric station ("**Ranney Falls GS**") and a new unit (the "**G3 Unit**") will replace the former G3 unit, which reached end of life. The new station will also include construction of an integrated spillway to bypass the flow of the existing two units (G1 and G2) and the G3 Unit during emergency situations to protect OPG assets and ensure protection of public safety (the "**Ranney Falls G3 Project**").

B. OPG and Her Majesty the Queen, in right of Canada, represented by the Minister of the Environment for the purposes of Parks Canada Agency ("**Her Majesty**") have entered into an interim licence agreement for the construction of the Ranney Falls G3 Project.

C. Upon completion of construction, OPG and Her Majesty intend to enter into a final licence, which will govern the operation of Ranney Falls GS and the G3 Unit (the "**Final Licence**"). It is anticipated that the Final Licence will have a term of thirty (30) years, with renewals at Her Majesty's discretion. The scheduled in-service date of the G3 Unit is December 31, 2019 and it is estimated to have a useful life of ninety (90) years.

D. The total cost estimate for the Ranney Falls G3 Project is $77.3 million (the "**Estimated Cost**"), including the $6.1 million previously approved on December 2011. OPG intends to finance the Estimated Cost through its cash flow.

E. The Ranney Falls GS is a regulated hydroelectric asset pursuant to O. Reg. 53/05 under the *Ontario Energy Board Act, 1998* and OPG expects to recover the Estimated Cost through the rate regulation process.

F. The project design has been completed and the environmental assessment for the project has been approved.

G. OPG intends to enter into certain project construction agreements, including agreements with the civil contractor and the water-to-wire contractor. Subject to Board approval, the agreements will be executed and Ranney Falls G3 Project construction activities will commence by March 12, 2017.

H. Further particulars about the Ranney Falls G3 Project are set out in the Ranney Falls G3 Project Approval memo and accompanying materials dated March 10, 2017 (the "**Board Memo**").

RESOLVED THAT:

Ranney Falls G3 Project

1. The Ranney Falls G3 Project, as described in the Board Memo, is approved and OPG is authorized to proceed with construction activities.

Project Costs

2. OPG hereby approves and authorizes OPG to finance the Estimated Cost in accordance with the project economic analysis detailed in the Board Memo.

Execution of Project Agreements

3. OPG hereby approves and authorizes any one of the President of Renewable Generation & Power Marketing or an officer of OPG to take such action, and sign and deliver such documents, as may be necessary or desirable in respect of the construction of the Ranney Falls G3 Project.

ONTARIO POWER GENERATION

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

Internal Use Only

OPG-FORM-0076-R005*

Type 3 Business Case Summary

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

Executive Summary and Recommendations

Project Information			
Project #:	HDEV0028	**Document #:**	Facility-BCS-SCI-Sequence# R00X
Project Title:	Sir Adam Beck Pump Generating Station Reservoir Refurbishment		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Sustaining
Phase:	Execution	**Release:**	Full
Facility:	Sir Adam Beck Pump Generating Station	**Target In-Service or Completion Date:**	April 1, 2017

Project Overview

The estimated cost of the Execution Phase of the Sir Adam Beck Pump Generating Station Reservoir Refurbishment Project is $47.4M. Since the Definition Phase was underspent by $2M (i.e., the release was for $9.3M and the actual is $7.3M) we recommend approval for the release of $45.4M for the project execution. This release value is based on Class 2 quality estimate, with a 95% confidence level. The estimated $47.4M includes $10.2M contingency. Combined with the costs of the Concept and Definition Phases, the total project cost will be $58.2M.

This release will fund the following scope of work:

- Refurbishment of the Sir Adam Beck (SAB) Pump Generating Station (PGS) reservoir by the Contractor,
- Owner's Representative and other OPG direct costs, and
- Interest during Construction.

Problem Statement/Business Need:

The Sir Adam Beck (SAB) Pump Generating Station (PGS) and its storage reservoir are integral parts of the SAB hydroelectric complex and the Ontario electricity system. Along with ability to store water in off-peak hours and generate during higher priced on-peak hours, the PGS also helps to control the diversion flow to the SAB complex, and enables the SAB1 and SAB2 generating stations to provide additional peaking power and services such as Automated Generation Control (AGC) and Operating Reserve.

The SAB PGS reservoir is enclosed by a 7.4km long rock-filled ring dyke that employs a natural clay material in its core and the extension of the core towards the reservoir bottom (referred to as the dyke tongue) to prevent water seepage. Although the containment dyke is stable, the underlying bedrock may contain open, continuous joints below the dyke, which could result in water seepage from the reservoir and cause migration of fine grained soils into the open joints. The northeast corner of the reservoir is the main area of concern, as this is where the water depth is the highest and a strong downward seepage gradient exists. Such bedrock characteristics could make the foundation, and potentially the dyke itself, susceptible to sinkhole formation, which could lead to a dyke breach. A dyke breach would result in significant financial impacts to OPG; these impacts would include both dyke repair costs and lost revenues from the PGS and the entire SAB Complex while the dyke is out-of-service for repairs. If a significant amount of water is released from the PGS as a result of a dyke breach, there could also be significant safety and environmental impacts to the surrounding community.

The Project will ensure that the PGS can continue to operate safely for the next 50 years. The project will also help to ensure that OPG can maintain its reputation as a safe dam operator and a trusted community partner.

Summary of Preferred Alternative:

The preferred alternative is to conduct the PGS reservoir refurbishment activities to reduce the risk of seepage from the reservoir that can lead to a dam safety event. The PGS reservoir refurbishment was identified as the preferred alternative in the facility's Life Cycle Plan (LCP), approved in 2014. The project has also been included in the 2014-2016 HTO Business Plan. The project is in line with the OPG's mandate to maintain and develop hydroelectric resources.

Financial evaluation in the LCP estimated that the PGS would yield a net present value (NPV) of $508M (2014$) of benefits to

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

Project Overview

the system, with this reservoir refurbishment project in the plan. Alternatively, if there is no project, the PGS would be harvested and decommissioned by 2017/2018 due to the anticipated poor condition of the reservoir then. The NPV would be negative $23M. The financial evaluation has been updated to 2015$ with updated System Economic Values (SEVs) and project cost. This reservoir refurbishment along with a number of capex projects identified in the LCP would enable the continued operations of the PGS, which would provide a NPV of $528M to the Ontario electricity system over the next 30 years.

The work will be executed between April 1, 2016 and March 31, 2017 and includes:

- Dewatering of the PGS reservoir and fish removal.
- Installation of engineered liners over the critical areas of the reservoir floor. This is referred to as the "partial liner," as opposed to the full liner option that would have covered the entire bottom of the reservoir.
- Construction of a bedrock grout curtain through the upstream slope of the dyke in the northeast corner of the reservoir.
- Re-grading of the reservoir floor within 30m of the upstream toe of the dyke in specified locations at the southeast corner to remove any depressions
- Covering the reservoir bottom areas remediated in 1958 with additional sediment blanket;
- Watering-up the reservoir and returning it to service.

A design-bid-build contracting approach was selected for the project to minimize costs while maintaining a high level of control over the design and technical aspects of the project. Golder Associates completed the comprehensive geotechnical investigation and design work during the Definition Phase, and will provide Owner's Representative services during the Execution Phase. Rankin Construction Inc. was selected amongst four qualified proponent as the construction contractor through a rigorous prequalification, evaluation and request for proposals process. Rankin has selected the liner installation and grouting subcontractors from a previously prequalified list of companies.

History of BCS releases and project cost estimates/ History of scope and schedule changes:

In April 2011, $2.0M of OM&A funds were released to complete the Concept Phase of the project, bringing the total released at that time to $3.5M of OM&A funds. Concept Phase work included documentation reviews and site exploration, preliminary geotechnical investigation, and preliminary scoping, design, costing and scheduling.

In September 2011, $9.3M of Definition Phase capital funds were released to finalize the design of the reservoir liner system and study the possibility of expanding the reservoir capacity. At the time, the expected total project cost was $287.3M with work being completed in 2014 and 2015. After completing the comprehensive geotechnical investigation in 2011, it was determined that complete lining of the entire PGS reservoir was not required and that a partial liner solution was appropriate. Furthermore, it was concluded that expanding the reservoir was not financially viable under current market conditions. The current scope of the PGS refurbishment was developed thereafter and refined over the Definition Phase. In the 2014 SAB PGS Lifecycle Plan, a project cost of $100M was estimated. The current estimated project cost of $58.2M was finalized upon completion of the Definition Phase design, procurement and estimating processes.

Key Assumptions and Risks:

Given that the PGS reservoir refurbishment is largely a civil work project with significant geotechnical risks (excavation over the dyke tongue, grouting into the bedrock through the dyke core and overburden interface, and lining installation connected to the dyke tongue), the project contingency might be higher than typical for OPG projects. A three-month contingency has also been included in the project schedule. The project used both qualitative and quantitative risk assessments, along with past lessons learned and industry knowledge, to develop the project contingency estimates. The areas of significant risk for the project are:

1) Uncertainty regarding subsurface and dyke conditions.
2) Liner supply, installation, quality and costs risks.
3) Technical issues with the grouting process and its impact on the dyke, as well as grouting material quantity risk.

A detailed risk register was created during the Definition Phase to capture all identified discrete risks and risk response plans.

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Type 3 Business Case Summary

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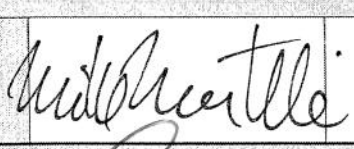
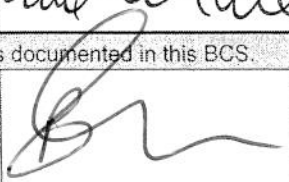
Project Cash Flows, NPV, and OAR Approval Amount

M$	LTD	2015	2016	2017	2018	2019	Future	Total
Currently Released – Concept Phase OM&A	3.5							3.5
Currently Released – Definition Phase Capital	6.5	2.8						9.3
Actual Spent – Definition Phase Capital	6.5	0.8						7.3
Requested Now	-	2.0	38.9	6.5				47.4
Future Required	-							
Total Project Cost	10.0	2.8	38.9	6.5				58.2
Incremental Ongoing Costs	-							0.0
Grand Total	10.0	2.8	38.9	6.5				58.2

Estimate Class:	Class 2	**Estimate at Completion:**	$58.2M
NPV:	$528M	**OAR Approval Amount:**	$58.2M

Additional Information on Project Cash Flows (optional):
See Appendix A for further information on Project Cash Flows.
The NPV of $528M refers to the NPV of the PGS's benefits to the system if the PGS is to continue to operate for the next 30 years.

Approvals

	Signature	Comments	Date
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Mike Martelli, SVP Hydro-Thermal Operations			17 Aug 15.
I concur with the business decision as documented in this BCS.			
Finance Approval: Beth Summers, SVP & Chief Financial Officer, per OPG-STD-0076			18 Aug 15
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Tom Mitchell, President & Chief Executive Officer, per OAR 1.1			18 AUG 15

ONTARIO POWER GENERATION

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

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Business Case Summary

Part A: Business Need

The Sir Adam Beck (SAB) Pump Generating Station (PGS) and its storage reservoir are integral parts of the SAB hydroelectric complex, which, along with the PGS, includes the Sir Adam Beck 1 (SAB1) and Sir Adam Beck 2 (SAB 2) generating stations, and the three water conveyance tunnels and the power canal that deliver water from the Grass Island Pool. The SAB PGS was constructed between 1953 and 1957, and is the only pump generating station in Canada. The six-unit reversible pump-turbine plant is capable of pumping water from the outlet of the tunnels and canals into its reservoir, and then generating 174 MW from that reservoir by discharging the stored water back into the SAB complex headpond. The PGS supports the peaking operation of the SAB complex by storing water in off-peak hours and generating during higher priced on-peak hours. The SAB PGS's operation is integrated with SAB1 and SAB2 as stored water is used to generate peaking power at all three stations. The PGS is also used for: 1) Improving the overall efficiency of operations at the SAB Complex, 2) Assisting SAB1 and SAB2 in the provision of Automated Generation Control (AGC) and Operating Reserve services to the Ontario Electricity System, and 3) Providing relief for the electricity system during periods of Surplus Baseload Generation (SBG) by providing a load which prevents other generators from spilling water or shutting down units.

The SAB PGS reservoir is enclosed by a 7.4km long rock-filled ring dyke, varying in height from 4.6 meters in the west to 20.5 meters in the east. The dyke employs a natural clay material in its core and at the connection point with the reservoir floor (referred to as the clay "tongue") to prevent water seepage. The PGS reservoir has operated satisfactorily since 1958 when it was returned to service after an outage to repair areas of leakage. Although the containment dyke is stable, the underlying bedrock may contain open, continuous joints below the dyke, which could result in water seepage from the reservoir and cause migration of fine grained soils into the open joints. The northeast corner of the reservoir is the main area of concern as that is the area where the water depth is the highest and a strong downward seepage gradient exists. Such bedrock characteristics could make the foundation, and potentially the dyke itself, susceptible to sinkhole formation, which in turn could lead to a dyke breach. A dyke breach would result in significant financial impacts to OPG; those impacts would include both dyke repair costs and lost revenues from the PGS and the entire SAB Complex while the PGS is out-of-service for repairs. If a significant amount of water is released from the PGS as a result of a dyke breach, there could also be significant safety and environmental impacts to the surrounding community, including the residential development west of the reservoir, Highway 405 north of the reservoir and the Canada-US Customs Office east of the reservoir.

Part B: Preferred Alternative: Refurbishment of the SAB PGS Reservoir

Description of Preferred Alternative

Proceed with the execution of the SAB PGS Reservoir Refurbishment Project to ensure that the station can continue to safely provide value to the Ontario electricity system. The Project will take remedial measures to protect against potential bedrock piping mechanisms under the dyke that may currently exist or develop over time. It was concluded that these remedial measures were required as a result of the studies completed during the Definition Phase, including a review of historical data, the comprehensive geotechnical investigations carried out in 2011 and seepage analysis. The Project will allow OPG to continue to operate the PGS for 50 years and maintain its reputation as a safe dam operator. The scope of work for the project, which will be executed between April 1, 2016 and March 31, 2017, includes:

- Dewatering of the PGS reservoir and fish removal.
- Installation of geomembrane and geosynthetic clay liners over the critical areas of the reservoir floor. This is referred to as the "partial liner," as opposed to the full liner option that would have covered the entire bottom of the reservoir. The full liner option was studied during the Concept Phase of the project and dismissed during the Definition Phase after review of the available information and the results of the 2011 geotechnical investigations.
- Construction of a bedrock grout curtain through the upstream slope of the dyke in the northeast corner of the reservoir.
- Re-grading of the reservoir floor within 30m of the upstream toe of the dyke in specified locations at the southeast corner to remove any depressions and cover the area with a 1m thick sediment blanket obtained from within the reservoir.

A diagram of the exact location of these remedial activities is provided in Appendix E. This approach was deemed to be the most appropriate to address potential seepage issues as a result of the analysis and geotechnical investigation completed during the Definition Phase by OPG and its Owner's Representative, Golder. In addition, OPG engaged an independent Dam Safety Review Panel comprised of three international geotechnical experts to review, contribute to and validate the agreed upon approach.

The expected cost of the project execution phase is $47.4M, which includes construction costs, Owner's Representative costs, OPG direct costs, interest during construction and contingency. Part E and Appendix A provide a detailed breakdown of the project cost flows along with the financial assumptions made. The SAB PGS is a regulated hydroelectric asset and as such will

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Part B: Preferred Alternative: Refurbishment of the SAB PGS Reservoir

Description of Preferred Alternative

receive the regulated rate for energy. The PGS Reservoir Refurbishment was identified as the preferred alternative in the facility's Life Cycle Plan, approved in 2014. The project has also been included in the 2014-2016 HTO Business Plan. The project is in line with the OPG's mandate to maintain and develop hydroelectric resources.

A design-bid-build contracting approach was selected for the project to minimize costs while maintaining a high level of control over the design and technical aspects of the project. The design, including technical specifications and associated drawings, was finalized by Golder Associates based on the work conducted during the Definition Phase. Rankin Construction Inc. was selected as the construction contractor through a rigorous prequalification, evaluation and request for proposals process. Rankin was evaluated as the technically most competent proponent and its cost estimate was competitive. The contractor has selected the liner installation and grouting subcontractors from a previously prequalified list of companies. Rankin is a large and reputable construction firm with proven hydroelectric experience. Its liner subcontractor's Layfield Environmental Containment is a leading supplier and installer of engineered liners in Canada. Rankin's grouting subcontractor, Advanced Construction Techniques, is a well-known grouting company operating in Canada and the U.S. Golder will be the Owner's Representative during project execution and will provide oversight of the construction activities.

Pros:

- Refurbishment of the reservoir will allow the PGS to continue to operate safely for the next 50 years. The PGS is a valuable asset for the Ontario electricity system; it facilitates optimization of the entire SAB complex and assists in the provision of AGC and peaking at the SAB generating stations. An economic assessment shows that continued operation of the PGS would provide approximately $528M of NPV to the Ontario electricity system based on the capacity value and the peaking energy value, compared to an NPV of negative $25M if the PGS has to shutdown in a few years due to no reservoir refurbishment.
- By completing the project, OPG will reduce the likelihood of a dam safety event at the PGS, particularly a failure of the dyke. This will protect OPG's neighbours in the Niagara and Niagara-on-the-Lake area and enhance OPG's reputation as a safe hydroelectric operator.
- The partial liner solution is significantly less expensive than the full liner solution first thought necessary during the Concept Phase.
- Energy storage, include pumped storage, is becoming increasingly valuable due to its potential to assist in integrating intermittent renewable energy, such as wind and solar.
- The project will have minimal environmental impacts because all construction activities will be contained within the reservoir. An environmental assessment is not required.
- The project has obtained support from the IESO regarding the April 2016 to March 2017 construction outage window.

Cons:

- Upfront capital will be required to complete the Project.

Deliverables:	Associated Milestones (if any):	Target Date:
Finalization of construction and liner fabrication/ installation contracts and site preparation activities	• Construction contract signed • Mobilization on site begins	September 2015
PGS is taken out of service and construction outage begins	• Start of reservoir dewatering	April 2016
Construction activities, including liner installation, grouting and grading of the reservoir floor.	• Liner installation complete • Grouting complete	April 2016 – March 2017
PGS returns to service (Schedule contingency: Jan-Mar, 2017)	• Reservoir is watered up	March 2017

Part C: Other Alternatives

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

Alternative 2: Base Case – SAB PGS Reservoir is not Refurbished

This alternative is not recommended. Not proceeding with the refurbishment of the PGS Reservoir would result in the shutdown and removal of the SAB PGS from operations in 2016 because of dam safety concerns. There is considerable cost, estimated at greater than $50M, associated with shutting down the PGS and putting it in a safe state. The economic analysis presented in Section E of this BCS shows that this option has a NPV of negative $25M.

Alternative 2: Base Case – SAB PGS Reservoir is not Refurbished

Pros:

- In absolute terms, not refurbishing the SAB PGS Reservoir and eventually shutting it down is a lower cost solution than the preferred alternative. Operating, maintenance and administration costs to continue to run the PGS would also be eliminated.

Cons:

- Until the PGS is shut down, the station will continue to run with a higher risk of a dam safety event occurring. Seepage associated with the potential bedrock piping will continue to be a major risk concern for OPG while the plant is operational.
- Once the PGS is shut down, OPG and the Ontario electricity system will lose a valuable asset. The ability of the SAB complex to provide peaking and AGC services for Ontario will be greatly impacted. This will make it more difficult to integrate and manage renewable energy in Ontario.
- OPG will lose generation from the PGS units and the corresponding improvement in output from SAB1 and SAB2 as a result of PGS operations.
- The project to shutdown and decommission the PGS is estimated to cost over $50M and will provide no value to OPG.

Alternative 3: Delay the SAB PGS Reservoir Refurbishment

This alternative is not recommended. Deferring the refurbishment of the PGS Reservoir will expose OPG to a greater risk of seepage and bedrock piping under the dyke, which can lead to potential sinkhole formation or dyke failure in certain areas. Given the analysis and site investigation completed during the Definition Phase, it is prudent for OPG to implement remedial measures to address the issues discovered as soon as possible. If a dam safety event were to occur during the time that the reservoir refurbishment is deferred, it would have severe impacts on OPG's reputation as a safe dam operator and its standing in the community.

Pros:

- The capital required to complete the project will not be needed in the immediate future.

Cons:

- The station will continue to run with a higher risk of a dam safety event occurring. Annual PGS maintenance costs may increase in order to prevent any potential seepage from the reservoir.
- Seepage and potential bedrock piping under the dyke may occur or worsen during the time that the reservoir refurbishment is deferred. This may lead to a larger scope of work or a more difficult refurbishment when the execution moves forward. Further site investigation and project definition will likely be required.
- A dam safety event during the time that the refurbishment is deferred will likely lead to intense regulatory and public scrutiny of OPG's dam safety practices. OPG's reputation is likely to be severely damaged.
- Obtaining buy-in from the IESO and other stakeholders on a new outage window for the project may be difficult given the other projects expected in the Ontario electricity system, particularly the Darlington Refurbishment, Bruce B Refurbishment and Pickering shutdown.

Alternative 4: Complete the Refurbishment and Expansion of the PGS Reservoir

This alternative is not recommended. In the SAB PGS Reservoir Refurbishment Definition Phase BCS, the project committed to investigating the feasibility of expanding the storage capacity of the PGS reservoir while refurbishing it. The project studied three options to expand the reservoir volume: 1) expanding the footprint of the reservoir, 2) raising the height of the PGS dyke perimeter, and 3) deepening the reservoir in the west end. Of the three options, increasing the height of the dyke perimeter appeared to be the lowest cost per volume increase. However, simulations of the value of the reservoir volume expansion showed that even this expansion option was unlikely to be economical under a wide range of circumstances (i.e., various combinations of forecasts for natural gas prices, CO2 prices and load growth were considered in the simulations). The base case estimates place the value of the reservoir volume expansion at 10% to 20% of what would likely be needed to justify the investment.

Pros:

- Refurbishment and expansion of the reservoir will allow the PGS to continue to operate safely for the next 50 years.
- The additional volume capacity of the reservoir will increase the station's value to the SAB Complex and the Province. In particular, the station will be able to shift supply from off-peak to on-peak times, which is important for its potential to assist in integrating intermittent renewable energy, such as wind and solar.
- By completing the project, OPG will reduce the likelihood of a dam safety event at the PGS, particularly a failure of the dyke. This will protect OPG's neighbours in the Niagara and Niagara-on-the-Lake areas and enhance OPG's reputation as a safe hydroelectric operator.

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Alternative 4: Complete the Refurbishment and Expansion of the PGS Reservoir

Cons:

- The expansion portion of the work is prohibitively expensive and uneconomical. The base case estimates place the value of the reservoir volume expansion at 10% to 20% of what would likely be needed to justify the investment.
- The complexity of the reservoir expansion may expose OPG to greater construction risks than just refurbishment of the reservoir, such as the possibility of damaging the existing dyke, disturbing the local community and interfering with the remediation work.

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

M$	LTD	2015	2016	2017	2018	2019	Future	Total
Currently Released – Concept Phase OM&A	3.5							3.5
Currently Released – Definition Phase Capital	6.5	2.8						9.3
Actual Spent – Definition Phase Capital	6.5	0.8						7.3
Requested Now	-	2.0	38.9	6.5				47.4
Future Required	-							
Total Project Cost	10.0	2.8	38.9	6.5				58.2
Incremental Ongoing Costs	-							0.0
Grand Total	10.0	2.8	38.9	6.5				58.2

Estimate Class:	Class 2	**Estimate at Completion:**	$58.2M
NPV:	$528M	**OAR Approval Amount:**	$58.2M

Additional Information on Project Cash Flows (optional):

See Appendices A and C for further information on Project Cash Flows and Financial Assumptions.

The NPV of $528M refers to the NPV of the PGS's benefits to the system if the PGS is to continue to operate for the next 30 years.

Part E: Financial Evaluation

M$	Reservoir Refurbishment	No Project & Decommission Reservoir	Delay Refurbishment Work	Refurbishment & Expansion	
Project Cost	$58.2M	$56.2M	N/A	$287.3M	
NPV	$528M	$-25M	N/A	N/A	
Other (e.g., IRR)					

Summary of Financial Model Key Assumptions or Key Findings:

Reservoir Refurbishment:

The economic assessment of proceeding with the preferred alternative has a Net Present Value of $528M over the 30-year assessment period. This analysis is based on OPG's evaluation of the capacity value and the peaking energy value of the PGS. Net present value calculations have used forecasts for System Economic Values as the basis for estimating the capacity and on-peak generation benefits. The analysis demonstrates that the capital investment to refurbish the reservoir is worthwhile, as the PGS provides substantial long-term value to the Ontario Electricity System. The analysis was included in the 2014 PGS Lifecycle Plan and updated during the preparation of this BCS.

The PGS is a regulated hydroelectric asset and as such will receive the regulated rate for energy. The impact on regulated Hydro rates to recover the cost of this project is estimated to be less than $0.2/MWh in 2016 based on current assumptions.

Summary of Financial Model Key Assumptions or Key Findings:

No Project & Decommission Reservoir:

It is estimated that the cost to remove the PGS from service in 2016, and then dewater and decommission it, would be approximately $56.2M. This option would also remove future economic benefits from the PGS and limit the operational flexibility of the entire SAB complex. Overall, this option has an NPV of negative $25M over the 30-year evaluation period.

Delay Refurbishment Work:

The cost and net present value of this alternative was not assessed. Given the dam safety and reputational risks related with this alternative, it was ruled out prior to being financially evaluated.

Refurbishment & Expansion:

Preliminary evaluation of this alternative during the Concept Phase valued the project to refurbish and expand the PGS reservoir at $287.3M. Simulations of the value of the reservoir volume expansion showed that even the cheapest expansion option was unlikely to be economical under a wide range of circumstances (i.e., various combinations of forecasts for natural gas prices, CO2 prices and load growth were considered in the simulations).

A summary of the financial model assumptions is provided in Appendix C.

Part F: Qualitative Factors

1) **Dam Safety:** OPG's main focus is on the safety of its employees and the general public. The PGS Reservoir Refurbishment will allow OPG to maintain its strong reputation as a safe dam operator by greatly reducing the probability of a PGS dyke failure. By reducing the likelihood of a dyke failure, the Project is also protecting the surrounding areas from the potentially devastating environmental and safety risks of a dyke failure.

2) **Community Reputation:** OPG has a positive reputation in the Niagara region and a strong working relationship with all major stakeholders, including the city of Niagara Falls and town of Niagara-on-the-Lake. A dam safety event at the PGS would negatively impact OPG's reputation in the area, particularly if it damages Highway 405 along the north side of the reservoir and the Canada-US Customs Office east of the reservoir.

3) **Wind and Solar Integration:** Energy storage, including pumped storage, has been widely discussed in recent years due to its potential to assist in integrating intermittent renewable energy, such as wind and solar, into the electricity system and maximize their contribution. There is potential for additional value, including new sources of value to the electricity system for pumped storage in the future as the share of wind and solar increases in Ontario's electricity system.

4) **Value to SAB Complex:** The PGS is extremely valuable to the operation of the SAB complex and the Ontario electricity system. Along with improving the overall efficiency of the SAB complex, it also assists providing Operating Reserve services to the Ontario electricity system and the provision of AGC at SAB2. Furthermore, there are opportunities to increase the output of the entire SAB Complex by 1) Improving the unit efficiencies and removing operation limits of PGS units, and 2) Refurbishing SAB1 Units 1 and 2. A key component to the business cases for these upgrades is the availability of the PGS to optimize SAB Complex operations.

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost/ Schedule	There is a risk that inclement weather occurs and impacts various construction activities, resulting in schedule delays and safety concerns. Extended periods of rain are the biggest threats, as they impact dewatering, sediment removal and relocation, and liner installation. Windy weather may also result in safety concerns during liner installation.	1) Clear specifications will be in place to ensure that work is conducted in the appropriate weather conditions. 2) Work will be scheduled with consideration of the seasonal weather conditions and weather forecasts. 3) A 3-month schedule contingency has been included to accommodate for poor weather and other delays. 4) Golder will monitor construction	High	High

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Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
		activities to ensure work is not being conducted in unsafe weather conditions.		
Cost/ Schedule	There is a risk that the grouting work may be extended due to potential damage to the dyke core and filters during drilling and grouting, unexpected conditions of the core and excessive grout take in bedrock.	1) Grouting specifications developed by Golder have been reviewed and commented by OPG, Dam Safety Panel and the grouting companies. 2) Golder will provide QA services during grouting and will provide quick responses if issues are identified.	Medium	High
Scope	There is a risk that new discoveries (such as the liquefaction issue observed at Ch. 56+00) appearing during the construction may require changes in the scope of work.	1) Contingencies are included in the project cost, schedule and resources. 2) Golder will maintain ability to respond to changing site conditions during construction.	Medium	High
Cost/ Schedule	There is a risk that excessive sediment (higher volume and slow drying time) is observed at the bottom of reservoir and this may delay the construction activities.	1) Contingencies are included in the project cost and schedule. 2) The issue was discussed with Rankin Construction for possible solutions for better sediment management.	Medium	High
Cost/ Schedule	There is a risk that the liner is not properly connected to the dyke tongue in the key trench, especially if the tongue could not be identified clearly or it does not exist.	1) The key trench design has been extensively studied and discussed among OPG, Golder and Panel. 2) Golder will provide QA services during liner installation and provide quick response if any tongue issues appear.	Medium	Medium
Quality/ Performance	There is a risk that the liner requires excessive rework or repairs during construction. Poor quality manufacturing or damage during installation could result in the need for rework/ repairs.	3) Liner manufacturing quality assurance practices was assessed by Golder during the procurement process. 4) Specifications are in place to ensure proper handling, placement and monitoring of liner. 5) Proper foundation/ bedding preparation criteria will be established. 6) Golder will provide quality assurance services during liner installation.	Medium	Medium

Additional Risk Analysis:

The Project completed a Qualitative Risk Assessment process during the Definition Phase to create its risk register. The risk register is a living document and will be used to record and track risk information throughout the Execution Phase. Among the list of risks described above, some other key risks being managed by the Project include:

1) Stakeholders oppose the project and take action to delay or halt it.
2) Fluctuating oil and energy prices impact the plastic resin and liner prices.
3) Bedrock formations underneath the dyke require more grout material than anticipated.
4) New discoveries or unexpected geological features are encountered during construction.
5) Aquatic species relocation during dewatering takes longer than expected.
6) Unanticipated environmental permits are required.

A Quantitative Risk Assessment was also completed to develop the Project contingency, further details are provided in Appendix F.

Part H: Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Comprehensive PIR	2017-03-31	2018-07-31

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
Target In-Service Date	March 31, 2017	March 31, 2017	Compared with contract completion date	HTO Project Execution
Actual Cost	$58.2M	$58.2M	Compared with approved release	OPG Finance
Reservoir Performance (total leakage and piezometer responses)	To be determined in February 2016 Testing	To be determined in February 2016 Testing	A 48-hour Static Head Test and piezometer readings will be completed in February 2016 to set baseline levels. The measurements will be repeated in April 2017 to determine the effectiveness of the remedial activities.	HTO Plant Engineering Services, Niagara Plant Group, Golder Associates

Part I: Definitions and Acronyms

Definitions:

Automated Generation Control (AGC) – The ability to adjust the power output of a generator in response to changes in electricity demand.

dyke – The water-retaining structure that surrounds the PGS reservoir. The PGS dyke is composed of a rock-full embankment with an impervious clay core.

dyke tongue – The extension of the clay core material from the dyke to the reservoir floor at the dyke toe. The tongue ensures water retention and reduces water seepage under the dyke.

geomembrane – A 2mm thick liner material made of High Density Polyethylene. The geomembrane will be used to line the bottom of the reservoir in select areas.

geosynthetic clay liner – A synthetic material that performs in a similar manner to clay. The membrane uses a bentonite material in its core. This liner will be used as a single layer to remediate some areas of the PGS reservoir, or will surround the geomembrane in other areas to protect it.

grout curtain – An underground barrier that protects the foundation of a dam from seepage. A grout curtain usually consists of a row of vertically drilled holes filled with pressurized grout. The holes are drilled in intervals and in such a way that they cross each other, creating a solid curtain.

key-trench – The area on the upstream side of the dyke where the geomembrane and geosynthetic clay liner will be tied into the dyke tongue.

operating reserve – Additional supply of energy available on request should an unanticipated event take place in the real-time energy market.

piezometer – A device used to measure the pressure of groundwater at a specific point.

static head test – A test where the reservoir is filled to maximum level and held for 48-hours to determine if changes in water level are occurring from sources other than the operation of the PGS units (i.e. seepage, evaporation, etc.).

Acronyms:

CO2 – Carbon Dioxide
IESO – Independent Electricity System Operator
MWh – Megawatt Hour
NPV – Net Present Value
OPG – Ontario Power Generation
PGS – Pump Generating Station
SAB – Sir Adam Beck
SAB1 – Sir Adam Beck 1 Generating Station
SAB2 – Sir Adam Beck 2 Generating Station

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Appendix A: Summary of Estimate									
Project Number:	HDEV0028								
Project Title:	Sir Adam Beck Pump Generating Station Reservoir Refurbishment								
M$	LTD	2015	2016	2017	2018	2019	Future	Total	%
Concept Phase – OM&A	3.5							3.5	6.0
Definition Phase – Capital including Interest	6.5	0.8						7.3	12.5
Project Management & Administration		0.1	0.7	0.3				1.1	2.0
Owner's Representative		0.2	3.4	0.1				3.7	6.4
Construction		1.6	28.8	0.0				30.4	52.2
Interest during Construction		0.1	1.1	0.8				2.0	3.5
Subtotal	**10.0**	**2.8**	**34.0**	**1.2**				**48.0**	**82.5**
Contingency			4.9	5.3				10.2	17.5
Total	**10.0**	**2.8**	**38.9**	**6.5**				**58.2**	**100**

Notes			
Project Start Date	2016-04-01	**Total Definition cost** (excludes unspent contingency for Nuclear)	$7.3M
Target In-Service (or AFS) Date	2017-03-31	**Contingency included in this BCS** (Nuclear only)	N/A
Target Completion Date	2017-03-31	**Total contingency released plus contingency in this BCS** (Nuclear only)	N/A
Escalation Rate	2.0%	**Total released plus this BCS without contingency** (Nuclear only)	N/A
Interest Rate	4.89%	**Total released plus this BCS with contingency** (Nuclear only)	N/A
Removal Costs	N/A	**Estimate at Completion** (includes only spent contingency for Nuclear)	$58.2M

Prepared by:	Approved by:
Clara Greco Project Manager Hydro-Thermal Project Execution Date 2015-07-23	Dick Jessop Director Hydro-Thermal Project Execution Date 23-Jul 2015

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

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in M$ (by year including contingency)						Future	Total Project Estimate
			Pre-2013	2013	2014	2015	2016	2017		
Concept Phase	3.5	15-Apr-11								N/A
Full Definition Phase	9.3	19-Sep-11	10.5	2.3	131.5	143.0				287.3
Full Execution Phase	45.4	21-Aug-15	6.8	2.5	0.7	2.8	38.9	6.5		58.2

Project Variance Analysis

Choose an item.	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management					
OPG Engineering (including Design)					
OPG Procured Materials					
OPG Other					
Design Contract(s)					
Construction Contract(s)					
EPC Contract(s)					
Consultants					
Other Contracts/Costs					
Interest					
Subtotal					
Contingency					
Total					

Type 3 Business Case Summary

Project #: HDEV0028 Document #: Facility-BCS-SCI-Sequence# R00X
Project Title: Sir Adam Beck Pump Generating Station Reservoir Refurbishment, <Full> <Execution> Release

Appendix C: Financial Evaluation Assumptions

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

Project Cost:

1. Definition Phase total costs of $7.3M, of which only $800k is included in the 2015$ NPV calculation because the remainder was sunk cost.
2. Execution Phase costs of $47.4M, which included $10.2M of contingency. Only $45.4M is included in the 2015$ NPV calculation because the IDC cost for execution phase of $1.98M shall not be included in the cash flows to avoid double-counting, as the effect of IDC has already been accounted for in the discount rate.
3. $3.5M OM&A spent during the Concept Phase was considered a sunk cost for the analysis.

Financial Assumption:

1. For NPV calculations, a Weighted Average Cost of Capital (WACC) of 7.0% was used to discount future cash flows to the base year of 2015.

Project Life:

1. Project is expected to occur from April 1, 2016, to March 31, 2017.
2. The financial analysis covers the 2015-2043 period.

Revenue/System Benefits:

1. Revenue/benefit from generation: Average 50 years of production from the SAB PGS will be 100 GWh's.
2. Revenue/benefit from capacity: Peaking capacity / MCR is 700MW during years when all 6 units are operating. Eleven of the years within the forecast period will have a capacity of 583MW due to planned overhaul programs when only 5 of 6 units are operational.

Operating Cost:

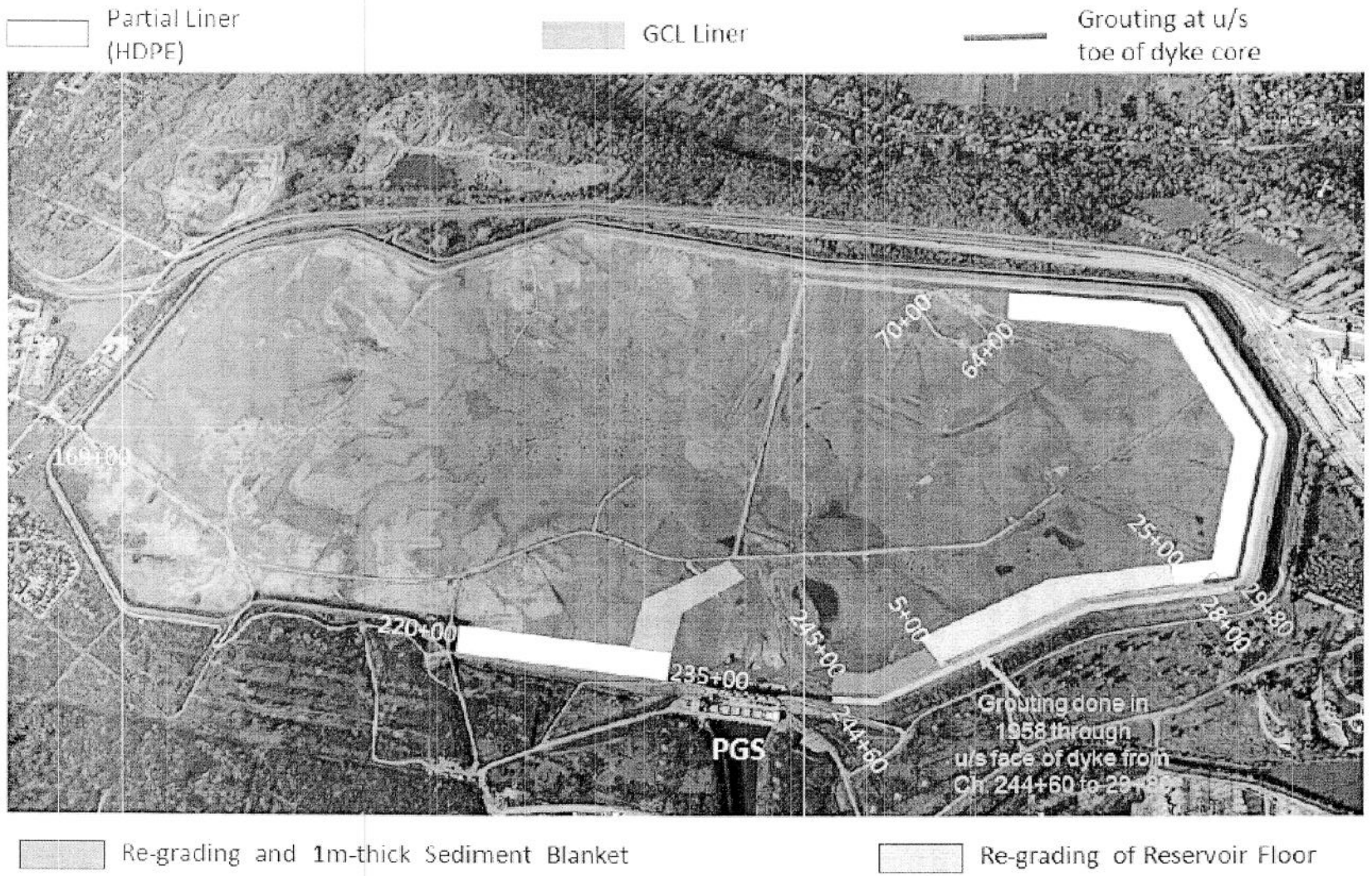
1. Average 50 years of uplift charges of $1.4M (2011$) which include rural rate assistance, debt retirement charge and charging energy.
2. Average standard and non standard OM&A of $10.3 M/yr, including unit overhaul programs.
3. Average sustaining capital expenditures of $1.57 M/yr.

Appendix D: References

1) Sir Adam Beck Pump Generating Station Reservoir Refurbishment – Project Charter
2) Sir Adam Beck Pump Generating Station Reservoir Refurbishment – Execution Phase Project Execution Plan
3) Life Cycle Plan: Sir Adam Beck Pump Generating Station
4) Sir Adam Beck Pump Generating Station Reservoir Refurbishment – Concept Phase Report

Type 3 Business Case Summary

Appendix E: Diagram of SAB PGS Reservoir Refurbishment Activities



Filed: 2024-03-22, EB-2023-0336, Exhibit L-H-SEC-01, Attachment 17, Page 16 of 18
Filed: 2025-12-12, EB-2025-0297, Ex. D1-1-2
Attachment 1, Tab 2, 80583, Page 16 of 18

Type 3 Business Case Summary

Project #: HDEV0028
Document #: Facility-BCS-SCI-Sequence# R00X
Project Title: Sir Adam Beck Pump Generating Station Reservoir Refurbishment, <Full> <Execution> Release

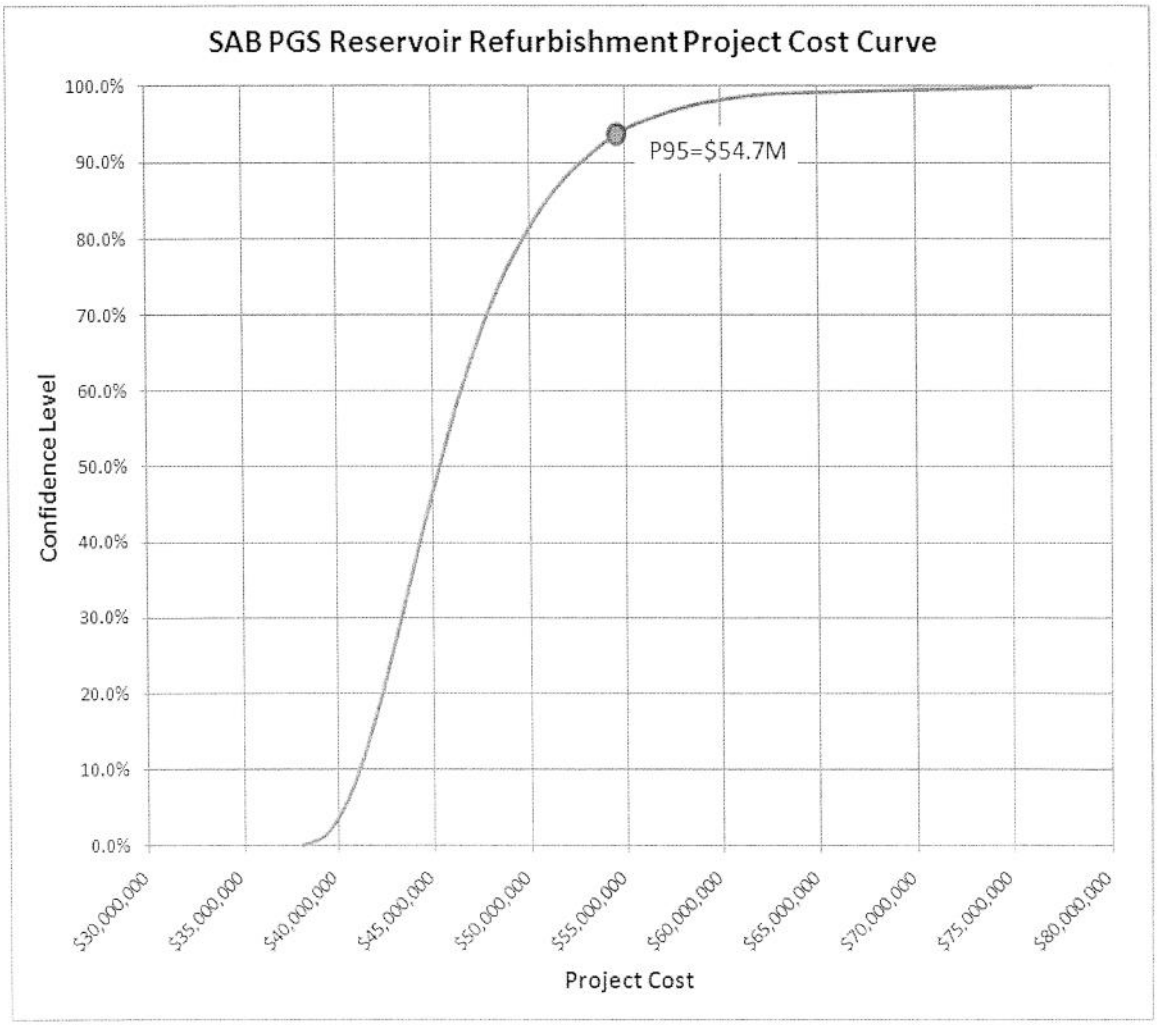
Appendix F: Risk Management and Contingency Development

The SAB PGS Reservoir Refurbishment Project overall cost estimate includes a Project Contingency of $10.2M.

Excluding the Concept Phase, the estimated project capital cost is $54.7M. The project completed a simple quantitative risk assessment to calculate these contingencies. The overall cost estimate, including contingency, is expected to be sufficient to cover project costs and risks at a 95% confidence level. The following areas of uncertainty and risk were included in the assessment:

1. Cost Estimate Uncertainty – The Owner's Representative provided best case, worst case and most likely estimates for each cost item. This analysis took into account the discrete project risks that were identified during the Definition Phase through a series of qualitative risk assessment workshops.
2. Schedule Uncertainty – The Owner's Representative and OPG Project Manager estimated the best case, worst case and most likely scenario for the project in-service date.

A project cost model was developed in Microsoft Excel 2007, based on the models developed for the Lower Mattagami River Project and New Post Creek Project. A Monte Carlo Simulation was used to develop the project cost distribution curve. The model also takes into account potential variability in interest rates and escalation rates. The cost probability curve is illustrated below:



Appendix F: Risk Management and Contingency Development

The Owner's Project Contingency ($10.2M) is equal to approximately 27% of the execution phase cost estimate, without contingency ($47.4-10.2=$37.2M). Given that the reservoir refurbishment is largely a geotechnical and civil based project, this amount of contingency is appropriate to cover the large amount of uncertainty and risk inherent in these types of projects. Past history with OPG projects has also confirmed that civil work with high levels of geotechnical risk is typically over estimates, as indicated in the following table:

Project	BCS Cost Estimate	Actual Cost	Percentage that Actual Cost was Above Estimate
Niagara Tunnel Project	$900 million	$1.5 billion	66.7%
Lower Mattagami River Project – Design Build Civil Work Only	$1.03 billion	$1.46 billion	41.7%

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Records File Information:
Records SCI/USI Retention
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Type 3 Business Case Summary

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

Executive Summary and Recommendations

Project Information			
Project #:	BK180649 (SAB10050)	Document #:	NIAG-REP-08707.021-0201
Project Title:	G10 Major Overhaul and Upgrade		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	Investment Type:	Sustaining
Phase:	Execution	Release:	Superseding
Facility:	SAB1	Target In-Service or Completion Date:	April 2017

Project Overview

We recommend the release of an additional $6.14M, including $1M of contingency. The project was originally released at $27M including $2.4M contingency, which will be consumed by cost variances as explained below. The revised estimated total project cost is $33.14M, including $1M of contingency. The quality of the estimate for this release is Class 1 (+15%), and for the total project is Class 1 (+15%).

This is accompanied by a shift of the in-service date from July 2016 to April 2017..

This release will provide **additional funding** to complete the following scope of work:

- Stator windings, electrical auxiliaries, new main transformer, static excitation and controls installation.
- New upgraded runner, headcover and bottom ring and overhauled turbine components installation.
- Start-up and commissioning.

The rehabilitated G10 unit is expected to produce 59 GWh annually, including an incremental increase of 13 GWh due to the installation of higher capacity stator windings, more efficient runner and transformer.

This sustaining investment is consistent with the approved Life Cycle Plan (LCP) for SAB1 and OPG's objective of continuing to increase clean, renewable generation from its existing fleet of hydroelectric assets.

Reasons for Variance:

1. **PWU support costs ($1,853):** The PWU support costs for contract monitoring and site preparation were not covered in the original EBCS; the project team initially planned to execute as an Owner Only contract at lower cost, but this did not transpire and the costs were not accounted for in the RQE.
2. **EPC contract pricing ($1,375):** The lowest contract bid price was significantly higher than the RQE allowance. It included higher than expected risk cost associated with an all-inclusive contract, which is the preferred contracting strategy as it shifts resource demand and performance liability to the contractor.
3. **New head cover and bottom ring ($1,100):** Based on emergent information from G9, a decision was made to procure a new head cover and bottom ring; these costs were not included in the original RQE or EBCS.
4. **Grit-blasting and lead abatement ($975):** A change in work method was requested to significantly improve containment of fugitive lead paint particulate, improving cleanliness in the powerhouse from a Health & Safety standpoint, thereby increasing execution cost.
5. **Interest Costs ($610):** Higher than expected EPC contract cost, combined with an overall nine month delay in the completion date contributed to higher than estimated interest costs.
6. **Runner currency exchange and escalation allowance ($450):** The value of the Canadian dollar declined significantly during execution; there was no allowance for escalation from the original blanket purchase order, in the original RQE or EBCS.
7. **Moody cone tip and stainless steel draft tube extension scope changes ($418):** Based on recent discovery of cavitation on G9, it was decided to change the draft tube extension material to stainless steel at an increased cost. In addition, after disassembly, the Moody Cone tip was discovered to be missing. A new tip was fabricated and installed to preserve runner performance guarantees.
8. **Windings delayed delivery (Schedule impact):** The EPC contractor experienced quality issues during fabrication of the generator windings which will result in an approximate nine month delay to the in-service date. Although the Contractor mitigated schedule impact where possible, this will result in carrying cost to OPG. Liquidated damages

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Type 3 Business Case Summary

Project #: BK180649 (SAB10050) Document #: NIAG-REP-08707.021-0201
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Project Overview

recovery will be negotiated but are not included in this estimate due to remaining schedule uncertainty.

9. **Other additional scope and discovery work ($786):** Major contributors - discovery work ($257) - penstock bulge injection /Moody Cone install/lower fan repair/thrust bearing/shaft steel replacement, Schedule delays ($220k) – Andritz mobilization was impacted by IESO and Powerhouse Crane not available early in the project. [redacted]

Key Assumptions and Risks:

The project, except for the runner supply, is being executed under a single, well-qualified EPC contractor, mitigating the risk to OPG associated with coordinating multiple contractors and suppliers. The unusually complex G10 stator winding configuration resulted in significant manufacturing challenges which have now been resolved through dedicated process improvements.

Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD	2016	2017	2018	2019	2020	2021	Future	Total
Currently Released	14,600	12,400							27,000
Requested Now	-	4,816	1,324						6,140
Future Required	-								
Total Project Cost	14,600	17,216	1,324						33,140
Ongoing Costs	-								
Grand Total	14,600	17,216	1,324						33,140

Estimate Class:	Class 1	**Estimate at Completion:**	33,140
NPV:		**OAR Approval Amount:**	33,140

Additional Information on Project Cash Flows:

The 2016 cash flow is being managed within the Niagara Operations budget envelope; the 2017 cash flow will be incorporated in the 2017 Business Plan.

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Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release
Document #: NIAG-REP-08707.021-0201

Approvals			
	Signature	Comments	Date
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Mike Martelli President, RG&PM			26 AUG 16
I concur with the business decision as documented in this BCS.			
Finance Approval: Ken Hartwick SVP & CFO per OPG-STD-0076			Aug 29, 2016
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Jeff Lyash President & CEO per OAR 1.1			Aug 31, 2016

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Records File Information:
Records SCI/USI Retention
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Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Document #: NIAG-REP-08707.021-0201
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Business Case Summary

Part A: Business Need

Execution of this project will ensure availability and reliability of SAB1 G10 for 25-30 years and also ensure that Renewable Generation and Power Marketing maintains and develops hydro resources.

A generator rewind and an upgraded runner will result in improved unit efficiency and a maximum continuous rating (MCR) increase of approximately 9 MW. This project is a sustaining investment required to ensure continued reliable operation of G10 and to maximize the use of water available from the Niagara River new third tunnel

Sir Adam Beck GS #1 (SAB1) G10 was originally placed in-service in 1930 as a 25Hz unit rated for 45MVA then converted to 60Hz in 1956. The last major overhaul completed on the unit was in 1986. During the upcoming overhaul, the opportunity exists to execute additional work which would increase the capacity and efficiency of G10 and allow Niagara Operations to better utilize the water available to the station. The recommended alternative upgrades the current rating of the unit to the following capabilities:

	Turbine			Generator		MCR
	Efficiency (%)	Power (MW)		Rating parameters		(MW)
	[redacted]	Best	Full Load	MVA	MW	
Existing Unit		43.0	57.0	55	55	45.9
Upgraded Unit		**55.0**	**59.0**	**63**	**59**	**55**
Improvement		+12.0	+2.0	+8	+4	9.1

A Life Cycle Plan (LCP) for SAB1 (R-NF20-01556-0002) was approved July 2008. The recommended alternative was an eight unit station (G3-G10) which included overhaul and upgrade of G10. This project is also included in the 2015-17 Business Plan.

- Init/Def BCS (NPG-08707.021-0127) approved Oct. 18/13 to complete the Technical Specification and Uprate Study.
- Partial BCS (NPG-08707.021-0141) approved June 21/14 to purchase a new uprated runner.

Part B: Preferred Alternative: Perform Major Overhaul and Upgrade unit to 55 MW, 63 MVA

Description of Preferred Alternative

The project is executing a complete refurbishment of the generator stator and rotor including a rewind, and replacement of all supporting electrical auxiliaries. A major overhaul of the turbine has been undertaken, including installation of a new, uprated runner, headcover, lower ring and new wicket gates. Inspection of the penstock, Johnson valve and scroll case has revealed the need for significant repair and polyurethane injection.

A Definition Phase Charter (NPG-00121.2-0055) was approved October 2, 2013 which included a detailed scope of work based on actual work completed on G7, G9, and G3.

An equipment supply agreement between OPG and American Hydro Corp (now WAH) was signed Feb 2007 for the supply of runners for G3-G10. The runner for G10 was purchased under the terms of this agreement. The decision to purchase 8 runners and the SAB1 overhaul program was recommended and supported by the 2008 LCP for SAB1. The G10 RQE failed to allow for escalation and exchange rate fluctuation, as provided for in the WAH agreement.

The Technical Specification covering equipment and components which was based on previous SAB1 upgrades has stood up well during execution of the main EPC contract. That general contractor is responsible for completing the design (mechanical, electrical, civil), manufacture of parts, supply of equipment (except the runner), removal of existing equipment, and installation of new and/or refurbished equipment and installation of all of equipment and materials. It is believed that his strategy has reduced the execution cost and the associated risk to OPG, over what it would be under a multiple contracts scenario.

An Initial Project Execution Plan (PEP) with Risk Analysis (NPG-00121.1-0025) was approved June 25, 2014 and is attached below.

The unit is being overhauled during a Planned Outage from October 2015 extended to February, 2017.

This approach was recommended since it addresses availability and reliability concerns, had the highest NPV, and lowest risk profile. It is also consistent with Renewable Generation and Power Marketing mandate to maintain and develop hydro resources

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

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Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release
Document #: NIAG-REP-08707.021-0201

Deliverables:	Associated Milestones (if any):	Target Date:
This phase of the project will: Complete the mechanical and electrical installation and commissioning work.	Equipment in Service	Feb 2017



EBCS BK180649
(SAB10050) G10 Majo

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

k$	LTD	2016	2017	2018	2019	2020	2021	Future	Total
Currently Released	14,600	12,400							27,000
Requested Now	-	4,816	1,324						6,140
Future Required	-								
Total Project Cost	14,600	17,216	1,324						33,140
Ongoing Costs	-								
Grand Total	14,600	17,216	1,324						33,140

Estimate Class:	Class 1	Estimate at Completion:	33,140
NPV:		OAR Approval Amount:	33,140

Additional Information on Project Cash Flows (optional):

The 2016 cash flow will be managed within the Niagara Operations budget envelope; the 2017 cash flow will be incorporated in the 2017 Business Plan.

Part E: Financial Evaluation (Revised to reflect current approval request)

M$	Upgrade to 55 MW, 63 MVA	Base Case No Project	Minor Overhaul	Major Overhaul	Upgrade to 61 MW, 68 MVA
Project Cost	33.1	N/A	7.1	22.3	44.6
NPV	22.0	21.9	18.3	17.5	19.5
Incremental NPV	0.1	N/A	(3.6)	(4.4)	(2.4)

Summary of Financial Model Key Assumptions or Key Findings:

Energy projections per the SAB1 LCP are still valid.

Project costs are based on actual costs and current projections of work to complete.

The potential for a higher MCR during the Darlington refurbishment program has not been included.



NPV SAB10050 G10
Overhaul & Up...

Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Document #: NIAG-REP-08707.021-0201
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Part F: Qualitative Factors

Sustainable Development
Since hydroelectric generation is a renewable source of energy, the loss of a hydroelectric generating unit will increase the environmental impact of meeting Ontario's electricity demands. This will potentially necessitate the supply of energy from other less sustainable sources; therefore, increasing the reliability and production of SAB1 will potentially reduce the environmental impact of meeting Ontario's electricity demands.

Station Enhancement
Upgrades performed on the unit such as the modernization of the excitation system, unit protections and controls will improve the unit response and ensure compliance with Electricity market rules. This will enhance the overall station performance.

Health and Safety
The work will be completed in a manner that ensures G10 and associated equipment will be compliant with current corporate and provincial health and safety standards. Efforts will also be made to ensure that any new equipment installed is ergonomic. Enhancements such as upgraded lighting will improve the work environment and reduce health and safety risks to workers.

Environmental
An Environmental Assessment is not required for this project as the scope of this upgrade does not extend the operational parameters for SAB1 past the parameters associated with the original 10 unit station configuration.

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	Costs higher than expected	Allowances have been made for the expected spending trends to the end of the project. A contingency is also included consistent with the Estimate Class. Although it is possible for additional problems to arise during commissioning, Niagara has had recent success with the Weir runner/Andritz overhaul combination. The rewind portion of the contract will be transitioned to Owner Only.	Medium	Medium
Scope	Planned Execution Phase not complete. Discovery Work	The odds of there being significant additional discovery work are reduced at this point.	Low	Low
Schedule	Delay in completion of construction will result in lost generation revenue. Potential risk to coil manufacturing.	Newly qualified fabrication process has been developed with a firm delivery date. Although it is possible for additional problems to arise during commissioning, Niagara has had recent success with the Weir runner/Andritz overhaul combination.	Medium	Low
Resources	Insufficient OPG resources (PES, PWU) to support the work	Required resources committed to date have been sufficient.	Low	Low
Quality/ Performance	Due to volume of work and consolidation of engineering packages, functional specs and RFP packages may contain errors.	Confidence has been established that we will receive high quality coils based on extensive work by Andritz at the expense of a schedule delay. The prototype coils successfully passed testing requirements and will continue to be spot checked.	Low	Low
Technical	Unit does not meet performance requirements	G10 is a repeat of G3 with some additions.	Low	Low

Additional Risk Analysis:

Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release
Document #: NIAG-REP-08707.021-0201

Additional Risk Analysis:

G3 project was managed with multiple contractors and purchase orders which created many issues. G10 is being executed by a single general contractor under only two purchase orders. Site execution to date has been very good. Major additional work items that were not captured in the specification have been identified and addressed.

Part H: Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Simplified PIR	February 2017	February 2018

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
MCR	45.9 MW	55 MW	Unit Metering	SAB1 Production
Apparent Power	55 MVA	63 MVA	Unit Metering	SAB1 Production
Runner Efficiency at best efficiency point.	1986 Gibson Test	[redacted]	Gibson Test	Tech Supp Eng HTO / P&T
Runner Cavitation	N/A	As per model testing results (cavitation guarantee is 59 MW)	Visual Inspection	NPG Asset/Projects

Part I: Definitions and Acronyms

BP	Business Plan
HTO	Hydro-Thermal Operations
LEM	Leading Edge Maintenance
LCP	Life Cycle Plan
MCR	Maximum Continuous Rating
MW	Megawatts
MVA	Megavolt Ampere (a unit of measure of apparent power)
NPG	Niagara Plant Group (now Niagara Operations)
NPV	Net Present Value
P&T	Performance & Testing
PES	Plant Engineering Services
PTFE	Polytetrafluoroethylene - a synthetic polymer with numerous applications. The best known brand name is Teflon.
PWU	Power Workers Union
RQE	Release Quality Estimate
RFP	Request for Proposal
SAB	Sir Adam Beck

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Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Document #: NIAG-REP-08707.021-0201

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Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Document #: NIAG-REP-08707.021-0201
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Appendix A: Summary of Estimate (Revised)										
Project Number:	BK180649 (BK180649 (SAB10050))									
Project Title:	G10 Major Overhaul and Upgrade									
k$	LTD	2016	2017	2018	2019	2020	2021	Future	Total	%
OPG Project Management	340	695	142						1,177	3.6
OPG Engineering (including Design)	67	291	50						408	1.2
OPG Procured Materials	1,698	545							2,243	6.7
OPG Cnst Labour	368	1,245	240						1,853	5.6
Design Contract(s)										
Construction Contract(s)	14,654	9,414	572						24,640	74.3
EPC Contract(s)										
Consultants	182	79	0						261	.8
Other Contracts / Costs										
Interest	160	633	120						913	2.8
Subtotal	17,469	12,902	1,124						31,495	95.0
Removal Costs	645								645	1.9
Contingency	0	800	200						1,000	3.1
Total	18,114	13,702	1,324						33,140	100.0

Notes			
Project Start Date	Oct-2015	Total Definition cost (excludes unspent contingency for Nuclear)	34
Target In-Service (or AFS) Date	February-2017	Contingency included in this BCS (Nuclear only)	N/A
Target Completion Date	February -2017	Total contingency released plus contingency in this BCS (Nuclear only)	N/A
Escalation Rate	1.7%	Total released plus this BCS without contingency (Nuclear only)	N/A
Interest Rate	5.26%	Total released plus this BCS with contingency (Nuclear only)	N/A
Removal Costs	$645k	Estimate at Completion (includes only spent contingency for Nuclear)	33,140

Prepared by:		Approved by:	
Rick Comacchio Project Leader	Date 2016-05-27	Ken Prince Section Manager - Projects	Date 2016-05-27

Type 3 Business Case Summary

Project #: BK180649 (SAB10050)
Project Title: G10 Major Overhaul and Upgrade, <Superseding> <Execution> Release

Document #: NIAG-REP-08707.021-0201

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

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in k$ (by year including contingency)						Future	Total Project Estimate
			2014	2015	2016	2017	2018	2019		
Init & Def	Full	2013-10-18	100	11,500	15,400					27,000
Exec	Partial	2014-05-17	820	12,750	13,430					27,000
Exec	Full	2015-01-13	990	13,610	12,400					27,000
Exec	Full		990	17,124	13,702	1,324				33,140

Project Variance Analysis

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management		1,385	1,177	(208)	Overestimate from original RQE has resulted in modest forecasted under run.
OPG Engineering (including Design)		240	408	168	Higher than budgeted cost, partly due to additional coverage re: winding manufacturing issues.
OPG Procured Materials		1,375	2,243	868	Additional cost of changing draft tube extension to stainless and unexpected need for new Moody cone tip.
OPG CNST Labour			1,853	1,853	No budget allowance included in original RQE.
Design Contract(s)					
Construction Contract(s)		21,150	25,285	4,135	Higher than expected cost on award, and higher cost for blasting and lead abatement, Moody cone installation, stator and lower fan repairs. Removal Costs included $645k
EPC Contract(s)					
Consultants		120	261	141	IESO/Hydro 1/Pinchin, etc.
Other Contracts / Costs					
Interest		303	913	610	7 months schedule extension
Subtotal		24,573	32,140	7,567	
Original contingency		2,427		(2,427)	Consumed by cost variances
Revised Contingency			1,000	1,000	Added new contingency: 15% of remaining spend
Total		27,000	33,140	6,140	

ONTARIO POWER GENERATION

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

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OPG-FORM-0076-R005*

Type 3 Business Case Summary

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

Executive Summary and Recommendations

Project Information			
Project #:	DQ280851 (Capital)	**Document #:**	NIAG-REP-08707.021-0189 R00
Project Title:	G2 Overhaul & Upgrade		
Class:	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others:	**Investment Type:**	Sustaining
Phase:	Execution	**Release:**	Full
Facility:	Decew Falls (NF23)	**Target In-Service or Completion Date:**	FEB 14-2018

Project Overview

We recommend the release of $37,350k, including $5,440k of contingency. The estimated total project cost is $38,100k, including $5,560k of contingency.

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

This release will fund the following scope of work:

- A new reliable 90 MVA Generator and overhauled Turbine, producing 72 MW MCR.
- Upgrade of relevant downstream electrical equipment and protections as required, to ensure G2 generator output is safely and reliably delivered to the grid.
- Removal of the current operating 9MW unit de-rating.

Problem Statement/Business Need:

The unit is currently de-rated, experiencing increased outages, and has a potential risk of generator failure. This project is necessary to ensure safe and reliable operation of the unit capable of meeting Independent Electricity System Operator ("IESO") committed Mega Watts ("MW"). As per the Risk Treatment Plan (NF23-PLAN-09823-0001) this project eliminates the very-high financial risk identified in the 2015 ERAP.

Summary of Preferred Alternative:

- Replace the generator with one that is appropriately sized to keep future options open. The project is based on accommodating operation of G2 at its maximum runner capability of ~76 MWe. Maximum Continuous Rating ("MCR") will remain at 72 MW.
- Replace the turbine shaft with one that is appropriately designed to keep future options open and provides an adequate safety factor. The same diameter is expected and a new head cover will not be required.
- Re-use the existing runner and include cavitation repairs to the runner and draft tube (overhaul turbine).
- Upgrade of electrical equipment such as breaker and switchgear, transformer cooling, full static excitation system and unit controls and instrumentation.

For detailed scope of work for this alternative refer to NIAG-REP-00121.2-0002

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

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Project Overview

History of BCS releases and project cost estimates:

Definition BCS release was approved on Feb. 6, 2015 for $750k which has covered costs for Scope Definition, creation of the Technical Specification and creating the Request for Proposals documents.

The 2015-17 Business Plan included $44,430 (CAP), based on a scope that included a new runner as well as powerhouse movement mitigation measures.

The revised project estimate based on mid-range contractor bids proposals is $38,100k encompassing Alt. 1 scope which includes; a new generator, overhauled turbine, and replacement of all necessary components. This alternative re-uses the existing runner.

History of scope and schedule changes:

Initial Scope was for a New Stator only (Initiation Phase Charter and Business Plan 2014-16).

Scope developed in the Definition Phase was for a New Upgraded Generator, New Turbine Shaft, and a Turbine Overhaul.

Including a new runner in the scope was discussed and evaluated during the Definition Phase, but was not the preferred alternative.

Key Assumptions and Risks:

The development of this project will be expedited to the extent possible, recognizing the increasing risk of failure as the unit continues to operate.

Project Cash Flows, NPV, and OAR Approval Amount

k$	LTD	2016	2017	2018	2019	2020	Future	Total
Currently Released	750							750
Requested Now	-	10,829	25,730	791				37,350
Future Required	-							
Total Project Cost	750	10,829	25,730	791				38,100
Ongoing Costs	-							
Grand Total	750	10,829	25,730	791				38,100

Estimate Class:	Class 3	**Estimate at Completion:**	38,100
NPV:	284,690	**OAR Approval Amount:**	38,100

Additional Information on Project Cash Flows (optional):

(k$)	2015	2016	2017	2018	Total
BP 2016-18	250	11,740	25,625	0	37,615
Summary of Estimate	222	11,357	25,730	791	38,100
Variance (SoE – BP)	(28)	(383)	105	791	485

The current Summary of Estimate is slightly higher than BP 2016-18; changes will be managed within the revised budget envelope.

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Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Approvals			
	Signature	**Comments**	**Date**
The recommended alternative, including the identified ongoing costs, if any, represents the best option to meet the validated business need.			
Recommended by (Project Sponsor): Allan Reid Plant Manager, Niagara Operations	Allan Reid		April 6/16
I concur with the business decision as documented in this BCS.			
Finance Approval: Ken Hartwick SVP Finance, Strategy, Risk & CFO per OPG-STD-0076	K HA		Apr 15, 2016
I confirm that this project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Approved by: Jeff Lyash President and CEO per OAR 1.1			April 20, 16

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Business Case Summary

Part A: Business Need

The unit is currently de-rated, experiencing increased outages, and has a potential risk of generator failure. This project is necessary to ensure safe and reliable operation of the unit capable of meeting Independent Electricity System Operator ("IESO") committed Mega Watts ("MW").

Background of Issues:

On November 13, 2012, a loud, low frequency hum was discovered by an Asset Engineer and recognized as a possible indicator of loose stator components. Preliminary investigation revealed severe fretting at the upstream split in the sectional stator, cracks in key-bar brackets, and other issues in this area of the stator core.

Plant Engineering Services ("PES") conducted a root cause technical investigation (R-NF23-42120--0003) on G2 stator failure which identified 2 main causes:

- Apparent overloading of the unit for the last six or more years (due to unrecognized design differences between G1 and G2)
- The opening of the stator core split in the upstream area (although this was the design philosophy of the original generator, it is recognized as a weak design today)

To conclude this project addresses G2's emergent generator issues: shortened life compared to design life, lower output, higher maintenance costs and longer outage duration. Completion of this project will restore lost revenue potential and mitigate the risk of unplanned generator outages.

Part B: Preferred Alternative: Upgrade Generator, Replace Turbine Shaft, and Turbine Overhaul

Description of Preferred Alternative

- Replace the generator with one that is appropriately sized to keep future options open (i.e. future runner replacement and associated draft tube re-profiling)
- Replace the turbine shaft with one that provides an adequate safety factor. The same diameter shaft is expected and a new head cover will not be required.
- Re-use the existing runner and repair cavitation on the runner and draft tube (overhaul turbine).
- A comprehensive look at the units' power equipment and condition to ensure all systems are sized to meet the units' current and expected future rating.
- This alternative produces the highest Net Present Value (see Part E), and is recommended as it provides an expedited schedule with fewer component interdependencies (co-ordinating generator design with runner design). A conservative approach is preferred given the current state of the unit and potential for generator failure.

Deliverables:	Associated Milestones (if any):	Target Date:
Present to Asset Management Committee		March 21, 2016
BCS Approval		April 15, 2016
NF23 G2 Outage Start		Nov. 7, 2016
Contractor Substantial Completion		Dec. 13, 2017
Planned Unit in Service		Feb. 14, 2018
Project Closure Report Complete		Aug. 30, 2018

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Part C: Other Alternatives

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

Alternative 2: Upgraded Generator & New Runner

- There exists a limit on the water that can be discharged by the Decew facility into the 12 Mile Creek. The water is currently portioned between ND1 (Decew GS #1 G5, G6, G7, G8) and NF23 (Decew GS #2 G1 and G2). The older ND1 station has a historically favourable GRC arrangement which negates efficiency gains that could be made by diverting more water through NF23. As such, a new runner would not be able to take advantage of higher throughput until water is available from ND1. This would happen when ND1's favourable arrangement expires.
- A new runner would improve cavitation performance to the extent possible, but would also require re-profiling the draft tube to realize efficiency gains.
- Replace the turbine shaft with one that provides an adequate safety factor. The same diameter is expected and a new head cover will not be required.
- This is not the recommended alternative as the schedule risks associated with the new runner were found to be intolerably high given the risk of generator failure and the gains from the new runner would not be realized until some future date.

Alternative 3: Status Quo (Base Case)

- Continue to operate the unit with regular inspections and repairs. This could include identifying an operating point that would result in minimal vibrations and applying operating restrictions to operate the unit at this point. This unit restriction would result in ongoing economic losses.
- This alternative was rejected as there is still a risk of generator failure (current repairs are expected to be a short term fix) resulting in a long term forced outage while an overhaul is carried out.

Alternative 4: Replace Generator Only

- Replace the generator with a unit that matches the previous 72MW rating.
- Cavitation repairs to the runner and draft tube.
- This alternative was rejected as it would leave a turbine shaft in place with a marginal factor of safety.

Alternative 5: Repair Stator Core

- The repair involves a re-pile of the core.
- This alternative was rejected as; it is difficult to complete without damaging other parts of the unit, the likelihood of a successful repair is low, and the longevity of the repair is probably only a few years.

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Part D: Project Cash Flows, NPV, and OAR Approval Amount (duplicate from Overview section)

k$	LTD	2016	2017	2018	2019	2020	Future	Total
Currently Released	750							750
Requested Now	-	10,829	25,730	791				37,350
Future Required	-							
Total Project Cost	750	10,829	25,730	791				38,100
Ongoing Costs	-							
Grand Total	750	10,829	25,730	791				38,100

Estimate Class:	Class 3	**Estimate at Completion:**	38,100
NPV:	168,659	**OAR Approval Amount:**	38,100

Additional Information on Project Cash Flows (optional):

(k$)	2015	2016	2017	2018	Total
BP 2016-18	250	11,740	25,625	0	37,615
Summary of Estimate	222	11,357	25,730	791	38,100
Variance (SoE – BP)	(28)	(383)	105	791	485

The current Summary of Estimate is slightly higher than BP 2016-18; changes will be managed within the revised budget envelope.

Part E: Financial Evaluation

k$	Preferred Alternative	Alternative 2	Status Quo	Alternative 4	Alternative 5
Project Cost	38,100	41,950	Alternative Rejected	Alternative Rejected	Alternative Rejected
NPV	294,077	291,191			
Incremental NPV		2,886			

Summary of Financial Model Key Assumptions or Key Findings:

Alternative 1 (Replace the Generator &Turbine Shaft, Overhaul the Turbine and Runner)

- Replace the generator with one that is appropriately sized for a future runner replacement and associated draft tube re-profiling.
- 30 year life, 72 MW Capacity restored from 63 MW de-rating, 80% Capacity Factor.

Alternative 2 (Replace the Generator & Associated Power Equipment, Turbine Shaft & Turbine Runner, Overhaul the Turbine)

- Assumes an increase in efficiency resulting in an additional 1 MW of capacity (MCR 73MW with available water).
- Assumes the Generator Fails before the runner can be delivered (24 month lead time).
- 30 year life, 73MW Capacity, 80% Capacity Factor.

Alternative 3 Status Quo (Overhaul the Generator, Turbine & Turbine Runner, Replace the Turbine Shaft

- Incremental OM&A is higher only for this option only.
- Minor Overhaul's assumed to gain approximately 10 years.
- Operating De-rate of 9 MW.

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Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Part F: Qualitative Factors

- The station is in the 'work horse' asset category and as such, the operating and maintenance strategy for the station follows a basic preventive maintenance program and sustaining investments receive medium to high priority.
- Alternative 1 is recommended as it has an expedited schedule with fewer component interdependencies (coordinating generator design with runner design).
- A conservative approach is preferred given the current state of the unit and potential for generator failure.

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
			Probability	Impact
Cost	Costs higher than expected.	A well-defined scope has been prepared, actual contractor pricing included and appropriate contingency carried.	Medium	Low
Scope	Additional scope discovered during execution	Project is carrying a contingency of ~15%; discovery work will be addressed as it comes up; strategy will be to accept necessary discovery work to ensure a quality product	Medium	Medium
	Powerhouse movement	Movement of the NF23 powerhouse is an ongoing concern and has the potential to impact the new unit's alignment in the future. An adjustable generator sole plate will provide some mitigation for this risk but more significantly, a project (DQ282672) is in development that will further define and implement powerhouse movement mitigation measures, as necessary.	Medium	Low
Schedule	Class EA not received before project start date.	Accept risk. Upfront planning and continual monitoring of status by designated action owners to mitigate risk.	Low	Medium
	CIA and SIA not completed before project end date.	Accept risk. Upfront planning and continual monitoring of status by designated action owners to mitigate risk.	Low	Medium
	The contract award is delayed, which leaves insufficient time for contractor to do adequate engineering, material purchases.	A 15 month outage has been programmed to provide adequate float. The turbine overhaul has been overflowed to BTU to alleviate strain on internal resources.	Medium	Low
Resources	Other outages/overhauls may strain resources. Not enough staff to commission the unit in a timely manner.	Early / quality planning and commitment from Production to prioritise and focus resources on G2.	Low	Low
Quality/ Performance	Unit reliability issues or does not meet performance expectations due to poor quality of workmanship.	QA/QC, ITPs, RFP submittal requirements, peer reviewed specifications based on recent projects and OPG standards.	Low	Medium
Technical	Some embedded parts may not be able to be repaired in place and may require replacement.	Evaluate as soon as unit is dismantled. Carry appropriate contingency.	Medium	Low
	Cast iron head covers have had problems in other plants.	Thorough inspection early, carry estimated contingency for possible repairs if doable. If new head cover required, then accommodate with CCA.	Low	Low

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Part G: Risk Assessment

Risk Class	Description of Risk	Risk Management Strategy	Post-Mitigation	
Integration	External Stakeholder (Hydro One & Shickluna) may require outages during the duration of the project	Accept risk. Upfront planning and continual monitoring and communication with external stakeholders to ensure minimal disruptions to the project.	Medium	Medium
	Interference or delays from parallel project within the plant group (West Approach Bridge & G2 Penstock Project)	Mitigate through early planning, execution and continual communication with internal stakeholders.	Medium	Low

Additional Risk Analysis:

There is a risk that the unit could prematurely fail prior to the scheduled overhaul. Should this happen the project schedule will be impacted as an accelerated execution will be highly desirable.

Part H: Post Implementation Review (PIR) Plan

Type of PIR Report	Target In-Service or Completion Date	Target PIR Completion Date
Simplified PIR	FEB-14-2018	FEB-28-2019

Measurable Parameter	Current Baseline	Target Result	How will it be measured?	Who will measure it? (person/group)
Unit In-Service	February 2018	February 2018	Assess at Project Closeout	Project Sponsor
Project Cost	$38.1M	$38.1M	Assess at Project Closeout	Project Sponsor
Power Output	72 MW	72 MW	Revenue meter	Asset Technical Engineer
Project Environmental Performance Index	100%	100%	Assess at Project Closeout	Project Sponsor

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Part I: Definitions and Acronyms
AACE – Association for the Advancement of Cost Engineering
BP – Business Plan
BTU – Building Trades Union
CAP – Capital
Cavitation – The formation of bubbles in a liquid due to pressure fluctuations which when collapsed can cause damage to surfaces due to cyclic stress.
CIA – Customer Impact Assessment
EA – Environmental Assessment
IESO – Independent Electricity System Operator
LTD – Life to Date
MCR – Maximum Continuous Rating
MOT – Main Output Transformer
MVA – Mega Volt Amp
MW – Mega Watt
MW_e – Mega Watt (electrical)
MW_m – Mega Watt (mechanical)
NPV – Net Present Value
OPG – Ontario Power Generation
OM&A – Operations, Maintenance and Administration
PES – Plant Engineering Services (OPG Engineering)
PF – Power Factor
PIR – Post Implementation Review
SIA – System Impact Assessment

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Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release

Document #: NIAG-REP-08707.021-0189 R00

For Internal Project Cost Control

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Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Appendix A: Summary of Estimate									
Project Number:	NIAG-REP-08707.021-0189 R00								
Project Title:	G2 Overhaul & Upgrade								
k$	LTD	2016	2017	2018	2019	2020	Future	Total	%
OPG Project Management	47	152	120	37				356	0.9%
External Project Management		99	273	50				423	1.1%
OPG Engineering (including Design)	99	475	441	38				1,053	2.8%
OPG Procured Materials		10						10	0.0%
OPG Other (PWU)		139	379					518	1.4%
Design Contract(s)	71							71	0.2%
Construction Contract(s)									0.0%
EPC Contract(s)		7400	18,810	525				26,735	70.2%
Consultants		501	50					551	1.4%
Other Contracts / Costs		111	395	32				538	1.4%
Interest	5	443	1100	37				1,585	4.2%
Removal		400	300					700	1.8%
Subtotal	222	9,730	21,868	719				32,540	85.4%
Contingency		1,627	3,862	72				5,560	14.6%
Total	222	11,357	25,730	791				38,100	100%

Notes			
Project Start Date	2016-11-07	Total Definition cost (excludes unspent contingency for Nuclear)	$222k
Target In-Service (or AFS) Date	2018-02-14	Contingency included in this BCS (Nuclear only)	N/A
Target Completion Date	2018-12-31	Total contingency released plus contingency in this BCS (Nuclear only)	N/A
Escalation Rate	Line specific escalation %	Total released plus this BCS without contingency (Nuclear only)	N/A
Interest Rate	5.26%	Total released plus this BCS with contingency (Nuclear only)	N/A
Removal Costs	$700k	Estimate at Completion (includes only spent contingency for Nuclear)	$38,100k

Prepared by:		Approved by:	
Richard Squires Project Leader	Date YYYY-MM-DD	Ken Prince Section Manager - Projects	Date 2016-03-31 YYYY-MM-DD

2016-03-31

Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

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

Comparison of Total Project Estimates

Phase	Release	Approval Date	Total Project Estimate in M$ (by year including contingency)						Future	Total Project Estimate
			2014 LTD	2015	2016	2017	2018	2019		
Definition	Full	02-05-2015		0.8	11.2	25.6				37.6
Execution	Full	04-29-2016		0.2	11.4	25.7	0.8			38.1

Project Variance Analysis

k$	LTD	Total Project		Variance	Comments
		Last BCS	This BCS		
OPG Project Management					Project Variance Analysis Not Applicable; This release represents the first full release for the project execution phase.
OPG Engineering (including Design)					
OPG Procured Materials					
OPG Other					
Design Contract(s)					
Construction Contract(s)					
EPC Contract(s)					
Consultants					
Other Contracts / Costs					
Interest					
Subtotal					
Contingency					
Total					

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Type 3 Business Case Summary

Project #: DQ280851 (Capital)
Project Title: G2 Overhaul & Upgrade, <Full> <Execution> Release
Document #: NIAG-REP-08707.021-0189 R00

Appendix C: Financial Evaluation Assumptions

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

Alternative 1 (Replace the Generator &Turbine Shaft, Overhaul the Turbine and Runner)

- Replace the generator with one that is appropriately sized for a future runner replacement and associated draft tube re-profiling.
- 30 year life, 72 MW Capacity restored from 63 MW de-rating, 80% Capacity Factor

Alternative 2 (Replace the Generator & Associated Power Equipment, Turbine Shaft & Turbine Runner, Overhaul the Turbine)

- Assumes an increase in efficiency resulting in an additional 1 MW of capacity (MCR 73MW with available water).
- Assumes the Generator Fails before the runner can be delivered (24 month lead time)
- 30 year life, 73MW Capacity, 80% Capacity Factor

Alternative 3 Status Quo (Overhaul the Generator, Turbine & Turbine Runner, Replace the Turbine Shaft

- Incremental OM&A is higher only for this option only
- Minor Overhaul's assumed to gain approximately 10 years.
- De-rate of 9 MW.

Project Cost:

Alt. 1. $38,100
Alt. 2. $41,950
Alt. 3. $60,000 over 3 minor overhauls

Financial (NPV):

Alt 1. $294,077k
Alt 2. $291,191k
Alt 3. $251,851k

Project Life:

Alt 1. 30 years
Alt 2. 30 years
Alt 3. Minor Overhauls every 10 years (compared over 30 year span)

Financial Evaluation As Reported above using SEVs



NF23 G2 BCS with Hydro FE Models-Aug

Appendix D: References

R-NF23-42120--0003 Root Cause Technical Investigation
NPG-00121.2-0061 Terms of Reference
NIAG-CHAR-00121.2-0079 Project Charter
NIAG-REP-08707.021-0158 Definition Business Case Summary
NIAG-REP-00121.2-0002 Scope of Work

Business Case Summary

Project #	82087	**BCS Document Number**	FS1-BCS-40000-00001
Project Title	82087 - CONISTON & STINSON GS REDEVELOPMENT		
Facility	CON - CONISTON	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2027-Dec-25
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $152,440K, including [redacted] of contingency. This will bring the total release to-date to $177,991k.

The estimated total project cost is $178M, including [redacted] of contingency.

This project will redevelop and ensure continued operation of the Coniston and Stinson Generating Stations (GS), which are at or approaching end-of-life, while increasing capacity at both stations to a combined total of 12MW. This release includes the detailed engineering, construction, testing and turnover to operations of two redeveloped generating stations. The existing powerhouses will be demolished down to the foundations, the existing Coniston GS intake and penstocks removed, and two 3MW units will be installed (per station) as well as new balance of plant mechanical and electrical systems. The redeveloped stations are expected to operate for approximately 80 years.

Investment Cash Flows

Project Number	82087 - CONISTON & STINSON GS REDEVELOPMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	10,780	14,771							25,551
Currently Requested	0	1,210	95,564	52,868	2,798				152,440
Total released to date	10,780	15,981	95,564	52,868	2,798				177,991
Future required	0								0
Total Project Cost	10,780	15,981	95,564	52,868	2,798				177,991
Ongoing Costs	0								0

Total OAR Approval	177,991.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer	Nicolle Butcher	2024-11-07
I concur with the business decision as documented in this BCS.		
Finance Approval : Aida Cipolla Chief Financial Officer	Aida Cipolla	2024-11-25
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient		

priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Ken Hartwick** **President & Chief Executive Officer**	Ken Hartwick	2024-11-25

EXECUTIVE SUMMARY – Project Overview

Ontario Power Generation (OPG) is undertaking the Coniston & Stinson Generating Station (GS) Redevelopment Project, as both of these stations are at or approaching end-of-life.

Coniston GS and Stinson GS are 119 years old and 99 years old, respectively. Most of the equipment at these sites has reached or is imminently approaching end-of-life. A redevelopment is necessary to mitigate the loss of generating capacity at both stations in the near future. The project also enables OPG to utilize available river flows more efficiently and optimize power generation at the two sites. The project will increase the combined stations' total capacity to approximately 12 MW and ensure continued operation of the stations for approximately 80 years.

The preferred alternative is to design, construct and commission two new 6 MW generating stations at Coniston GS and Stinson GS. This will entail demolition of the existing powerhouses down to the foundations, and replacement of the existing Coniston GS intake and penstocks. The new stations will each have two 3 MW DIVE Turbine hydro units as well as new balance of plant mechanical and electrical systems. The redeveloped Coniston GS is expected to be in-service by Q1 2027, and the redeveloped Stinson GS is expected to be in-service by Q2 2027. In the absence of a redevelopment, the two stations would reach end-of-life and be permanently shut down.

The project is consistent with the Province's request that OPG modernize small hydro generating facilities to improve existing generating capacity, uncover additional efficiencies, and in some cases rehabilitate an entire site (Powering Ontario's Growth report, p. 53), and its incremental generation output will contribute to meeting Ontario's increasing electricity demand.

The Gate 2 release has successfully achieved its deliverables: completing the value engineering, procurement of long lead items, cofferdam design and permit applications, continuing consultation with Indigenous peoples and identifying sub-contracting and direct hire opportunities. This release will fund the construction, commissioning, available for service (AFS) declaration, close out, and OPG oversight on these activities for the project.

The key risks to the project include:
- First Of A Kind (FOAK) - Integrating the inverter power pack with a permanent magnet generator turbine: Risk is being mitigated through OPEX gained from industry peers and additional oversight on integration and commissioning of the system.
- Escalation in Steel and Concrete Prices: Price escalation for these quantities could be higher than anticipated. Contingency is being held to compensate for this potential risk.
- Fish Compensation Area: No fish habitat compensation is assumed as the new DIVE units are more fish friendly than what's currently installed. Contingency is being held in the event that regulators deem additional compensating habitat is required.

Business Need

For Project Level A or B

Coniston GS is a 4 MW station built in 1905, with Unit 1 placed into service in 1905, and Units 2 and 3 placed in service in 1907 and 1915, respectively. The generating station has reached the end of its expected service life. Unit 1 was removed from service in 2013 when the penstock collapsed, and Unit 2 was permanently shut down in 2019 after the penstock steel was deemed too thin for continued safe operation. In 2024, Unit 3 suffered major wicket gate failures and was taken out of service. Redeveloping the station provides an opportunity for OPG to continue operations, while increasing capacity and utilizing the available river flows more efficiently at the site for an estimated 80 years, rather than permanently shutting down the station.

Stinson GS is a 2-unit, 5.2 MW station built in 1925. It is directly upstream from Coniston GS on the Wanapitei River. Stinson GS's equipment is approaching end-of-life. Unit inspections in 2024 revealed significant issues including multiple failed wicket gates, cracked downstream shift rings and cracked distributor rings. Stinson GS has also experienced recent failure of the Babbitt bearing and generator guide bearing. The extent of component failures indicates that a substantial component replacement is necessary to ensure efficient and reliable operation, exceeding the scope of a traditional overhaul. Given the overall age and asset condition, it is likely that Stinson GS would be permanently shut down within five years in the absence of a redevelopment.

The redeveloped facilities are expected to provide clean, renewable generation for another approximately 80 years, at a time when a significant rise in Ontario's electricity demand is projected. According to the IESO's recently released 2025 Annual Planning Outlook forecast, electricity demand is projected to grow by 75 percent by 2050.

As rate regulated facilities, the recovery of prudently incurred costs and return on investment for the project will be enabled through the Ontario Energy Board rate setting process. Subject to meeting the eligibility criteria, project expenditures are expected to benefit from the 15% federal Clean Electricity Investment Tax Credit (ITC), which will reduce the project's net cost to ratepayers.

Preferred Alternative:	Redevelop Coniston GS and Stinson GS with New DIVE Units	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative at Coniston GS is a redevelopment, which includes the following:
- Installation of an upstream cofferdam in the existing power canal
- Demolition of the existing powerhouse superstructure (maintaining the current foundation) and removal of the three end-of-life turbine/generators and associated balance of plant equipment
- Demolition of the existing intake structure, service gates and four penstocks
- Erection of a new prefabricated powerhouse on the existing foundation with a new powerhouse crane
- Construction of new deeper intake structure with two service gates and two new penstocks
- Installation of two 3MW DIVE turbine/generators and balance of plant equipment

The preferred alternative at Stinson GS is a redevelopment, which includes the following:
- Demolition of the existing powerhouse superstructure (maintaining the current foundation) and removal of the two end-of-life turbine/generators and associated balance of plant equipment
- Erection of a new prefabricated powerhouse on the existing foundation with a new powerhouse crane
- Rehabilitation of the headworks concrete deck and installation of a new headworks superstructure/hoists and rehabilitation of the existing headgates (sandblast and paint and new wheels/seals)
- Installation of two 3MW DIVE turbine/generators and balance of plant equipment

Completing this scope of work will provide 12 MW of capacity and approximately 54 GWh of annual energy generation over an estimated 80-year operating life. The levelized cost of energy (LCOE) of this alternative relative to the base case is estimated at approximately $110/MWh (2024$), including project costs to date. On a forward-looking cost basis, the LCOE of the alternative is approximately $95/MWh (2024$) relative to the base case. OPG's analysis shows that this redevelopment will provide positive economic value to the province's electricity system.

From an operational standpoint, the preferred alternative will match production at both sites with the same flow rates, allowing optimal coordination of water usage through the Wanapitei River system while complying with the existing Water Management Plan. The Project has been established in consultation with the Wahnapitae First Nation and the Atikameksheng Anishnawbek First Nation. The Contractor has been working with the host communities to develop a plan to provide employment opportunities during the execution of the project, which supports OPG's Reconciliation Action Plan goals. Additionally, the selected DIVE units have a much lower fish mortality rate than traditional vertical Kaplan units.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
FEED Phase Design	Preliminary Design Complete		2024-07-31
Contract issued for Engineering Design	Detailed Engineering Start		2024-08-01
Contract Issued for T/G Supplier	Procurement Contracts Awarded/PO Issued		2024-09-30
G3 Approval		82087M0018 - G3 BCS Approval	2024-11-14

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
G3 - Gate 3 approval	Gate G3 Approval		2024-11-14
Project Complete	Project Close Out Completed		2027-12-24

Future Release: N/A

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Not recommended. If the project were not to progress, Coniston GS will be permanently and imminently shut down. The penstocks would need to be removed, the powerhouse put in a safe state and the intake canal closed-off and filled in. These decommissioning efforts would require incremental expenditures, estimated at $25 to $35 million, and there would continue to be ongoing costs to maintain site infrastructure for water management, environment, and public safety obligations, without any power generation.

As per the unit assessment completed in early 2024, the Stinson GS units are at end-of-life. If the project were not to progress, the units may continue to generate electricity for a relatively short period until a critical component failure forces them offline. At that point, the facility would be permanently shut down and incremental expenditures incurred, estimated at $25 to $35 million, to safe state the station in a controlled manner, similar to Coniston GS. For purposes of the analysis, it is assumed that Stinson GS would be permanently shut down approximately five years after Coniston GS.

This alternative would represent a lost opportunity to maintain and enhance the clean hydroelectric generation provided by the Coniston GS and Stinson GS, and a lost opportunity to help meet the Province's energy transition targets and objectives of the Province's Powering Ontario's Growth strategy.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Not considered. Units are at end of life (see Alternative 2).

Alternative 4:	**Redevelopment of both Sites with New SAXO Units**	For Project Level A, B

Not recommended. The project contemplated installing traditional vertical (SAXO) turbine/generator units as part of the redevelopment scope. Vertical units occupy several floors below ground level, requiring a substantial amount of civil works during construction. Coniston GS and Stinson GS are both single floor powerhouses (no basements) and installing SAXO units would entail excavating down below the tailrace level to construct two additional basement levels. This requires large downstream cofferdams during the construction phase and the addition of permanent tailrace gates to the station to allow for isolation of the units in the future.

The project estimate for vertical units is in the order of $250M, or approximately $70M more expensive than the preferred alternative. Both Alternative 1 and Alternative 4 provide approximately the same overall capacity total (12MW) with an estimated 80-year design life.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Technical	FOAK - Power Pack integration with PMG Turbine	Mitigate 68505 - FOK - Power Pack integration with PMG Turbine 12/31/2025	High
Procurement - Materials	Escalation in steel and concrete	Accept	Medium
Technical	Fish Compensation Area	Mitigate	Medium
Technical	Stinson Head Gate Condition	Mitigate	Low

Additional Risk Analysis — For Project Level A or B

None at this time.

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$K	Alternative	Base Case (No Project)	Delay Work	Alternative 4	Alternative 5
Project Cost	$178M	~$50M - $70M	-	$250M	
Other: (e.g., IRR)	Estimated LCOE (net of ITCs) ($2024). ~$110/MWh (incl. costs to date) ~$95/MWh (forward looking costs)	N/A		Estimated LCOE (net of ITCs) ($2024). >~$110/MWh (incl. costs to date) >~$95/MWh (forward looking costs)	

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Key Assumptions:

The Base Case (No Project) alternative assumes decommissioning of Coniston GS, followed by Stinson GS in 5 years. Project cost is based on Owner's Engineer Estimate.

The preferred alternative cost is based on EPC Contract Class 3 estimate.

The vertical unit option (alternative 3) cost is based on market information from mid-2023.

Financial/Economic:
1. Corporate tax rate: 25%
2. CCA rate (preferred alternative): 30%
3. Discount rate: 6.5%
4. Annual escalation – Operating costs: 2%
5. Clean Electricity ITC (preferred alternative): ~80% excl. interest

Project Life – Preferred Alternative:
1. Project in service by: Apr. 2027
2. Operating life: 80 years

Energy Production – Preferred Alternative:
1. Total stations' capacity: 12 MW
2. Annual energy production: 54 GWh

OM&A Expenses & Sustaining Capital:
1. Annual OM&A ($2024): $0.4 M (preferred alternative)
$0.2 M (base case)
2. Gross Revenue Charge (preferred alternative): ~$4.9 /MWh
3. Total sustaining capital costs ($2024) (preferred alternative): $14 M
4. Major overhaul frequency (preferred alternative): 25 years

Qualitative Factors For Project Level A or B

The Coniston & Stinson GS Redevelopment Project aligns with OPG's business imperatives.

1. Social Licence – Sustainable Energy Development
Hydroelectric redevelopment demonstrates OPG's commitment to clean, renewable power and is in-line with OPG's Climate Change Plan, which includes opportunities for redevelopment of hydroelectric generating stations (Climate Change Plan, page 45).

2. Operational Excellence – Improved Asset Reliability
The project addresses operational reliability and safety concerns with the aging equipment on site. New equipment is fundamentally more reliable and safer to operate.

3. Social Licence – Local Community and Indigenous Relations
The project will have several opportunities during the Definition and Execution Phases to engage, consult and build relationships with the local Indigenous Communities. The project will continue to maintain a strong working relationship with First Nations during subsequent phases, supporting OPG's Reconciliation Action Plan. The project will also be seeking and identifying Execution Phase subcontracting opportunities for First Nations businesses.

4. Operational Excellence – Environmental Considerations
The project is not expected to necessitate changes to the flows in the Water Management Plan, and the new turbine designs are estimated to improve fish mortality rates as compared to the existing units.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2028-12-31

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Actual turbine/generator output	Coniston GS is currently operating at 0 MW, with 2 units permanently shut down and 1 unit out of service Stinson GS is at 5 MW station, but units are at end-of-life	Coniston GS upgraded to a 6 MW station Stinson GS upgraded to a 6 MW station	Actual turbine/generator output will be compared to the performance guarantees in the Contract. Performance testing will be	OPG Performance and Testing (P&T)

			conducted to verify flow and output.	
Unit vibration and hydraulic stability	Industry Standard ISO 20816-5	As per Contract technical specifications	Vibrational testing during testing/commissioning	OPG Machine Dynamics & Component Integrity (MDCI) or third-party testing company

APPENDICES

Appendix A1: Summary of Estimate

Project Number	82087 - CONISTON & STINSON GS REDEVELOPMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management	11	30	111	792	27				971	1
1 - Project Management	4,721	2,406	2,920	2,101	413				12,561	7
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	10,780	15,981	95,564	52,868	2,798				177,991	100
Removal Costs (incl. above)			1,620						1,620	1

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.00

Business Case Summary

Appendix A3: Summary of Estimate - In-Service Estimates				
$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs & contingency			
Project#	**Date**	**Description**	**Amount**	**%**
82087	2026-05-15	Coniston Powerhouse and Crane	26,502	18.0
82087	2026-09-26	Stinson Powerhouse and Crane	28,514	19.0
82087	2026-10-30	Coniston Intake & Gates	30,387	20.0
82087	2026-11-08	Stinson Headgates	4,679	3.0
82087	2026-11-13	Coniston G1 In-Service	20,564	14.0
82087	2027-01-09	Coniston G2 In-Service	11,200	8.0
82087	2027-02-10	Stinson G1 In-Service	11,200	8.0
82087	2027-04-01	Stinson G2 In-Service	14,003	9.0
82087	2027-12-25	Project Closeout	1,997	1.0
		Total:	**149,046**	**100**

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Dave Bonell Senior Manager Projects HALO 1	2024-10-31	Subo Sinnathamby Chief Projects Officer Enterprise Projects	2024-11-05

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Business Case Summary

Project #	82089	**BCS Document Number**	Q13-BCS-00120.03-1046703
Project Title	82089 - CALABOGIE GS REDEVELOPMENT		
Facility	CAL - CALABOGIE	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Superseding)	**Target Project Completion Date**	2023-Dec-31
Estimate Class (Current Request)	Class 2	**Estimate Class (Overall Project)**	Class 2

Recommendation

We recommend a release of $22.5 M, including $1.9 M contingency.

This will bring the total released-to-date to $167.5 M including $5.6 M contingency.

This superseding release is to address the additional cost in completing the new 10.7 MW Calabogie Generating Station (GS) redevelopment resulting from additional effort and schedule extension. The project is forecasted to require additional funding brought about by various events including site conditions, concrete placement quality, COVID (Omicron) in 2022 and increase of material cost.

The initial execution release BCS of $136.5M, including $10.6M of contingency was approved by the Board in November 2019 and a project over-variance release for $8.5M was approved by the Board in Novermber 2021, which brought the prior approved funding to $145M.

Investment Cash Flows

Project Number	82089 - CALABOGIE GS REDEVELOPMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**Future**	**Total**
Previous releases	91,292	47,193	6,515						145,000
Currently Requested	0	10,890	11,610						22,500
Total released to date	91,292	58,083	18,125						167,500
Future required	0								0
Total Project Cost	91,292	58,083	18,125						167,500
Ongoing Costs	0								0

Total OAR Approval	167,500.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer	Nicolle Butcher	2022-10-25
I concur with the business decision as documented in this BCS.		
Finance Approval : Aida Cipolla CFO & SVP - Finance	Aida Cipolla	2022-10-26

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Ken Hartwick** **President & Chief Executive Officer**	Ken Hartwick	2022-10-26

EXECUTIVE SUMMARY – Project Overview

The original 5 MW Calabogie GS was placed in-service in 1917 and had reached the end of its expected service life. In September 2018, the station was critically damaged by a tornado and has been out-of-service since.

The Calabogie GS Redevelopment Project is currently underway to design, construct, commission and turnover a new 10.7 MW Calabogie GS. The new station will make better use of water at site to generate electricity, thereby doubling the output of the original station, while continuing to respect the water levels and limits in the existing Water Management Plan. As part of the project, dam safety concerns will also be alleviated by building a new powerhouse and forebay embankment.

The project entered into Execution Phase in November 2019, after the completion of the front-end engineering and design (FEED) phase. An engineering, procurement and construction (EPC) agreement was executed and negotiated with the contractor in May 2020.

This superseding release is required to address the additional cost to complete the Calabogie GS Redevelopment Project resulting from schedule extension and additional effort, brought about by various events, including:

• Construction challenges and schedule delays related to quality, geotechnical conditions, turbine-generator installation, COVID (Omicron) outbreaks in 2022, as well as increased material costs
• Additional and prolonged resource requirements for project management, quality assurance, quality control, design engineering and commissioning
• Extended OPG and owner's representative costs
• Discovery work and scope changes
• Additional contingency carried to achieve P90 level of confidence, bringing remaining contingency to $5.6M

The new station is expected to be in service by May 2023.

With the project being over 80% complete, the key risks remaining include:

• Commissioning and transfer of operating control delays and not meeting the expectation of Eastern Operations
  - Plan including training is in place, to demonstrate design to set and meet expectation.
• Performance of the operating units not meeting specifications
  - Performance guarantees are included in the EPC agreement.
[redacted]

The Project has placed $99M of asset in-service to-date, with another $34M projected to be in-serviced by the end of 2022 when forebay is watered up. This will bring the total in-service asset to $133M by end of 2022. A remaining $27M associated with turbine-generator equipment, site access and fencing will be placed in-service in 2023.

Business Need

For Project Level A or B

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Business Case Summary

The Calabogie GS is located in Calabogie, Ontario, 22 km south of Renfrew. The station is on the Madawaska River, downstream of Mountain Chute GS and Barrett Chute GS, and upstream of Stewartville GS and Arnprior GS. The old 5 MW Calabogie GS was placed in-service in 1917 and has reached the end of its expected service life. In September 2018, the station was critically damaged by a tornado and has been out-of-service since, with Eastern Operations maintaining the station in a safe state. While in this safe state, OPG is losing generation potential at the site, while still responsible for maintaining the site and managing the water to ensure public safety.

The Calabogie GS Redevelopment Project provides an opportunity for OPG to utilize the available river flows at Calabogie GS more efficiently and optimize power generation at the site. The old generating station had a rated flow of 66 cms and was considerably smaller than the other stations along the Madawaska River. Given Calabogie's position as the middle station on the river, it is a bottleneck on the river and the main spillway is often used to pass water that is in excess of what can be used by the generating station. By increasing the rated flow of Calabogie to 160 cms, and thus the station capacity to 10.7 MW, OPG will be able to capture more of the potential energy from the available water. This larger station size was selected based on an analysis of site and river characteristics and restrictions carried out by the contractor. The new station will continue to respect the water levels and limits in the existing Water Management Plan.

The project will also address dam safety concerns identified at the site. Past dam safety reviews have identified seepage and stability concerns for three specific areas within the forebay. The contractor has considered these issues and addressed them within the project design scope. These concerns would have to be remediated whether the project proceeds or not.

Preferred Alternative:	Construct a New Calabogie GS and Demolish the Old Station	For Project Level A, B or C

Description of Preferred Alternative

Proceed with the Execution Phase of the Calabogie GS Redevelopment Project to construct, test and turnover to Eastern Operations a new powerhouse. The new powerhouse will be approximately 50m upstream of the old station and consist of two horizontal Kaplan pit turbines. The station will have a rated flow of 160 cms, a net head of approximately 9 m and a capacity of 10.7 MW. The existing station and existing inlet structure will be demolished. Dam safety concerns will also be addressed though the location of the powerhouse and remediation efforts within the forebay. There will be no modifications to the existing north channel and main spillways. The total project is estimated to cost $167.5M and be in-service by May 2023.

Pros:
• Provides 10.7 MW of capacity and approximately 46.5 GWh of annual energy generation with an estimated 90-year life. This represents incremental generation for the system given that the site has been out-of-service since September 2018 due to the tornado damage.
• The option to redevelop the site and construct a new powerhouse was selected based on an assessment completed prior to initiating the FEED phase.
• Addresses dam safety concerns identified at the site, including seepage and stability concerns for three specific areas within the forebay, which is required whether the project proceeds or not.
• Reduces the bottleneck at the Calabogie site as the new station will have a rate flow of 160 cms. This will allow Eastern Operations to better coordinate water usage through the entire Madawaska River system.
• Complies with defined water levels in the existing Water Management Plan.
• The Project is in consultation with the Algonquins of Pikwakanagan, Algonquins of Ontario and the Williams Treaty First Nations. The contractor has a plan in place to provide employment opportunities to Indigenous peoples in these communities for the Calabogie GS Redevelopment Project and its own future local projects.
• Environmental considerations have been included in the new station design, including reduced flow velocities to minimize fish harm and allowances for future American Eel passage.
• Project has received a letter of support from the Council of the Greater Madawaska Township (Township).
• Investment, contracting, employment and training opportunities for the Greater Madawaska Township and surrounding communities.
• The turbine supplier, selected through an open and transparent procurement process led by the contractor, is a leading pit turbine manufacturer that specializes in the small hydro market.

Cons:
• Like other new construction projects in Ontario, the Calabogie GS Redevelopment Project will face risks to meeting cost, schedule and quality targets, particularly due to labour productivity, inflation, material shortages, potential discovery of adverse geotechnical issues and contractor interface management.

Deliverables:

Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Award Design Build Contract		Limited Notice To Proceed (Complete)	2019-12-01
Environmental Assessment (EA) Approval		EA Statement of Completion (Complete)	2020-03-10
Award Design Build Contract		Execute EPC Agreement (Complete)	2020-06-05
Powerhouse Construction		Start of Construction - Mobilization (Complete)	2020-06-08
Powerhouse Construction		1st Stage Concrete Ready for Embedded Parts (Complete)	2021-01-20
Powerhouse Construction		Pits Ready for Turbine Generator Installation (Complete)	2022-07-11
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Powerhouse Construction		Turbine Generator Installation Complete	2023-02-28
Station Commissioning and Start-Up		Capital In-Service	2023-05-31
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

The alternative to not proceed with the project is not recommended. Considering the project is over 80% complete, stopping all work in progress and putting the site on safe state represent foregoing the work completed to-date and incurring significant sunk cost. It also represents a lost opportunity to complete the redevelopment and to enhance the site that has generated clean, affordable electricity for Ontario since 1917, with less than 20% of work remains. This alternative fails to take advantage of the available flow at the site, which if economically utilized could produce an average of 46.5 GWh of electricity in a typical water year.

Furthermore, in the event the project does not proceed, alternate investments are required to remediate the site, and address dam safety concerns.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

The alternative to delay the project is not recommended. There is no benefit to delaying all work in progress and restart the project in later years. Delaying the project represents additional work and cost require to safe state the work in progress and it would leave the site out of service. A delay also introduces risks to the project, including a high likelihood that the project cost to complete the remaining work will increase. The current contractor may decline to complete the work if the work is delayed to later years, leading to significant cost increases in order to achieve the appropriate level of preparation with a new contractor.

Alternative 4:	**N/A**	For Project Level A, B

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Business Case Summary

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Stakeholder/Reputational	Commissioning and transfer of operating control delays and not meeting the expectation of Eastern Operations.	Mitigate Plan including training is in place, to demonstrate design to set and meet expectation. 3/31/2023	Medium
Technical	Performance of the operating units not meeting specifications.	Accept Performance guarantees are included in the EPC agreement.	Medium
Commercial ([redacted]/Legal)	[redacted]	Accept [redacted].	Medium

Additional Risk Analysis	For Project Level A or B
A Monte Carlo risk analysis, which takes into account OPG risks, contractor risks, cost estimate uncertainties, schedule uncertainties and variations in escalation and interest during construction, was completed to develop the project contingency value of $5.6M.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
Project Cost	167.5	> 167.5 including sunk cost	> 167.5		

Analysis of Financial Evaluation – Key Assumptions and Key Results:

The original full release BCS determined that the redevelopment alternative was the most economic solution for the Calabogie site and compared favourably to the cost of hydroelectric energy procured by the IESO in 2015. A financial re-analysis has determined that, with the project more than 80% completed, continuing with the redevelopment remains the preferred alternative.

Qualitative Factors For Project Level A or B

ONTARIO POWER GENERATION

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Business Case Summary

1. Sustainable Development
The station will provide 10.7 MW of emission-free hydroelectric generation for the Province of Ontario. Given the increase in intermittent generation in Ontario, such as wind, additional flexible hydroelectric generation is extremely valuable. Hydroelectric generation is the most environmentally sustainable form of generation that accomplishes this task.

2. Existing Operations Improvement
The project addresses dam safety concerns identified at the site, including seepage and stability concerns for three specific areas within the forebay, which is required whether the project proceeds or not. It also reduces the bottleneck at the Calabogie site as the new station will have a rate flow of 160 cms. This will allow Eastern Operations to better coordinate water usage through the entire Madawaska River system.

3. Indigenous Relations
The project has taken several measures during the Definition and Execution Phases to engage, consult and build relationships with the Algonquins of Ontario, Algonquins of Pikwakanagan and Williams Treaty First Nations. This includes developing a detailed process to provide employment and business opportunities for interested and qualified community members and funding a Traditional Ecological Knowledge Study for the Algonquins of Pikwakanagan. The project has also incorporated eel passage considerations into the project design at the request of the Algonquins of Ontario. The project continues to maintain a strong working relationship with these First Nations during the Execution Phase, supporting our Reconciliation Action Plan.

4. Economic Benefits to Eastern Ontario
A significant portion of the total project expenditure will occur in Eastern Ontario, resulting in benefits to the local and regional economy. These benefits will include, but not be limited to, contracting opportunities for local businesses, employment for local craft workers and indirect benefits to local businesses due to increased activity in the area. OPG has also entered into an agreement with the Township of Greater Madawaska to provide excavated rock from the project for use on roads and public works.

5. Health and Safety Performance
Safety program/performance was a significant factor in the contractor evaluation process. The selected contractor develops and implements a comprehensive site-specific safety plan for construction safety, public safety and security.

6. Supplier Relationships
Through a competitive procurement process led by the contractor, a turbine manufacturer was selected that has not previously done work for OPG. However, the turbine supplier is a leading low-cost pit turbine manufacturer in the small hydro industry. Since a large portion of OPG's small hydro fleet is aging, there is great benefit to expand the number of trusted small turbine manufacturers.

The project also competitively procured the contractor joint venture that has not completed a major renewable generation redevelopment project in recent history. Utilizing a front-end engineering and design (FEED) phase, OPG has developed a working relationship with this contractor, which will be a benefit during the construction phase and may also benefit future OPG projects.

7. Securing Hydro One connection
During the Definition Phase, OPG executed a Connection Cost Agreement with Hydro One for the project. Continuing with the project will ensure OPG maintains the required capacity on the distribution lines.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2025-12-31

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Actual Turbine/Generator Output	Existing station is out-of-service	New 10.7 MW station	Actual turbine/generator output will be compared to the performance guarantees in the contract	RG Performance and Testing Department (to oversee an external performance testing consultant)
Dam Safety	Dam safety deficiencies in existing forebay	Remediation of dam safety deficiencies in forebay	Forebay dam inspection for stability and seepage	Dam Safety, RG Plant Engineering Services (Civil)

Definitions and Acronyms

DFO	Fisheries and Oceans Canada (Department of Fisheries and Oceans)

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	82089 - CALABOGIE GS REDEVELOPMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2022	2023	2024	2025	2026	2027	Future	Total	%
0 - Cost Management	5,182	2,796	1,004						8,982	5
1 - Project Management	18,520	6,841	5,571						30,932	18
2 - Inspection		550							550	0
3 - Engineering	10,263	2,841	279						13,383	8
4 - Procurement	30,917	19,485	800						51,202	31
5 - Construction	23,961	21,122	3,155						48,238	29
6 - Commissioning	110	1,237	1,472						2,819	2
Closeout										0
Subtotal	88,953	54,872	12,281						156,106	93
Outside WBS										0
Contingency			5,589						5,589	3
Subtotal w/ Contingency	88,953	54,872	17,870						161,695	97
Interest	2,339	3,211	255						5,805	3
Other										0
Total	91,292	58,083	18,125						167,500	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.00	Interest Rate (going-forward)	3.46

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
82089	2022-04-01	Tailrace Channel	22,696	14.3
82089	2022-10-20	In-service the following milestones: - Intake: Left & Right Wingwall - Substation - Powerhouse - Overhead Crane	76,356	47.6
82089	2022-10-31	Embankment	17,966	11.2
82089	2022-11-30	Headgates	16,041	10.0
82089	2023-05-31	U1 Substantial Completion Date	6,577	4.0
82089	2023-05-31	U2 Substantial Completion Date	14,598	9.2
82089	2023-12-31	Final Completion	6,023	3.8

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Total:	**160,257**	**100**

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Tony Palma Senior Manager Projects Calabogie/Coniston	2022-10-21	Mike Martelli Enterprise Projects	2022-10-25

Appendix B: Total Project Estimate Variance Analysis$K				**(Only required when more than one Execution Phase BCS)**					
Phase Gate	**LT YE last year**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**Future**	**Total**
POVA	114,190	30,005	805						145,000
G3	91,292	58,083	18,125						167,500

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Business Case Summary

Project #	82391	**BCS Document Number**	P4-41100-1230910
Project Title	82391 - ALX G1 RUNNER REPLACEMENT		
Facility	ALX - ALEXANDER	**Investment Classification**	Sustaining
Project Level (Scalability)	D	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2027-Jun-13
Estimate Class (Current Request)	Class 5	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $150k, including [redacted] of contingency for the ALX82391 - G1 Runner Replacement project. The total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This project release will involve the following planning activities:
- Prepare Scope Of Work;
- Detailed cost estimate;
- Project execution schedule; and,
- Development of execution BCS to implement project plan.

Investment Cash Flows

Project Number	82391 - ALX G1 RUNNER REPLACEMENT	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

$K	**LT YE last year**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0		150						150
Total released to date	0		150						150
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	150.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Laura Hurley Asset Manager NWO Production Support	Laura Hurley	2023-04-04
I concur with the business decision as documented in this BCS.		
Finance Approval : John Sim Finance Controller	John Sim	2023-04-18
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : **OAR Element : 1.1** **Brian Dietrich** **Director Asset & Project Mgmt**	Brian Dietrich	2023-04-19

EXECUTIVE SUMMARY – Project Overview

G1 Runner Replacement:
The G1 Runner was originally put in service in October 1930, and replaced with cast steel runners in 1956. The G1 runner was last inspected in 2018 and found the condition to be fair. Minor cavitation pitting was present on the suction side of all the blades near the inlet edge. Cavitation weld repairs have been completed on this runner. In 2015, a study was completed by an OEM titled “Alexander Falls G1 G2 and G3 Hydro Generator Uprate Study” to determine if the Alexander Falls generators #1, #2, and #3 can operate at the “overload” rating of 17.25MW safety. The findings confirmed that there are no mechanical/structural or electrical obstacles to operating at 17.25MW. A more recent HUUE analysis was performed and a conceptual estimate of the achievable generator output due to a runner upgrade is 15MW at normal station gross head of 17.8m. This represents a 1.8MW (13.6%) increase over the current runner design. Under maximum head conditions and high river flows this runner upgrade concept could produce up to 17.25MW, which matches the generator rating of the OEM study. The energy gain expectations in a one unit, two unit and three unit runner upgrade scenario are as follows:
- One unit upgrade = 9.0 GWh
- Two unit upgrade = 16.8 GWh
- Three unit upgrade = 22.4 GWh

Given the potential energy gains and the current age and condition of the runner, it is recommended to replace the existing runner. The 2021 Alexander Generating Station Plant Condition Assessment (PCA) recommends the replacement of the G1 Runner.

This BCS will fund planning activities, including scope, cost and schedule development.

Gating Strategy:

The gate strategy is to proceed from Gate 1 to Gate 2 due to the lead time required from the procurement of the runner.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR1	Gate G1 Approval	ALX82391 - G1 Runner Replacement	2023-04-01
SOW	Scope of Work Document Complete	ALX82391 - G1 Runner Replacement	2024-06-19
LLT	Long Lead Time Material Identified	ALX82391 - G1 Runner Replacement	2024-06-19

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
LDC	Labour Determination Completed	ALX82391 - G1 Runner Replacement	2024-06-19
GR2	Gate G2 Approval	ALX82391 - G1 Runner Replacement	2024-07-10
TES	Technical Specifications Complete	ALX82391 - G1 Runner Replacement	2024-08-28
GR3	Gate G3 Approval	ALX82391 - G1 Runner Replacement	2024-11-13
EPC	Award Contracts / PO Issued	ALX82391 - G1 Runner Replacement. Purchase Runner	2025-03-29
EPC	Award Contracts / PO Issued	ALX82391 - G1 Runner Replacement Runner Design	2025-09-10
SOI	Start of Installation	ALX82391 - G1 Runner Replacement	2026-01-07
SOO	Start of Outage	ALX82391 - G1 Runner Replacement	2026-01-28
FOO	End of Outage	ALX82391 - G1 Runner Replacement	2026-12-02
AFS	Available for Service and/or Ready For Service Completed	ALX82391 - G1 Runner Replacement	2026-12-09
PCO	Project Close Out Completed	ALX82391 - G1 Runner Replacement	2027-06-13

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	2028-06-13
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	82391 - ALX G1 RUNNER REPLACEMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2022	2023	2024	2025	2026	2027	Future	Total	%
0 - Cost Management										0
1 - Project Management			37						37	25
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total			150						150	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	4.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jason Bailey Program Coordinator / Advisor Programming	2023-03-29	Darryl Flank Section Manager Western Overhauls	2023-02-23

ONTARIO POWER GENERATION

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Business Case Summary

Project #	82542, 82515	**BCS Document Number**	FJ32-BCS-41000-0003_FEBCS
Project Title	82542 - OTTER G1 CAPITAL UPGRADE 82515 - OTTER G1 NON STANDARD OVERHAUL		
Facility	OTR - OTTER RAPIDS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES 62030 - OM&A - PROJECT
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2027-Jun-01
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a full execution release of $48,172k including [redacted] of contingency. Project specific releases below are:

OTR 82542 (Capital): $38,165k (including [redacted] of contingency)
OTR 82515 (Non-Standard): $10,007k (including [redacted] of contingency)

This will bring the total released-to-date to $50,671k, including [redacted] contingency.

These two projects are for the refurbishment/overhaul of the G1 unit at Otter Rapids Generating Station. The overhaul program will also provide additional plant capacity of up to 23 MW (5.75 MW per unit) with the runner replacements, stay vane modifications and efficiency gains.

This release will fund:
- Contract award for the G1 unit overhaul
- Contract award for stay vane modifications
- Ongoing maintenance and operating costs for the Otter camp and road
- Completion of all remaining G1 unit upgrade and overhaul scope of work including all applicable construction, commissioning activities and closeout.

This work will restore the integrity, reliability and long-term viability of this generator for the next 25 years.

Investment Cash Flows

Project Number	82515 - OTTER G1 NON STANDARD OVERHAUL					**FAC**	62030 - OM&A - PROJECT		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0		1,857	8,135	15				10,007
Total released to date	0		1,857	8,135	15				10,007
Future required	0								0
Total Project Cost	0		1,857	8,135	15				10,007
Ongoing Costs	0								0

Project Number	82542 - OTTER G1 CAPITAL UPGRADE	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

ONTARIO POWER GENERATION

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Business Case Summary

$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total
Previous releases	17	46	2,436						2,499
Currently Requested			7,130	30,974	61				38,165
Total released to date	17	46	9,566	30,974	61				40,664
Future required									
Total Project Cost	17	46	9,566	30,974	61				40,664
Ongoing Costs									

Total OAR Approval	50,671.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicholas Pender SVP Renewable Generation SVP RG & PM	Nicholas Pender	2024-11-12
I concur with the business decision as documented in this BCS.		
Finance Approval : Alec Cheng SVP Chief Controller & Acctng Offcr	Alec Cheng	2024-11-13
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Nicolle Butcher Chief Operations Officer	Nicolle Butcher	2024-11-21

EXECUTIVE SUMMARY – Project Overview

ONTARIO POWER GENERATION

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Business Case Summary

Otter Rapids Generating Station is a 4-unit station located on the Abitibi River, about 120km northeast of Smooth Rock Falls. The first two units were placed in commercial service in 1961 and the remaining two units were placed in commercial service in 1963.

The goal of this project is to return the Otter Rapids G1 unit to a state of long-term reliability with low life cycle costs. The Otter Rapids G2 unit overhaul will start execution in Q2 2024. The remaining units (G4 and G3), will also undergo capital upgrades and overhauls in subsequent years following G1 execution (under different project numbers).

The preferred alternative is to complete a G1 Unit Capital Upgrade and Non-Standard (OM&A) Overhaul beginning in September 2025. This alternative meets the business needs and is the recommended option of the Initiation Phase Report. The last G1 refurbishment was completed in 1999. The major refurbishment cycle on these units is 25 years, and the G1 unit is in need of a major refurbishment. The unit is currently experiencing high vibrations, cavitation damage to the runner and discharge ring, and the generator rotor poles are due for refurbishment. The scope of work will address these items as well as the installation of a new runner, new lower bracket, efficiency improvements to the water passage stay vanes, and refurbishment of all turbine generator components.

The previous Partial and Full Definition Phase BCS releases funded these 5 categories:
- Completion of the Definition Phase Engineering including the development of technical requirements and scope of work documentation.
- Assembly of required RFP documentation including owner's requirements and pricing submission form.
- Receipt and evaluation of proponent proposals and development of purchasing documentation for the EPC agreement.
- Internal labour for project management, engineering and site support for the project activities.
- Procurement and delivery of a new Lower Bracket for the G1 unit only.

The Otter Rapids GS Capital upgrades/overhauls have been organized as unitized projects. Each generating unit will have a capital and non-standard release with individual project numbers, enforced by the Accounting Treatment of RG Turbine-Generator Overhaul Project expenditures document. The G1 non-standard overhaul (OTR82515) project scope includes disassembly and removal costs, general maintenance, cleaning and minor repairs. The G1 capital upgrade (OTR82542) project scope will include system upgrades, new installations, and other refurbishments that will extend the useful life of this asset.

Two risks highlighted for this project are:

1) Station electrical upgrade projects
- These electrical upgrades will utilize the same outage for the Otter G1 overhaul and integration will be crucial. The scope is still being defined and the risk is a delay to the completion of the overall commissioning activities. The mitigating actions include frequent early meetings with the project's stakeholders, identifying deliverables, and proper sequencing of work activities.

2) Outage extension due to discovery work
- There is a potential for the installation schedule to be extended by discovery work. The mitigating action for this was to include a 3 month schedule contingency internally within the outage plan.

Business Need	For Project Level A or B

Otter Rapids Generating Station is an important workhorse asset amongst OPG's fleet of hydroelectric assets, having a capacity of 190.8 MW and an average annual energy output of 455,435 MWh (average 2016-2022). The G1 unit will have been in operation for nearly 26 years since last overhauled once this overhaul starts in 2025. G1 is currently experiencing high vibrations, cavitation damage to the runner and discharge ring, and aging generator rotor poles, requiring refurbishment. The scope of the preferred alternative will address these items as well as include the installation of a new runner, upgrades of the water passage stay vanes, new lower bracket and refurbishment of all turbine and generator components, which have also neared their end of life. The turbine regulation equipment is expected to be worn due to age and will also be refurbished or replaced. Additionally, the existing generator governor (1st generation digital) has been problematic and is difficult to source parts for; it will be upgraded to ensure reliability and availability of parts. To ensure unit operation for an additional 25 years it is recommended to complete all major overhaul items to the G1 unit.

Preferred Alternative:	Capital Upgrade & Overhaul	For Project Level A, B or C

Description of Preferred Alternative

Business Case Summary

It is recommended to proceed with the mechanical and electrical overhauls at Otter Rapids GS. Executing the overhauls will restore reliability to end of life components and systems, as well as meeting the stated project objectives.

The future full execution phase (Gate 3) scope of work, as described in the Otter Rapids GS Unit #1 to #4 Overhaul and Runner Upgrade Technical Specification, includes:

Components and activities funded under the non-standard project OTR82515:

- Unit disassembly
- Unit cleaning
- Scroll case inspection and repairs
- Turbine non-rotating component inspections and minor repairs
- Generator mechanical and electrical component inspections and minor repairs

Components and activities funded under the capital project OTR82542:

- Replace thrust bearing pads with new polytetrafluoroethylene (PTFE) bearing pads
- Refurbish discharge ring
- Re-insulate/refurbish field poles
- Generator & bearing cooling system replacements
- Install new rotor turning device
- Replace split phase current transformers (CT's) and neutral CT's
- Design and procurement of static exciter stub shaft and slip rings
- Install new main shaft seal and water filtering system
- Re-profile, sandblast and paint stay vanes as per specifications.
- Install new runner to provide additional plant capacity of up to 23 MW (5.75 MW per unit), the increased output will be realized in years 2 and 4 of the overhaul program once the electrical upgrades are completed under projects OTR80685, 83187, 83188 and 83189
- Servomotor refurbishment
- Install new turbine pit monorail
- Install new neutral grounding resistor cabinet and instrumentation and control cabinets
- Install new monitoring and diagnostic (M&D) center online monitoring system
- Unit reassembly and commissioning
- Installation of a new lower bracket.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Definition BCS (Partial)	Definition Business Case Summary(Partial or Full) Approved	Completed Date	2019-02-28
Technical Requirements (Design)	Technical Specifications Complete	Completed Date	2022-04-14
Issue RFP (design/build)	Request for Proposals for EPC or Non LLM Contracts	Completed Date	2022-11-19
Full Definition Release BCs	Definition Business Case Summary(Partial or Full) Approved	Completed Date	2024-05-03
Procurement of Lower Bracket	Legacy_Long Lead Time Material Contracts Awarded		2024-07-01

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Full Execution Release BCS	Execution Business Case Summary (Partial or Full) Approved		2024-10-01
Contract Release Added	Award Contracts / PO Issued		2024-12-13
Design Completed	Detailed Design Complete		2025-08-15
Mobilization	Start of Construction		2025-08-25
Start of Outage	Start of Outage		2025-09-12
Installation Complete	Finish of Installation		2026-11-26
Complete Commissioning	Commissioning Finished		2026-12-10
End of Outage	End of Outage		2026-12-10
Equipment in Service	Available for Service and/or Ready For Service Completed		2026-12-10
PCR	Project Close Out Completed		2027-06-01
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
No future releases expected.			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2, Base Case - No project, would involve ceasing all remaining execution work and operating the G1 unit in its current state. OPG operations would continue to use the unit as is with the current maintenance strategy.

Advantages:
• No upfront capital expenditure

Disadvantages:
• Increases maintenance requirements
• Potential lost revenue and energy production due to unplanned outages
• Lost opportunity to realize energy gains from new runner
• Elevated risk of continued operation with high vibration levels

This alternative will not meet the business need of continued reliable operation for the next 25 years.
The base case alternative has no project/execution cost or schedule implication. This option carries an unacceptable level of safety and operational risk due to aging and deteriorating equipment that is currently decreasing in reliability.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3, Delay Work, would involve ceasing all remaining execution work and deferring the project to a future date.

This option is not feasible due to the increasing operational risk of running the unit in its current state.

Alternative 4:	**N/A**	For Project Level A, B

N/A

Business Case Summary

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Stakeholder/Reputational	Outage extension due to discovery work	Mitigate 3 mth Schedule contingency carried in outage plan over and above the duration communicated to the vendor 3/31/2026	Low
Project Management	Station Electrical upgrade project	Mitigate Frequent early meetings with project stakeholders from electrical upgrade project to identify risks to their project deliverables and develop actions to mitigate impact to overhaul execution 6/7/2025	Medium
Resources	Insufficient PWU resources for Contract Monitor and QA/QC	Mitigate Contract strategy is potentially switching to Owner Only 1/20/2025	Medium
Quality	Quality of materials does not meet Technical Requirements	Mitigate Enforce the QA/QC documentation for fabrication of materials and referencing the standards in the Technical Specifications. 5/19/2025	Low
Health and Safety	Asbestos/PCBs present at Otter Rapids	Mitigate We can use the G2 overhaul project as a benchmark for what to expect, and plan accordingly. 5/1/2025	Low

Financial Evaluation			For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing		
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects.

Qualitative Factors For Project Level A or B

Execution of the preferred alternative will result in the following qualitative benefits:
- Increase generator output
- Restore integrity, long-term reliability and ensure the continued availability of the generating units at Otter Rapids GS
- Re-establish rotor-stator air gap and runner discharge ring clearances
- Reduce risk of thrust bearing failures
- Implement component and system design improvements to improve health and safety and operational performance

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)			
Is PIR Required?	Yes	**PIR Completion Date**	2028-06-01

ONTARIO POWER GENERATION

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Business Case Summary

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Unit Output (MW)	47.5 MW	53.25 MW	Performance Testing	Station Engineering Services (SES) along with Performance and Testing Group
Unit Life Extension	Major components have been identified at end of life requiring refurbishment and/or replacement	Component refurbishment or replacement completed as identified in the technical specifications and verified	Testing and commissioning prior to return to service; ensuring the unit performs as designed.	Station Engineering Services and Project Commissioning Coordinator.

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	82515 - OTTER G1 NON STANDARD OVERHAUL						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management			79	284	15				378	4
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total			1,857	8,135	15				10,007	100
Removal Costs (incl. above)			239						239	2

Project Number	82542 - OTTER G1 CAPITAL UPGRADE						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management	17	44	369	1,416	61				1,907	5
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

Business Case Summary

Interest	[redacted]									
Other										
Total	17	46	9,566	30,974	61				40,664	100
Removal Costs (incl. above)			680						680	2

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**3.80**	**Interest Rate (going-forward)**	**4.00**

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
82542	2026-12-10	G1 Unit in Service	34,019	95.0
82542	2027-06-01	Project Close Out	1,790	5.0
		Total:	**35,809**	**100**

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Matthew Corbeil Project Leader PM Group 1	2024-08-14	Bruce Robertson VP Regional Operations Eastern Region	2024-08-23

ONTARIO POWER GENERATION

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Business Case Summary

Project #	82543, 82521	**BCS Document Number**	FJ32-BCS-41000-1648285
Project Title	82543 - OTTER G2 REFURBISHMENT 82521 - OTTER G2 OVERHAUL		
Facility	OTR - OTTER RAPIDS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES 62030 - OM&A - PROJECT
Release: Gate and Project Phase	G3 - Execution - b (Superseding)	**Target Project Completion Date**	2026-Nov-15
Estimate Class (Current Request)	Class 2	**Estimate Class (Overall Project)**	Class 2

Recommendation

We recommend an additional release of $26,256 k, including [redacted] of contingency. Project specific cumulative releases (including contingency):

OTR82543 (Capital): $78,045 k (including [redacted] of contingency)
OTR82521 (Non-Standard): $16,126 k (including [redacted] of contingency)

This will bring the total released-to-date to $94,171 k, including [redacted] contingency.

The estimated total project cost is now $94,171 k, compared to $67,917 k in the previous G3B BCS release.

These two projects are for the refurbishment/overhaul of the G2 unit at Otter Rapids Generating Station. The refurbishment program is expected to also provide additional plant capacity of up to 23 MW (5.75 MW per unit) with the runner replacements and efficiency gains.

This 3B Superseding release will fund cost increases associated with the following:

- Change in Constructor Role;
- Change in schedule from 6 days per week to 7 days per week;
- increased cost for stayvane modifications due to weld repair discovery work and schedule extension;
- additional costs for discovery work during execution as well as additional costs for road maintenance and construction camp operations and maintenance due to schedule extension;
- additional internal project management (including Construction Insurance), engineering and PWU site QA support costs due to schedule extension

This work is expected to restore the integrity, reliability and long-term viability of this turbine-generator unit.

Investment Cash Flows

Project Number	82521 - OTTER G2 OVERHAUL					**FAC**	62030 - OM&A - PROJECT		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	7,395	8,731							16,126
Currently Requested	0								0
Total released to date	7,395	8,731							16,126
Future required	0								0
Total Project Cost	7,395	8,731							16,126
Ongoing Costs	0								0

Project Number	82543 - OTTER G2 REFURBISHMENT	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

ONTARIO POWER GENERATION

Records File Information:
Retention Permanent

Business Case Summary

$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total
Previous releases	29,844	21,856	89						51,789
Currently Requested		26,247	9						26,256
Total released to date	29,844	48,103	98						78,045
Future required									
Total Project Cost	29,844	48,103	98						78,045
Ongoing Costs									

Total OAR Approval	94,171.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Shelley Babin Chief Operations Officer Chief Operations Officer	Shelley Babin	2025-07-02
I concur with the business decision as documented in this BCS.		
Finance Approval : Alec Cheng SVP Chief Controller & Acctng Offcr	Alec Cheng	2025-07-02
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Nicolle Butcher President & Chief Executive Officer	Nicolle Butcher	2025-07-02

EXECUTIVE SUMMARY – Project Overview

Business Case Summary

Otter Rapids Generating Station is a 4-unit station located on the Abitibi River, about 100km northeast of Smooth Rock Falls. The first two units were placed in commercial service in 1961 and the remaining two units were placed in commercial service in1963.

The goal of this project is to return the Otter Rapids G2 unit to a state of long-term reliability with low life cycle costs. The remaining units (G1, G4 and G3), will also undergo capital refurbishments and overhauls in subsequent years following G2 execution (under different projects).

The preferred alternative is to complete a G2 Unit Capital Refurbishment and Non-Standard (OM&A) Overhaul which began in June 2024. This alternative meets the business needs and is the recommended option of the Initiation Phase Report. The last G2 refurbishment was completed in 1997. The major refurbishment cycle on these units is approximately 25 years, and the G2 unit was in need of a refurbishment. The unit was experiencing high vibrations, cavitation damage to the runner and discharge ring, and the generator rotor poles will be refurbished. The scope of work is expected to address these items as well as execute the installation of a new runner, efficiency improvements to the water passage stay vanes, and refurbishment of all turbine generator components.

The previous Gate 3B execution release funded the remaining material procurement as well as labour costs for construction for both mechanical and electrical portions of the overhaul. This included unit disassembly (complete), discharge ring refurbishment (50% complete), operating ring refurbishment (complete), lead paint abatement (complete) and turbine component re-machining (complete). The unit outage started in June 2024.

This current Gate 3B Superseding release will add funding to facilitate the completion of the site installation phase including but not limited to the auxiliary systems replacements (e.g. cooling water systems), turbine and generator re-assembly, unit re-alignment, commissioning and project closeout activities. Target completion date for construction is November 2025.

The outage work will include the installation of a new excitation system for the G2 Unit under project OTR83188 Breaker and Exciter Replacement. There is no excitation system procurement included in this project as it is being procured under project NEO83568, however, a new generator exciter stub shaft and slip rings will be designed and procured as part of the G2 Capital Refurbishment project.

The Otter Rapids GS Capital refurbishments and overhauls have been organized as unitized projects. Each generating unit will have a capital and non-standard release with individual project numbers. The non-standard overhaul (OTR82521) project scope includes significant cleaning and repair of generator and turbine components. The capital refurbishment (OTR82543) project scope will include system upgrades and new installations.

Business Need

For Project Level A or B

Otter Rapids Generating Station is an important asset amongst OPG's fleet of hydroelectric assets, having a capacity of 190.8 MW and an average annual energy output of 455,435 MWh (average 2016-2022). The G2 unit will have been in operation for nearly 27 years once the overhaul begins in 2024. G2 is currently experiencing high vibrations, cavitation damage to the runner and discharge ring, and aging generator rotor poles, requiring refurbishment. The scope of the preferred alternative will address these items as well as include the installation of a new runner, upgrades of the water passage stay vanes, and refurbishment of all turbine and generator components, which have also neared their end of life. The turbine regulation equipment is expected to be worn due to age and will also be refurbished or replaced. Additionally, the generator governor (Woodward 1st generation digital) has been problematic in that the first generation digital governors are prone to frequent component failures and are difficult to source parts for; it will be upgraded to ensure reliability and availability of parts. Performing an overhaul of unit G2 is expected to ensure unit operation for an additional 25 years.

In addition to the above-mentioned operational and aging concerns, both the Engineering Risk Assessment Program (ERAP) and Plant Condition Assessment recommend the refurbishment of the G2 unit.

As part of the G2 project, additional work as listed below will be or has been completed, which will not be required again under the subsequent three overhauls in future years:

- Installation of warehouse building (ongoing, to be completed Q3 2023) - complete
- Removal of three transformer insulating oil storage tanks, piping and filtering equipment - complete
- Replacement of three new lubricating oil storage tanks - complete
- Installation of a replacement backup diesel generator, removal of the existing propane-powered generator (PO approved in 2022, delivery of genset Q3 2023) - procurement complete
- Installation of new building for the three lubricating oil storage tanks, backup generator, and generator fuel tank
- Inspection and repairs to the existing sanitary sewer system - complete
- Installation of new tailrace level gauge and stilling well - engineering ongoing
- road upgrades/safety improvements to main road from Abitibi Canyon GS to Otter Rapids GS per recommendations contained in Tulloch Engineering's road assessment report - PO issued to vendor

Due to the above noted scope items, the cost for the first overhaul for G2 is higher than the costs of the subsequent overhauls on G1, G3 and G4.

Business Case Summary

Preferred Alternative:	Capital Upgrade and Overhaul	For Project Level A, B or C

Description of Preferred Alternative

It is recommended to proceed with the mechanical and electrical overhauls and capital refurbishments at Otter Rapids GS. Executing the refurbishments and overhauls is expected to restore reliability to end of life components and systems and meet the stated project objectives.

The following full execution phase (Gate 3B) scope of work, is described in the Otter Rapids GS Unit #1 to #4 Overhaul and Runner Upgrade Technical Specification (FJ32-SPEC-41000-42000 Rev0), includes:

Components and activities funded under the non-standard Overhaul project OTR82521:

- Unit disassembly
- Scroll case inspection and repairs
- Turbine embedded component maintenance
- Turbine non-embedded and non-rotating component inspection and overhaul
- Governor component maintenance including Permanent Magnet Generator (PMG)
- Generator mechanical and electrical component inspection and overhaul

Components and activities funded under the capital refurbishment project OTR82543:

- Replace thrust bearing pads with new polytetrafluoroethylene (PTFE) bearing pads
- Refurbish discharge ring
- Re-insulate/refurbish field poles
- Generator & bearing cooling system replacements
- Install new rotor turning device
- Replace split phase current transformers (CT's) and neutral CT's
- Design and procurement of static exciter stub shaft and slip rings
- Install new main shaft seal and water filtering system
- Re-profile, sandblast and paint stay vanes as per [redacted] specifications.
- Install new runner to provide additional plant capacity of up to 23 MW (5.75 MW per unit), the increased output will be realized in years 2 and 4 of the overhaul program once the electrical upgrades are completed under projects OTR80685, 83187, 83188 and 83189
- Servomotor refurbishment
- Install new turbine pit monorail
- Install new neutral grounding resistor cabinet and instrumentation and control cabinets
- Install new monitoring and diagnostic (M&D) center online monitoring system
- Unit reassembly and commissioning

Deliverables:

Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Partial Release Execution BCS Gate 3A	Gate G3A Approval	Partial Release Execution BCS Gate 3A	2020-08-14
Complete Road Upgrade Assessment	Award Contracts / PO Issued	Contract Award for Road assessment PO issued - Complete	2021-11-03
Procure back-up genset	LLM_Contract Awarded PO Issued	PO issued for back up genset procurement - Complete	2022-06-07
Develop Design Build RFP documents for Overhaul	Technical Review Complete for EPC or Non LLM Contracts	Complete	2022-09-28
Complete Civil Renovations Engineering RFP documents	Request for Proposals	Issue RFP to Proponents - Complete	2022-12-15
Receive proponent Bids	Bids Received for EPC or Non LLM Contracts	Start Bid Evaluation - Complete	2023-03-20
Evaluate bids	Technical Review Complete	Bid Evaluation Finalized - Complete	2023-04-14
Full Release BCS Gate 3B	Gate G3B Approval	Approved Gate 3B BCS release - Complete	2023-06-30
EPC Contract Award	Award Contracts / PO Issued for EPC or Non LLM Contracts	Contract Issued - Complete	2023-06-30
Mobilization	Start of Construction	Site Execution Start - complete	2024-06-10
Start of Outage	Start of Outage	Start of Removals - complete	2024-06-17
Design Completed	Detailed Design Complete	Design under EPC Contract -Complete	2024-08-14
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Installation Complete	Finish of Installation	Start of Commissioning	2025-08-11
Complete Commissioning	Commissioning Finished	Equipment Available for Service - REIS	2025-10-31
Equipment in service	Available for Service and/or Ready For Service Completed	REIS	2025-11-15
Closeout	Project Close Out Completed	PCR	2026-05-15
Post Implementation Review	Post Implementation Review	PIR	2026-11-15
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
No Future Releases Expected			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2, Base Case - No project, would involve ceasing all remaining execution work and operating the G2 unit in its current state. OPG operations would continue to use the unit as is with the current maintenance strategy.

Advantages:
• No upfront capital expenditure

Disadvantages:
• Increases maintenance requirements
• Potential lost revenue and energy production due to unplanned outages
• Lost opportunity to realize energy gains from new runner
• Elevated risk of continued operation with high vibration levels

This alternative will not meet the business need of continued reliable operation for the next 25 years.
The base case alternative has no project/execution cost or schedule implication. This option carries an unacceptable level of safety and operational risk due to aging and deteriorating equipment that is currently decreasing in reliability.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3, Delay Work, would involve ceasing all remaining execution work and deferring the project to a future date. This option is not feasible due to the increasing operational risk of running the unit in its current state.

Alternative 4:	For Project Level A, B

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Resources	Schedule delays due to Production labour activity levels.	Mitigate 50640 - Schedule delays due to Production/Contractor labour activity levels. 50641 - Schedule delays due to Production/Contractor labour activity levels. 50642 - Schedule delays due to Production/Contractor labour activity levels. 52536 - Schedule delays due to Production/Contractor labour activity levels. 8/29/2025	Medium
Stakeholder/Reputational	Outage duration extension due to lack of resources, contractor delays	Mitigate 50649 - Outage duration extension, communication 50650 - Outage duration extension - monitor/control impact 50651 - Outage duration extension contract impact 9/12/2025	Medium
Resources	Lack of resourcing availability for commissioning result in potential schedule impact to project	Mitigate 59604 - Resourcing availability for commissioning 5/16/2025	Medium
Project Management	Station Electrical upgrade project delays outage	Mitigate 59605 - Station Electrical upgrade project delays outage 4/25/2025	Medium
Technical	Stay Vane Modifications Impacting Critical Path	Accept	Medium

Business Case Summary

Additional Risk Analysis	For Project Level A or B
Risk Review Completed Quarterly and updated in EPMX	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects without multiple feasible alternatives.

Qualitative Factors	For Project Level A or B

Execution of the preferred alternative is expected to provide the following qualitative benefits:
- Restore integrity, long-term reliability and ensure the continued availability of the generating units at Otter Rapids GS
- Re-establish rotor-stator air gap and runner discharge ring clearances
- Reduce risk of thrust bearing failures
- Implement component and system design improvements to improve health and safety and operational performance

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2027-11-15

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
Unit Output (MW)	47.5 MW	53.25 MW	Performance Testing	Station Engineering Services (SES) along with Performance and Testing Group

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	82521 - OTTER G2 OVERHAUL						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management										0
1 - Project Management		455							455	3
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	7,395	8,731							16,126	100
Removal Costs (incl. above)										0

Project Number	82543 - OTTER G2 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management	58								58	0
1 - Project Management	2,752	2,439	89						5,280	7
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

Business Case Summary

Interest	[redacted]									
Other										
Total	29,844	48,103	98						78,045	100
Removal Costs (incl. above)	1,002								1,002	1

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**2.83**	**Interest Rate (going-forward)**	**3.95**

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
82543	2023-12-12	Warehouse complete and in-service	7,771	11.0
82543	2025-11-15	G2 Unit in-service	61,916	88.0
82543	2026-04-14	PCR	408	1.0
		Total:	**70,095**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Pat Bourgouin Senior Project Management Eng/Officer PM Group 1	2025-06-27	Shelley Babin Chief Operations Officer Enterprise Operations	2025-06-30

Appendix B: Total Project Estimate Variance Analysis$K — **(Only required when more than one Execution Phase BCS)**

Phase Gate	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total
G3A-82543	43,110								43,110
G3B-82543	37,642	14,149							51,791
G3A-82521	6,952								6,952
G3B-82521	10,275	5,852							16,127
G3B Superseding-82543	29,844	48,103	98						78,045

Total Project Estimate Variance Explanation

Business Case Summary

The total project Cost has increased by $26,256 K, including contingency.

The primary sources of cost and schedule variances to the forecast to completion, compared to the previous gate, are summarized below for the major scope areas currently in execution:

1. Schedule Change: The initial proposal accounted for a six-day work week, including provision for the Construction camp however, upon transferring the Constructor Role to [redacted], OPG requested [redacted] to sub-contract with [redacted] for the stayvane scope. At that point it was identified that a 6 day per week execution schedule was carried and upon inclusion of the stayvane work, the schedule would extend 50 days for base scope. It was then requested to work 7 days per week and the schedule extension was reduced to 21 days for base scope. [redacted]
2. Stayvane Modifications - Vendor costs increased due to shifting market conditions and additional expenses arose from unforeseen discovery work, including weld repairs, as well as the associated schedule extension. Non-Destructive Examination (NDE) was performed on high stress areas of the stayvanes ahead of execution, additional NDE performed after trimming the stayvanes identified cracks and required remedial actions; stayvane fitment issues - although all units had a 3D scan well ahead of the outage to mitigate the need for field fit changes, larger gaps were identified between the upper and lower transitions where the new modification pieces transitioned to the scroll case, these larger gaps needed to be filled with backing material and more weld than expected; significant amount of grinding of welds and trailing edges for new profile; the project encountered a 123 day schedule extension due to [redacted], as a result of the Constructor role change. [redacted]
3. Constructor Role Adjustment: Changes in the Constructor role led to additional cost impact - once into execution it was identified that there were not sufficient internal resources to support the project schedule and the Constructor Role was transferred to [redacted]
4. Discovery work and part refurbishment: Additional costs for discovery work and part refurbishment during execution contributed to added expenses [redacted]
5. Camp security: Security measures for the camp were not initially budgeted leading to additional expenses [redacted]
6. Higher Interest Calculations: The schedule extension resulted in increased interest calculations, contributing to the further cost overruns [redacted]
7. Contingency: Carried to cover unknown changes during reassembly, and potential schedule extension from the impact of the electrical upgrade project [redacted]
8. Construction Insurance costs [redacted]

ONTARIO POWER GENERATION

Records File Information
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Business Case Summary

Project #	BK182777, BK182199	**File #**	NF20-BCS-08707.021-0004
Project Title	G5 Major Overhaul – Capital, Non-Std		
Facility	SAB1 (NF20)	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	☒ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Choose an item. G0☐: Initiation ☐ Choose an item. G1☐: Choose an item.		☐ Choose an item. G2☐: Definition ☒ Superseding G3C☒: Execution
Estimate Class (overall project)	Class 2	**Target Project Completion Date**	2022-09-20

Recommendation

We recommend a release of $4,569 K, including $500 K of contingency. This will bring the total released-to-date to $47,666 K.

The total project cost is now estimated at $47,666K, compared to $43,098 K in the previous released, including contingency.

This release is to fund the schedule extension both for additional Contractor support and OPG labour costs and materials to complete the project commissioning phase.

This Superseding BCS is requesting an in-service date change to 20-Sep-2021.

The project BK182199 (non-standard portion of the project), is not included in the approved 2021-26 Business Plan.
The project BK182777 (capital portion of the project), is included in the approved 2021-26 Business Plan.
The 2021 funding will be managed within the South Central Operations Capital budget and Non-Standard budgets.

Investment Cash Flows - OMA BK182199

$K	LTD	2021	2022	2023	2024	2025	2026	Future	Total
Previous releases	2,494	180							2,674
Current request	-	(194)							(194)
Total released to date	**2,494**	**(14)**	**-**	**-**	**-**	**-**	**-**	**-**	**2,480**
Future required	-								-
Total Project Cost	**2,494**	**(14)**	**-**	**-**	**-**	**-**	**-**	**-**	**2,480**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$2,480 K

Investment Cash Flows - CAP BK182777

$K	LTD	2021	2022	2023	2024	2025	2026	Future	Total
Previous releases	29,970	10,453							40,423
Current request	(5)	4,769							4,764
Total released to date	**29,965**	**15,222**	**-**	**-**	**-**	**-**	**-**	**-**	**45,186**
Future required	-								-
Total Project Cost	**29,965**	**15,222**	**-**	**-**	**-**	**-**	**-**	**-**	**45,186**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$45,186 K

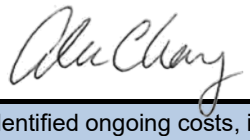
Investment Cash Flows - Total OMA/CAP

$K	LTD	2021	2022	2023	2024	2025	2026	Future	Total
Previous releases	32,464	10,633							43,097
Current request	(5)	4,574							4,569
Total released to date	**32,459**	**15,208**	**-**	**-**	**-**	**-**	**-**	**-**	**47,666**
Future required	-								-
Total Project Cost	**32,459**	**15,208**	**-**	**-**	**-**	**-**	**-**	**-**	**47,666**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$47,666 K

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

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Business Case Summary

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Paul Seguin VP Regional Operations, Niagara		17 Sep. 2021
I concur with the business decision as documented in this BCS.		
Finance Approval: Alec Cheng VP Treasurer		Sep 19 2021
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: Sean Granville Chief Operations Officer		17-Sep-21

EXECUTIVE SUMMARY – Project Overview

The original outage plan for G5 was scheduled for 6-May-2019 to 29-July-2020. In order to minimize the overlap between G1/G2 removals, the G5 outage was postponed and shortened to the period of 27-Jan-2020 to 6-May-2021.

The POVA requested and approved an outage change starting 29-Jan-2021 to 8-Jul-2021 and included additional funding for added scope to complete the project. We have since spent all funding from the POVA, and the scheduled in-service date has been pushed out due to an extended dry commissioning phase and equipment failure during wet commissioning.

The OMA project is coming in under budget by $166,405. The CAP project is requesting additional funding of $4,763,622. The total net additional funding request is $4,569,625.

This Superseding Business Case Summary (SBCS) is requesting additional funding to cover costs for:

1. OPG Labour costs for the extended commissioning schedule, late unknown scope, and hardware failure repairs of $1,934,149.77
2. Voith Hydro Inc – Total Ask $2,329,472.10 due to additional reassembly costs, site management, new scope and schedule changes.
3. Overall project Contingency of $500,000.00

Business Need

For Project Level B

The business needs of this project are:

1. Ensure availability, reliability, and continued operation of SAB1 G5 for the next 25-30 years.
2. Enhance the capacity of the generating asset by 2 MW of clean power and maximize utilization of available water resources.

	Turbine Rating	Generator Mechanical Limit
Pre-Overhaul Ratings	53.1 MW	73 MW
Post-Overhaul Ratings	**55.1 MW**	73 MW
Improvement	+2.0 MW	-

Background

Sir Adam Beck 1 (SAB1) G5 was placed in-service in 1923 as a 25 Hz unit rated for 45 MVA. It underwent frequency conversion to 60 Hz in 1985 as part of the runner upgrade program. SAB1 G5 has not had a major overhaul since 1985. Hydroelectric units of this type normally require overhauls on a 25-30 year cycle to maintain reliable operation. As a unit approaches end of life, it faces higher potential for production losses due to degraded reliability.

G5 has now passed the 25-30 year window (2010-2015) and since 2012 has had a restricted operating window in order to mitigate the effects of high generator rotor vibration. This approach has been used to manage the deterioration of the unit beyond its 30-year major overhaul schedule, due to a heavy overhaul program, which began in 2007. For the period from 2007-2018, a primary focus for Niagara Operations has been to overhaul and upgrade SAB1 units as they reached or exceeded the 25-30 year mark in their overhaul cycle. Over this period, G7 was converted to 60 Hz and upgraded (2009), while G9 (2010), G3 (2013) and G10 (2017) underwent major overhauls and runner replacements.

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

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Business Case Summary

Business Need

For Project Level B

The 2015 SAB1 G5 Condition Assessment (R-NF20-01550—0011) included major water-to-wire electrical, mechanical and civil equipment/ structures related to G5, and assessment of an upgrade alternative.

The total required funding for this project is broken down in the following table.

k$	LTD	2021	2022	2023	2024	Future	Total
BK182199 Non-Std	2,494	-14				0	2,480
BK182777 Cap	29,965	15,222				0	45,187
Total Project Cost	32,459	15,207				0	47,666

Deliverables:	**Associated Milestones (if any):**	**Actual Date** (DD-MMM-YYYY)**:**
Previous releases: EBCS		
Gate 1 Review Change Request Authorization (CRA)	GR1	Jun 18, 2013
Project Manager Milestones	PMM	Jul 9, 2015
Gate 2 Business Case Summary Approved	GR2	May 4, 2018
Gate 2A Partial Business Case Summary Approved for procurement of long lead components and remaining definition phase deliverables.	GR2A	Aug 29, 2018
Gate 3 Execution Funds Approved signed by OAR		Nov 18, 2018
Gate 3 Review for Execution Business Case RG PGR Committee Meeting	GR3	Dec 12, 2018
EPC PO issued to Voith Hydro Inc.	EPC	May 29, 2019
Outage start / Start of Installation	SOI	Jan 27, 2020
Start of Work Suspension due to COVID-19	7 week on site work suspension; engineering continued off-site	Mar 26, 2020
Finish of Installation	FOI	Mar 19, 2021
Current release: POVA		
Gate 3B POVA Project Over Variance Authorization Approved	GR3B	Mar 22, 2021
Future release: SBCS		**Target Date** (DD-MMM-YYYY)**:**
Gate 3C approval and BCS signed by OAR	GR3C	Aug 31, 2021
Available for Service	AFS	Sep 20, 2021
Report of Equipment In Service	REIS approved	Sep 30, 2021
Project Close Out Completed	PCO	Dec 31, 2021
Project Closure Report	PCR approved	Sep 30, 2022
Post Implementation Review Complete PIR approved	PIM	Sep 30, 2022

Key Risk Assessment

For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Schedule	COVID-19 may further delay the project with increased cost and schedule delay.	Mitigate: • The work teams continue to off set shift start, breaks and finish times so that resources do not overlap in lunch/break rooms and entering and exiting the site at the same time.	No	Low

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

Business Case Summary

Key Risk Assessment		For Project Level A, B or C		
Risk Class	**Description of Risk**	**Response Type/ Actions/Final TCD**	**For Additional Review**	**Residual Ranking**
		• Full PPE warn and extra care taken at all times when congregated around display screens during commissioning. • OPG and the Contractor have identified additional support resources to step in to continue and complete the commissioning testing if required. **Final TCD: [17-Sep-2021]**		
Cost	During Commissioning, a component failure may force the unit out of service.	Mitigate: • The team have executed a number of wet commissioning tests already with no indication of further issues. **Final TCD: [17-Sep-2021]**	No	Low

Additional Risk Analysis — For Project Level A or B

COVID-19 Variant Concern: There are a large group of internal resources involved with the G5 Wet commissioning along with 3rd party resources. Voith have been limiting attendance to tailboard and commissioning face-to-face meetings sending 1 delegate at a time. OPG engineers are also being cautious and alternating on-site test witnessing.

The Commissioning Team are being cautious during the completion of the wet testing. Equipment failure has already occurred at the initial start of wet commissioning, and there is still a risk of equipment failure until the load rejection testing has completed and all data has been reviewed and analyzed.

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$M	Alt2 – Major OH & Upgrade	Alt1 – Status Quo	Alt3 – Major OH Only	Alt4 – Minor OHH
Project Cost	47,666	2.3	31.0	14.5
NPV	136	119	130	119

Analysis of Financial Evaluation – Key Assumptions and Key Results:

- Evaluated over a 25 year span
- All on-going OM&A costs (i.e. standard operating expenses) are equivalent for each alternative
- Utilized Base System Economic Values (SEV)
- Capacity Credit not used
- Major Overhaul will be taken for each alternative in 25 years (2043)
- Alt1 Status Quo: Vibration issue requires an outage for Major OH in 2023 (5 years). Operating restrictions are maintained. An unplanned outage would be required circa Oct 2023 to Oct 2024, which coincides with PNGS shutdown.
- Preferred Alternative – Alt2 Major OH & Upgrade: 2MW increase in capacity achieved with the runner upgrade. Planned outage May 2019 to July 2020. Since revised to 29-Jan-2020 to 17-Sep-2021.
- Alt3 Major OH only: Planned outage May 2019 to Jul 2020
- Alt4 Minor OH: Planned outage May 2019 to Oct 2019 with another outage within 5 years
- The project will be completed in time to minimize the schedule impacts on BK182198 (G1/G2)

Refer to original EBCS

- The team is confident that the in-service date will be mid September
- The OPG Engineering Lead has confirmed through commissioning testing to-date, that the unit has achieved an additional 2MW output.

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
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Business Case Summary

Qualitative Factors

- G5 is one of four units that provide station service power. Reliability of this unit is important to the stability of the station service system.
- Experience gained from G5 will be applied to the SAB2 overhaul program in alignment with the Strategic Imperative for Project Excellence.
- P&C panel design and fabrication was removed from the scope for the main contractor and is being performed by OPG. There should be fewer delays due to vendor integration issues. Installation of the OPG design will be proven out on G5 and can then be applied to the G1, G2 project.

Post Implementation Review (PIR) Plan (refer to OPG-PROC-0056)

Type of PIR Report	Simplified/Standard PIR	**PIR Completion Date**	2022-09-30

☐ Detailed PIR KPIs will be provided in future BCS(s) when Execution Phase BCS release is requested.

PIR KPIs	Current Baseline	Target Result	How to measure?	Who will measure?
MCR (MW)	53.1	55.1	Unit Metering	SAB1 Production
Apparent Power (MVA)	55	63	Unit Metering	SAB1 Production
Runner Efficiency at best efficiency point.	Pre-overhaul Gibson Test (best) or G4's 1986 results.	[redacted]	Post-overhaul Gibson Test	Tech Support Eng. With RG P&T
Operating Restrictions	Rough zone >40% Must run >80% Shutdown on high gen runout alarm	Operating Window consistent with other SAB1 Units. Range 85% to 100% of maximum flow.	Visual Inspection	NIA Operations and SAB1 Production

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

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Business Case Summary

Definitions and Acronyms

AS7 – Asset Suite 7
BP – Business Plan
BTU – Building Trades Union
CAP – Capital
COMES – Constructability, Operability, Maintainability, Environment and Safety review
CSA – Cost and Schedule Analyst
DPC – Definition Phase Charter
EA – Environmental Assessment
EBCS – Execution Business Case Summary
ETA – Estimated Time of Arrival
Hz – Hertz
ITP – Inspection and Test Plan
LNTP – Limited Notice to Proceed
LTD – Life to Date
MCR – Maximum Continuous Rating
MOT – Main Output Transformer
MVA – Mega Volt Amp
MW – Mega Watt
NA, N/A – Not Applicable
Non-Std – Non Standard
NPV – Net Present Value
OAR – Organization Authority Register
OEM – Original Equipment Manufacturer
OH - Overhaul
OPG – Ontario Power Generation
OM&A – Operations, Maintenance and Administration
PBCS – Partial Business Case Summary
PCR – Project Closure Report
PDRI – Project Definition Rating Index
PEP – Project Execution Plan
PES – Plant Engineering Services (OPG Engineering)
PIR – Post Implementation Review
PO – Purchase Order
QA/QC – Quality Assurance/ Quality Control
REIS – Report of Equipment In-service
RFP – Request for Proposals
RG - Renewable Generation
SAB1 – Sir Adam Beck Generating Station 1
SAC – Surface Air Cooler
SEV – System Economic Values
SIA – System Impact Assessment
SoE – Summary of Estimate
TWh – Terra Watt hours
VP – Vice President
WOs – Work Orders

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate - Released to date										
Project Number:	**BK182777 / BK182199**									
Project Title:	**G5 Major Overhaul CAP / OMA**									
$K	**LTD**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Future**	**Total**	**%**
Project Mgmt	5,499	4,019							9,518	20%
Inspection									-	0%
Engineering	1,008	719							1,727	4%
Procurement	653	209							861	2%
Construction	24,483	6,193							30,677	64%
Commissioning	212	2,670							2,883	6%
Closeout									-	0%
Turnover (Doc. & Training)	39	43							82	0%
Subtotal	31,893	13,854	-	-	-	-	-	-	45,747	96%
Outside WBS	-	-							-	0%
Contingency	0	500							500	1%
Subtotal w/ Contingency	31,893	14,354	-	-	-	-	-	-	46,247	97%
Interest	565	853							1,419	3%
Other									-	0%
Total	**32,459**	**15,208**	-	-	-	-	-	-	**47,666**	**100%**
Removal Costs (incl. above)	1,054	7							1,061	2%

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	1.7%	**Interest Rate (going-forward)**	3.45%

Appendix A3: Summary of Estimate – In-Service Estimates				
$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project #	**Date (YYYY-MM-DD)**	**Description**	**Amount**	**%**
BK182777	2021-09-17	G5 Major Overhaul	46,605	100%
				0%
Total			46,605	100%

Prepared by:	Reviewed and Endorsed by:
Michele Sokol 15-Sep-2021	Ray DeJonge 15 Sept 2021
Michele Sokol	Ray DeJonge
Project Leader, Maintenance Projects	Work Centre Manager, Maintenance Projects
Date	Date

Project #: BK182777, BK182199
Project Title: G5 Major Overhaul – Capital, Non-Std
Document #: NF20-BCS-08707.021-0004

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Business Case Summary

$K	LTD	2018	2019	2020	2021	2022	2023	Future	Total
G3A -EBCS	-	554	27,506	8,933					36,993
G3B -POVA				32,464	10,633				43,097
G3C -SBCS				32,459	15,208				47,666

Total Project Estimate Variance Explanation (delete if not required)

This Superseding Business Case Summary (SBCS) is requesting additional funding to cover costs for:

1. OPG Labour costs for the extended commissioning schedule, late unknown scope, and hardware failure repairs of $1,934,149.77
    - An increased number of OPG Engineers supporting IESO/COVER/SIA for electrical design changes, programming and testing, with additional field OPG labour estimated $120,000.00
    - Labour for hardware failure: engineering support, disassembly, removal, replacement, reassembly estimated $320,000
    - Higher than forecast labour commissioning schedule estimated $1,094,149.77 (May 6 - Sep 13)
    - Interest to cover schedule extension estimated $280,000
    - Allowance for schedule extensions of $60,000/week; assuming a 2 week schedule extension Sept. 13-27, 2021 $120,000

2. Voith Hydro Inc – Total $2,329,472.10 for prior outstanding costs not known at the time of the POVA. These costs cover site management, schedule changes, new scope and contingency.
    a) Reassembly costs from March, April, May 2021 (General T&M) of $1,382,714.23
        - Site & Office Management hours and expenses
        - New Scope based on original completion forecast of December 2020 in the field with the following vendors: The State Group, Tower Scaffolding Services, Acklands, Altra Construction Rentals, Bickles and Newman Bros.
    b) Project Change Directives for Site Management, Site Running Costs and Project Office Management caused by Schedule changes of $710,522.86
        - PCD-013 Original Fixed Commissioning Cost from the Voith proposal is based on 2 month scheduled duration. Due to circumstances outside of Voith's control, the Commissioning Schedule was extended to a 3 month duration. Total cost impact: $392,728.57
            - Original May 6, 2021 moved to July 8,2021
            - Actual (at the time of PCD-013): May 3, 2021 to August 14, 2021
        - PCD-014 Generator Shroud Seal failure occurred on June 29, 2021 and was resolved on August 3, 2021. This incident forced Voith Hydro to focus support personnel on the recovery effort and postponed the commissioning activities by one (1) additional month. As of August 12, 2021, the in-service date is pushed to September 13, 2021.Total cost impact: $317,794.29
    c) Project Change Directives (PCD-013 & 014) for new scope and replacement materials total cost estimates of $152,827.90
        - Additional Demobilization Cost $36,592.89
        - GeoArc/GKM training $2,864.40
        - Governor Spare Parts $16,889.43
        - Penstock Stress Analysis $36,538.00
        - Air Gap Sensor Extension Cable $4,046.40
        - Spare High Pressure Lift Pump/motor Assembly & Gear $3,231.63
        - Spare Strainers $12,715.14
        - Replacement Air Gap Sensors $32,430.10
        - Replacement GP03 material (estimate) $933.36
        - Replacement Shroud Rubber Seal $6,371.40
        - Replacement Shroud Rivets, washer, etc. (estimate) $215.15
    d) Allowance for schedule extension estimate $60,000/per week. 2 weeks schedule extension Sept. 13-27, 2021 $120,000.00

3. Overall project Contingency of $500,000.00

ONTARIO POWER GENERATION

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Business Case Summary

Project #	83148	**BCS Document Number**	FA12-BCS-41000-0002
Project Title	83148 - ABI - G1 CAPITAL UPGRADES		
Facility	CAN - ABITIBI CANYON	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2031-May-30
Estimate Class (Current Request)	Class 5	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $1.349M including [redacted] of contingency.
The total estimated project cost range will be determined upon Gate 2 approval to proceed to the Definition Phase.
This release is to commission a hydraulic study of Abitibi Canyon G1/G2 as well as G3/4/5 with the assumption that G1/2 are identical, and G3/4/5 are identical ahead of the upcoming overhauls.
This will be performed as part of the Programmatic Approach with Andritz and will form both part of the value engineering analysis as well as develop the project scope for these upcoming overhauls.

Investment Cash Flows

Project Number	83148 - ABI - G1 CAPITAL UPGRADES					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	213	704	432					1,349
Total released to date	0	213	704	432					1,349
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	1,349.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Brad Bacvar Director Asset & Project Mgmt Production Support Manager	Brad Bacvar	2025-02-26
I concur with the business decision as documented in this BCS.		
Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	2025-02-26
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : **OAR Element : 1.1** **Jamey Deforge** **Director Plant Operations**	Jamey Deforge	2025-03-06

EXECUTIVE SUMMARY – Project Overview

The runner on unit G1 at Abitibi Canyon suffered a major failure in 2022 which required the runner to be removed from the unit and moved to the Dymond Machine Shop for extensive repairs. This repair was only intended to get the unit back online until the upcoming unit overhaul. This was the second major failure of this runner since the original installation in 1997 and with the multiple repairs the integrity has been compromised from a longevity standpoint. This runner must be replaced to ensure reliability for the next 25 years post-overhaul.

With the province's electricity demand increasing due to electrification, this proposed hydraulic study will be used to determine how much more power and efficiency can be gained with a runner upgrade and possible unit modifications as the cost per megawatt is typically much less than that of a redevelopment or new build.

Business Need

For Project Level A or B

A new runner is required in unit G1 to ensure a reliable unit for the next 25 years post overhaul and since we are replacing the runner we will complete a hydraulic study to determine how much more energy and efficiency can be gained from the Abitibi Canyon units and at what cost. This investment will be part of the value engineering analysis and will also be utilized to develop the project scope for these upcoming overhauls at Abitibi Canyon.

Preferred Alternative:	Runner Replacement	For Project Level A, B or C

Description of Preferred Alternative

Replace the runner on Abitibi Canyon G1 as part of the overhaul and complete a hydraulic study to determine if a unit uprate is feasible and economical.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Project Charter Approved	Project Charter Approved		2024-07-11
Gate 1 Approval	Gate G1 Approval		2024-09-14

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Hydraulic Study Complete	Conceptual Design Complete		2025-12-31
Develop Scope of Work with Andritz	Scope of Work Document Complete		2026-02-28
Schedule and Resource	Detailed Construction and Commissioning Schedule Ready		2026-03-30
Class 4 Estimate	Release Quality Estimate		2026-03-30
Gate 2 Approval	Gate G2 Approval		2026-04-30

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Award detailed design contract / release	Award Contracts / PO Issued		2026-06-30
Long Lead Items Identified	Long Lead Time Material Identified		2026-09-30
Detailed Design Complete	Detailed Design Complete		2027-06-30
Class 3 Estimate	Release Quality Estimate		2027-08-30
Risk Mitigation Plan Prepared	Risk Mitigation Plans Prepared		2027-10-30
Gate 3 BCS Approved	Gate G3 Approval		2027-12-30
Start of Installation	Start of Installation		2029-06-01
Available for Service	Available for Service and/or Ready For Service Completed		2030-11-30
Project Close-Out	Project Close Out Completed		2031-05-30

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
The do-nothing option is not a viable option as this will result in further runner failures resulting in long unit outages. The unit was out of service for an unplanned outage for well over a year to perform the last repair. Cons: Unplanned outages, loss of generation, high repair cost as it is unplanned, may have impact on other project outages, repeated unit disassembly/reassembly, potential energy gains not realized, if a complete failure new runner is, 2–3 year delivery. Pros: No immediate cost		
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
Delaying the runner replacement is the same as alternative 2.		
Alternative 4:	**Replace the Runner**	For Project Level A, B
This alternative replaces the runner during the unit overhaul which is the most efficient time to complete this work as the unit must be dismantled regardless. A new runner will increase the unit reliability resetting the unit reliability post overhaul for another 25 years. This is also the best time to complete a runner upgrade as other turbine/generator minor modification may be required that are best performed during overhauls.		

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
N/A			

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					

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Business Case Summary

Is PIR Required?	**Review (PIR) Plan** (refer to OPG-GUID-00120-0007)	**PIR Completion Date**	2032-05-30

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	83148 - ABI - G1 CAPITAL UPGRADES						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		16	53	18					87	6
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest		28	91	30					149	11
Other										0
Total		213	704	432					1,349	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Kevin Morrissette Plant Programming Coordinator Programming	2025-01-14	Cheryl St. Amour Senior Manager Projects Project Management - Abitibi/Otter Rapid	2024-09-05

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Business Case Summary

Project #	ABI83155, 83156, 82520	**Controlled Doc #**	FA12-PLAN-22000-0007
Project Title	Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation		
Facility	Abitibi Canyon GS	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	☒ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Choose an item. G0☐: Initiation ☐ Choose an item. G1☐: Choose an item.		☐ Superseding G2☐: Definition ☒ Full G3☐: Execution
Estimate Class (overall project)	Class 2	**Target Project Completion Date**	Jun-2022

Recommendation

We recommend a release of an additional $35,221 K, including $8,000 K of contingency. This will bring the total released-to-date to $37,055 K.

The estimated total project cost range is between $31,497 K and $44,466 K, including $8,000 K of contingency.

The total project cost is now estimated at $37,055 K, compared to $34,925 K in the previous release. This project cost is based upon vendor estimates.

This release is to:

- complete the contract award for execution,
- complete detailed engineering and design,
- complete the unit overhaul scope of work (projects ABI83155 and ABI83156), **NOTE:** ABI83156 is the Non-Standard component of this project execution.
- complete the installation of a new head gate and hoist (included in project ABI83155)
- install a new excitation system, previously procured by OPG (Exciter Installation Project is ABI82520)

Previous release of $1,488 K was for RFP development and to procure a new rotor spider, including design, fabrication and delivery. The previous release was under the Capital project ABI83155.

Investment Cash Flows

$K	LTD	2019	2020	2021	2022	2023	2024	Future	Total
Previous releases - 83155 CAP		888	600						1,488
Current request - 83155 CAP	-	946	14,239	10,858					26,043
Current request - 83156 N/S	-		5,265	3,510					8,775
Current request - 82520 CAP	-		449	299					748
Total released to date	**-**	**1,834**	**20,554**	**14,667**	**-**	**-**	**-**	**-**	**37,055**
Future required	-								-
Total Project Cost	**-**	**1,834**	**20,554**	**14,667**	**-**	**-**	**-**	**-**	**37,055**

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Bruce Robertson VP Operations - Northeast		12/12/2019
I concur with the business decision as documented in this BCS.		
Finance Approval: Elli-Jane Michalagas Acting Director RG Controllership		12/12/2019
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: John Hefford Acting Chief Operating Officer		12/12/2019

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
Document #: FA12-PLAN-22000-0007

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Business Case Summary

EXECUTIVE SUMMARY – Project Overview

Abitibi Canyon Generating Station is a five unit hydroelectric station located on the Abitibi River, 77 km north of Smooth Rock Falls. The generating station is remotely controlled from the North East Control Centre. It has a maximum continuous rating (MCR) of 349 MW and produces 997.5 GWh/year. Construction began in 1930 by the Dominion Construction Company and was taken over by the Province of Ontario in 1933. The first two generators were placed in service later that year and followed by two more in 1936. The fifth unit went into service in 1959. All five units have General Electric, 60Hz generators, rated at 70 MVA.

The goal of this project is to return the Abitibi Canyon G2 to a state of long term reliability with low life cycle costs. G2 presently indicates multiple signs of fatigue, high vibrations with multiple factors and general wear and tear on most major systems. The issues identified in past Plant Condition Assessments, reports and collected information prior and after the major runner work done in 2011 clearly indicates a major overhaul is needed.

The preferred alternative is to complete the G2 overhaul along with the head gate and hoist replacement beginning in September 2020. This alternative meets business needs and is the recommended option of the Initiation Phase Report (FA12-CHAR-42000-0002_IPR). It is recommended due to lowest project cost, best NPV value while eliminating all on-going maintenance related issues. Also OPG would benefit from the elimination of all known risk for failures, forced shut downs, and associated revenue losses, while providing G2 as a reliable generating system for years to come.

This release is to complete the execution phase of the overhaul along with the head gate and hoist replacement. Through the competitive RFP evaluation process, an OEM has been selected as the Overhaul Contractor and will also design supply and install a new head gate and hoist system. This work is to be completed beginning in September 2020 and be completed by the end of Q2 of 2021.

Approval of this release is required in order to complete the design and engineering to have the construction completed within the scheduled unit outage between September 2020 and June 2021. The outage work will also include the site installation of a new excitation system for G2. There is no exciter procurement included in this work as it has been previously procured under project NEO83568 and will be free issued to the contractor.

Business Need

Abitibi Canyon GS is classified as a "Workhorse" asset in OPGs fleet of hydroelectric stations with five vertical hydroelectric units. Construction began in 1930 by the Dominion Construction Company. Table 1 shows average production and reliability statistics for Abitibi Canyon GS for the period January 2011 to December 2015.

Table 1 – Average Production and Reliability Statistics (2011-2015)

Average Energy Production	997,510 MW/year
Rank in Energy Production out of 64 Hydro Stations	6th
Average Capacity (MCR)	349.0 MW
Rank in Capacity (MCR) out of 64 Hydro Stations	5th

The runner for G2 was replaced in 1992 with a stainless steel runner. It has operated since then, up to the rated generator output with minimal cavitation damage. In 2010, the runner was inspected and crack repairs were required on the runner as well as the shaft mating surface.

Since 2011, the G2 generator bearing vibrations have been increasing steadily and are in continuous alarm. The alarms levels have been raised to prevent frequent trips. Numerous factors have been identified as contributors to the vibration issues. Some of the reasons are that the stator is not centered and out of round and also the rotor has a loose rim which has some cracks which is concerning. During the generator overhaul the windings will be replaced and a full rewind will be completed.

In 2006, General Electric (GE) provided a study on rotor cracking defects. Solutions had been implemented, but in 2016 additional cracks were identified towards the center section of the G2 rotor. This is a concern for the long-term reliability of the unit. Based on this concern, the rotor spider will be replaced during the overhaul and a PO has been issued for design, fabrication and supply. Expected delivery of the rotor spider is Q4 of 2020.

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
Document #: FA12-PLAN-22000-0007

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Business Case Summary

Business Need

The head gate and hoist system is original with the exception of maintenance performed on the seals, gate rollers and gate re-surfacing in 1990. The roller path is in poor condition with noticeable plastic deformation and the surrounding concrete is deteriorating. The head gate is overstressed by approximately 35-60% and experiencing signs of corrosion. The mechanical hoist system needs a new wire rope, controls are aging and it is difficult to service. The head gate lifting lugs are undersized and inadequate for gate jamming loads. The head gate work is to be scheduled in conjunction with the unit overhaul to avoid separate outages.

The objective of the project is to address deficiencies on the G2 generator/turbine system, along with the head gate system as previously noted and which have been identified in the following documents:

- FA12-19900112 document-October 5, 1990 (Hydraulic Stations Department)
- 1994 PCA (Plant Condition Assessment)
- 2000 PCA
- 2007 PCA
- 2010 Dam Safety Periodic Review Of Flow Control Equipment DSP-08410.1-01.033-0009, which includes the 2006 RAT International - Head Gate No.2 Abitibi Canyon (September 25 – 28, 2006)
- 2016 PCA
- Runner rebuild project executed in 2010-2011 (CANY0045)
- Engineering Risk Assessment Program (ERAP) 2017 program recommendations

Preferred Alternative:	**G2 Capital Upgrade/Overhaul with Head Gate, Hoist and Embeds replacement**

Description of Preferred Alternative

Implementation of this alternative will involve the following scope:

- Removal and disposal of the old rotor spider and Installation of a new rotor spider
- The loose rim issues will be corrected on the rotor. There will be a new rotor spider and the rim will be re-shrunk
- Replacing windings which are end of life, 35 years old.
- Re-insulating rotor poles to ensure good conditions and reliable operation.
- Re-machine the mating surfaces on the generator and turbine shaft to correct the dog leg which is currently a cause of high vibration.
- Alignment of the stator centreline which will even the air gap.
- Replace the worn bushings, seals and re-design a reliable gate lock system for the wicket gates.
- Improve access from the turbine pit to lower bracket area.
- Grouting of penstock near scroll case to stop leakage near the draft tube access door.
- Lead abatement and recoat surfaces with lead free coating.
- Runner refurbishment to repair cracks and possible cavitation damage for reliable operation for the next 25 years.
- Install a new head gate, new hoist and embedded components for system reliability.

Advantages:

- Prevents un-planned shutdowns and associated revenue losses by coordinating project schedules.
- Mitigation of all known unit maintenance and operational issues, thereby reducing maintenance costs
- Province will have a reliable unit for the next 25 years, and the unit will be available when Pickering Nuclear shuts down in 2024
- Improves the head gate reliability and mitigates the dam safety risk of a head gate failure

Disadvantages:

- Expected unit outage duration of at least 44 weeks, loss of generation and revenues

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Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
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Business Case Summary

Deliverables:	Associated Milestones (if any):	Target Date:
Previous releases:		
Definition BCS	Complete Technical Specifications	Feb 28, 2019
Complete RFP documents (PSF, General Requirements)	Issue RFP to proponents	June 2019
Superseding Definition Phase BCS	Issue PO for NEW Rotor Spider	August 2019
Complete Bid evaluation	Complete contractor selection	Sept 2019
Current release:		
Develop Full Execution Phase BCS	Obtain BCS approval	Nov 2019
Contract Award	Issue PO	Dec 2019
Mobilization	Start of Construction	Sept 2020
Construction Complete	REIS	May 2021
Closeout Documentation Received	PCR	June 2022

Alternative 2: **Base Case – No Project**

No direct cost or schedule as no planned work will be done. There will undoubtedly be indirect maintenance costs and unit forced outages, resulting in decreased availability, possible major system failures and possibly linked additional operational problems. This option carries an unacceptable level of risk since there is potential for damage to the unit and possible multiple forced outages.

Canyon G2 unit has been without a major rehabilitation since 1992, other than a runner crack repair in 2011. Currently, there is a high risk of the exciter system failing, to the point that the exciter system has been procured ahead of time in case of near future failure. There is also an increased risk caused by high vibrations (above normal accepted limits) which increases the cracking of the rotor. Recent cracking is now present not only at the torque block keys but also at the center of the shaft connections which were recently found in 2016.

The G2 head gate is also showing its age, plastic deformation of the roller path, overstressed head gate structure, rope has been suggested to be changed with new and where the last gate overhaul date was close to thirty years ago.

Advantages:

- Defer Cost.

Disadvantages:

- Does not address any of the concerns raised within the plant conditioning assessments (PCAs)
- Does not satisfy end of life components as indicated within PCA's
- Risk of rotor failure increases with continued use and increasing vibration of the unit.
- Risk of failure of the exciter system increases with time.
- Risk of failure of the winding systems, beyond their useful life.
- The head gate roller path has known plastic deformation problems which increases the risk of a head gate failure, head gate jamming, or head gate/hoist overstressing.
- G2 unit would be unreliable to the Province after Pickering Nuclear's end of commercial operations in 2024.
- Continuing to operate G2 in this condition, could potentially increase wear and tear of adjacent and associated systems, therefore increasing maintenance costs and risk of un-planned shutdown.
- Least favourable Net Present Value (NPV).

This option is not recommended, since it does not meet project objectives and carries an unacceptable level of risk including:

- Rotor cracking failure beyond the point of operation or beyond the point of possible repair. This could severely impact the project timelines and overhaul execution phase if the need for designing and supplying a brand new rotor is deemed necessary.
- Windings are at the end of life.
- The shaft transmission system has a noticeable dog leg which induces vibration and increases the chance of failure.
- There is also risk of head gate failure if the existing head gate is kept in its current state of operation.

These are all major concerns at this time and are possible causes for costly forced outages at some point in the future.

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
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Business Case Summary

Alternative 3:	**G2 Capital Upgrades and Non-Standard Overhaul now, followed by Head Gate, Hoist and Embeds replacement 10 years later**

Implementation of this alternative would involve the following scope:

- Addressing the concerns and complete repair of the spider cracking problems, where other cracks where found during a bi-annual inspection in 2016.
- Addressing the loose rim issues on the rotor.
- Replacing windings which are at the end of life.
- Re-insulating rotor poles to ensure good conditions and reliable operation.
- Addressing the concerns of dog leg (both transmission shafts), a cause of high vibration.
- Alignment of the generator system which will even the air gap.
- Addressing the wicket gate system, worn bushings and re-design a reliable gate locking system.
- Adjustments of vertical misalignment, which contributes to high vibration.
- Addressing the pit access, to the brake system.
- Addressing all leakage near the draft tube access door area.
- Addressing the pit area, lead paint abatement.
- Addressing possible small cracks and pitting on the runner.

Advantages:

- Prevents forced outages and associated revenue losses.
- Addresses all known system maintenance requirements.
- Prevents costly downtime caused by the:
  - Rotor cracking further potentially causing a catastrophic failure.
  - Failure of rotor keys locking system (holding welds are cracked).
  - Failure of windings which are at end of life.
  - Major damage to the runner.
  - Increased vibration to the point of damage to unit components.
- Lower upfront capital expenditure.

Disadvantages:

- Will require another shutdown in 10 years for head gate associated work, including additional revenue losses, mobilization costs, etc.
- Will still require same outage time as Alternative 2.
- Less favourable NPV compared to the preferred alternative.
- Possible breakdown/increased maintenance over the next 10 years related to the head gate system.
- Possible failure of head gate crack and drop test.

This alternative does not meet business needs since it does not address all known maintenance and operational risks. Significant risk would still exist with any failures or forced shut downs associated with the head gate system.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Cost	There is a risk that costs exceed project estimate	Mitigate: • Release is to fund all execution phase work (RFP process) • Firm pricing received from OEM for base scope with contingency for forced discovery items **Final TCD: October 31, 2019**	No	Low
Scope	There is a risk that additional scope will get added to the specifications late and delay project	Mitigate: • Early upfront discussions with project stakeholders have been held to	No	Low

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
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Business Case Summary

Key Risk Assessment			For Project Level A, B or C	
Risk Class	**Description of Risk**	**Response Type/ Actions/Final TCD**	**For Additional Review**	**Residual Ranking**
		obtain their buy in regarding the scope identified. • Lessons learned will be used to identify forced discovery items. • Monitored as project progresses **Final TCD: May 15, 2021**		
Resources	There is a risk that Resources will not be available to complete execution phase deliverables	Mitigate: • Lead engineer and support team as well as Project Leader already assigned and committed. • Internal resources have already been identified • Ongoing monitoring to take place as project needs change • Early upfront communication with production for onsite resources **Final TCD: May 31, 2021**	No	Low
Schedule	There is a risk that Definition Phase deliverables and/or the rotor spider are late thus impacting ability to execute on time	Mitigate: • Early upfront discussion with Plant Engineering Services (PES) and commitment from Supply Chain • PO placed in July for long lead rotor spider procurement • LNTP to be issued for execution phase engineering if PO cannot be issued in a timely manner post BCS approval • Ongoing schedule monitoring to occur throughout execution phase **Final TCD: June 15, 2021**	No	Low

Additional Risk Analysis	For Project Level A or B
[See Guidance]	

Financial Evaluation			For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing		
$K	Preferred Alternative	Base Case (No Project)	Delay work	Alternative 4	Alternative 5
Project Cost	$37,055	$37,900	$37,936		
NPV	n/a	n/a	n/a		
Other: (e.g., IRR)					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

- Estimate accuracy for this release and the total project is Class 2 (-15% + 20%)
- Costs estimates for this Full Execution phase BCS are based on firm competitive bids received from OEM's during a thorough RFP process using a design-build construction strategy (EPC).
- Capital costs classified according to US GAAP whereby capital work involves life extensions and upgrades.
- This Full Execution phase release includes 21.6% contingency or $8,000 K.
- Abitibi Canyon GS is a rated regulated station under the OEB.
- The total project cost estimate in this BCS is reported in the current 2019-2023 BP at $34.978 M which includes the Capital Upgrade, the non-standard overhaul and the head gate replacement. Including the excitation replacement the total project cost is $35.678 M

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
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Business Case Summary

Qualitative Factors
• Prevents un-planned shutdowns and associated revenue losses by coordinating project schedules. • This alternative will mitigate all known unit maintenance and operational issues and will improve the unit reliability/availability for the next 25 years • Improves the head gate reliability for the next 50 years

Post Implementation Review (PIR) Plan (refer to OPG-PROC-0056)

Type of PIR Report	Project Closure Report (PCR)	PIR Completion Date	Jun-2022

☐ Detailed PIR KPIs will be provided in future BCS(s) when Choose an item. Phase BCS release is requested.

PIR KPIs	Current Baseline	Target Result	How to measure?	Who will measure?

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
Document #: FA12-PLAN-22000-0007

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Business Case Summary

APPENDICES

Project Number:	**ABI83155_83156_82520**									
Project Title:	**Abitibi Canyon G2 Capital Upgrade, Overhaul, Headgate Replacement, and exciter installation**									
$K	**LTD**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Future**	**Total**	**%**
Project Mgmt		26	145	129					299	1%
PWU Support			162	143					305	1%
Engineering		156	152	134					442	1%
Procurement		498	608	44					1,150	3%
Construction		904	13,187	9,316					23,407	63%
EPSCA			530	470					1,000	3%
Removal			675						675	2%
Subtotal	-	1,585	15,458	10,236	-	-	-	-	27,278	74%
External Eng/QA			424	376					800	2%
Contingency		200	4,180	3,619					7,999	22%
Subtotal w/ Contingency	-	1,785	20,062	14,231	-	-	-	-	36,077	97%
Interest		49	333	296					678	2%
Procured Materials			159	141					300	1%
Total	-	**1,834**	**20,554**	**14,668**	-	-	-	-	**37,055**	**100%**
Removal Costs (incl. above)			675						675	2%

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	3.00%	**Interest Rate (going-forward)**	4.33%

Appendix A3: Summary of Estimate – In-Service Estimates

$K Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project #	**Date (YYYY-MM-DD)**	**Description**	**Amount**	**%**
ABI83155	2021-05-15	G2 Unit and Headgate placed in service	21,263	97%
ABI82520	5/15/2021	G2 Excitation sytem placed in service	749	3%
Total			22,012	100%

Prepared by:		**Reviewed and Endorsed by:**	
Pat Bourgouin Projects – TS5 Project Leader	December 4, 2019 Date	Tom Gauthier Projects – TS5 Section Manager	19.12.04 Date

Project #: ABI83155, 83156, 82520
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement and Exciter Installation
Document #: FA12-PLAN-22000-0007

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Business Case Summary

APPENDICES (Continued)

Appendix C: Financial Evaluation Assumptions	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing
Key assumptions used in the financial model of the project are:	
[See BCS Writing Guidance]	

References	For Project Level A or B
[See BCS Writing Guidance]	

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Project Over-Variance Approval

Project #	ABI83155 CAP, ABI83156 N/S, ABI82520 CAP	**Controlled Doc #**	FA12-PLAN-22000-0011
Project Title	Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement & Exciter Installation		
Facility	Abitibi Canyon GS	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	☒ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Over-variance G0☐: Initiation ☐ Over-variance G1☐: Choose an item.		☐ Over-variance G2☐: Definition ☒ Over-variance G3☐: Execution
Estimate Class (overall project)	Class 2	**Target Project Completion Date**	JUN-2022

Recommendation

We recommend a release of $3,600 K, including $1,000 K of contingency. This will bring the total released-to-date to $40,655 K.

The total project cost is now estimated at $40,655 K including $1,109 K of contingency, compared to $37,055 K in the previous release, including contingency.

This release is to fund:

- Substantial discovery items during part refurbishment at off-site shops and other discovery items during execution.
- additional EPSCA costs and internal costs as a result of site schedule extension (engineering, project management and work center support)
- COVID impact costs (not captured in original release Q4 2019) including costs to defer outage start date from October 2019 to January 2020

Investment Cash Flows

$K	LTD	2022	2023	2024	2025	2026	2027	Future	Total
ABI83155 Previous releases	25,760	1,771							27,531
ABI83155 Current request		3,417							3,417
ABI83156 Previous releases	6,382	2,393							8,775
ABI83156 Current request									-
ABI82520 Previous releases	711	38							749
ABI82520 Current request	-	183							183
Total released to date	**32,853**	**7,802**	**-**	**-**	**-**	**-**	**-**	**-**	**40,655**
Future required	-								-
Total Project Cost	**32,853**	**7,802**	**-**	**-**	**-**	**-**	**-**	**-**	**40,655**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$40,655 K

Project Overview

This project is to return the Abitibi Canyon G2 to a state of long term reliability with low life cycle costs. G2 presently shows multiple signs of fatigue, high vibrations with multiple factors and general wear and tear on most major systems. The issues identified in past Plant Condition Assessments, reports and collected information prior to and after the major runner work done in 2011 indicates a major overhaul is needed.

The preferred alternative is to complete the G2 overhaul along with the head gate and hoist replacement beginning in September 2020. This alternative meets business needs and is the recommended option of the Initiation Phase Report (FA12-CHAR-42000-0002_IPR). It is recommended due to lowest project cost, best value while eliminating all on-going maintenance related issues. OPG would also benefit from the elimination of all known risks for failures, forced shut downs, and associated revenue losses, while providing G2 as a reliable generating system in the long run.

Project #: ABI83155 CAP, ABI83156 N/S, ABI82520 CAP
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement & Exciter Installation
Document #: FA12-PLAN-22000-0011

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Project Over-Variance Approval

Project Overview

This release is to fund additional costs associated with schedule extension from part refurbishment cycle, execution schedule extension, as well as additional discovery items during execution. This additional release will also allow for the completion of punch list items in the Spring of 2022 and fund closeout activities.

The following project numbers are defined below:

83155 CAP – G2 Capital Upgrade and headgate replacement
83156 N/S OM&A - Overhaul
82520 CAP- G2 Exciter Replacement

Station Background:

Abitibi Canyon Generating Station is a five unit hydroelectric station located on the Abitibi River, 77 km north of Smooth Rock Falls. The generating station is remotely controlled from the North East Control Centre. It has a maximum continuous rating (MCR) of 349 MW and produces 997.5 GWh/year. Construction began in 1930 by the Dominion Construction Company and was taken over by the Province of Ontario in 1933. The first two generators were placed in service later that year and followed by two more in 1936. The fifth unit went into service in 1959. All five units have General Electric, 60Hz generators, rated at 70 MVA.

Total Project Estimate Variance Explanation

The $3.6M of total project estimate variance is primarily due to:

- Start date was deferred from October 2019 to January 2020, this was to allow for the completion of the G5 rewind which was delayed due to COVID additional costs incurred
- 10 week critical path extension due to part refurbishment cycle, this was related to the age of the parts and the number of defects found during NDE which required repairs, the extent of the defects found was not expected, significant Extension of Time (EOT) change order received
- Impact to Substantial completion date (SCD) from offsite refurbishment as well as Contractor quality issues and rework during installation and commissioning phases, this resulted in additional internal Labour (engineering, project management and work center support)
- COVID impact costs not originally forecasted in initial BCS release
- Additional EPSCA costs from site execution schedule extension
- Additional discovery items during onsite execution, T&M change orders submitted

Project #: ABI83155 CAP, ABI83156 N/S, ABI82520 CAP
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement & Exciter Installation
Document #: FA12-PLAN-22000-0011

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Project Over-Variance Approval

Appendix A1: Summary of Estimate								
Project Number:	**ABI83155, 83156, 82520**							
Project Title:	**Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement & Exciter Installation**							
	ABI83155		**ABI83156**		**ABI82520**			
$K	**LTD**	**2022**	**LTD**	**2022**	**LTD**	**2022**	**Total**	**%**
Project Mgmt	553	134					687	2%
PWU Support	1,352	348			349	64	2,114	5%
Engineering	755	110					864	2%
Procurement	1,268	153					1,421	3%
Construction	20,606	3,198	6,152	2,150	348	121	32,574	80%
EPSCA	640	127	222	44	7	29	1,069	3%
Closeout							-	0%
Subtotal	25,174	4,069	6,373	2,193	703	215	38,728	95%
Outside WBS							-	0%
Contingency		1,000		109			1,109	3%
Subtotal w/ Contingency	25,174	5,069	6,373	2,302	703	215	39,837	98%
Interest	585	119			9	6	718	2%
Other OPG Materials			9	91			100	0%
Total	**25,759**	**5,188**	**6,382**	**2,393**	**712**	**221**	**40,655**	**100%**

Appendix A3: Summary of Estimate – In-Service Estimates				
$K	Only applicable to capital projects. In-Service amount shall include interest but exclude remo			
Project #	**Date (YYYY-MM-DD)**	**Description**	**Amount**	**%**
ABI83155	3/31/2022	G2 Unit and Headgate Placed in Service	26,921	87%
ABI83155	6/15/2022	G2 Unit and Headgate Placed in Service- Additional Discovery Work Complete	3,026	10%
ABI82520	6/15/2022	G2 Excitation System place in Service	933	3%
Total			30,880	100%

Prepared by:		**Reviewed and Endorsed by:**	
Pat Bourgouin Projects – TS5 Senior Project Leader	Date April 4, 2022	Tom Gauthier Projects – TS5 Section Manager	Date April 4, 2022

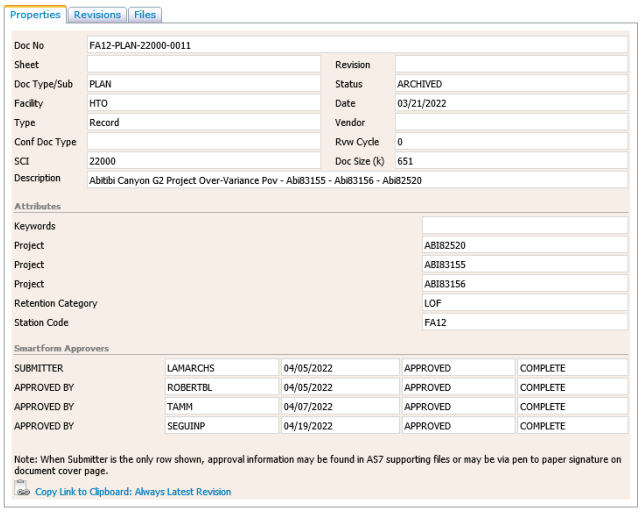
Project #: ABI83155 CAP, ABI83156 N/S, ABI82520 CAP
Project Title: Abitibi Canyon G2 Capital Upgrade, Overhaul, Head Gate Replacement & Exciter Installation
Document #: FA12-PLAN-22000-0011

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Project Over-Variance Approval

Approvals	Signatures	Date
Recommended by: Project Sponsor Bruce Robertson VP Operations – Eastern Region	Routed in Smart Form ID 00758166	See PowerSearch
Finance Approval: Maha Tam VP Controllership	Routed in Smart Form ID 00758166	See PowerSearch
Line Approval per OAR 1.1: Paul Seguin SVP Renewable Generation	Routed in Smart Form ID 00758166	See PowerSearch



Properties | Revisions | Files

Doc No	FA12-PLAN-22000-0011		
Sheet		Revision	
Doc Type/Sub	PLAN	Status	ARCHIVED
Facility	HTO	Date	03/21/2022
Type	Record	Vendor	
Conf Doc Type		Rvw Cycle	0
SCI	22000	Doc Size (k)	651
Description	Abitibi Canyon G2 Project Over-Variance Pov - Abi83155 - Abi83156 - Abi82520		

Attributes

Keywords	
Project	ABI82520
Project	ABI83155
Project	ABI83156
Retention Category	LOF
Station Code	FA12

Smartform Approvers

SUBMITTER	LAMARCHS	04/05/2022	APPROVED	COMPLETE
APPROVED BY	ROBERTBL	04/05/2022	APPROVED	COMPLETE
APPROVED BY	TAMM	04/07/2022	APPROVED	COMPLETE
APPROVED BY	SEGUINP	04/19/2022	APPROVED	COMPLETE

Note: When Submitter is the only row shown, approval information may be found in AS7 supporting files or may be via pen to paper signature on document cover page.

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Business Case Summary

Project #	83194	**BCS Document Number**	FA85-BCS-29400-0002
Project Title	83194 - FREDERICK HOUSE LAKE DAM REHABILITATION		
Facility	TIM - TIMMINS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2026-Jun-30
Estimate Class (Current Request)	Class 2	**Estimate Class (Overall Project)**	Class 2

Recommendation

We recommend a release of $86.05 M, including [redacted] contingency. This will bring the total release-to-date and total project cost to $90 M, including [redacted] contingency.

The estimated total project costs is $90 M.

The project is required to address deteriorated concrete, and corrosion and deformation of steel components impacting dam operations and its structural integrity. The project will rehabilitate the structure to ensure structural stability and safe operations, extending the service life by 50 years. This release is to carry out execution phase work, including construction, commissioning, and close-out.

The previous BCS release funded planning activities, including detailed engineering, cost and schedule development, and environmental assessment work.

Investment Cash Flows

Project Number	83194 - FREDERICK HOUSE LAKE DAM REHABILITATION					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	2,854	1,096							3,950
Currently Requested	0	27,179	41,658	16,403	810				86,050
Total released to date	2,854	28,275	41,658	16,403	810				90,000
Future required	0								0
Total Project Cost	2,854	28,275	41,658	16,403	810				90,000
Ongoing Costs	0								0

Total OAR Approval	90,000.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer	Nicolle Butcher	2023-05-25
I concur with the business decision as documented in this BCS.		

Business Case Summary

Finance Approval : **Aida Cipolla** **CFO & SVP - Finance**	Aida Cipolla	2023-05-25
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Ken Hartwick** **President & Chief Executive Officer**	Ken Hartwick	2023-05-29

EXECUTIVE SUMMARY – Project Overview

The Frederick House Lake Dam has been in service for 85 years and is exhibiting moderate to very severe deterioration of the concrete, and corrosion and deformation of the steel components associated with the flow control elements of the structure. These conditions represent a risk to the safe operation of the dam and therefore the dam needs to be rehabilitated to restore operational reliability and structural integrity. The rehabilitation will extend the dam's service life by 50 years.

The previous BCS funded planning phase activities, which included completion of engineering design in accordance with the current dam safety design standards and regulatory requirements, cost and schedule refinement, and significant engagement with local Indigenous communities and environmental regulators for project permitting.

This execution phase release will fund the preferred alternative, to rehabilitate the Frederick House Lake Dam.

The scope of work will include rehabilitating of the dam, improving dam stability, widening the dam to improve access, replacing the gains, sills, concrete decks and the associated components above the decks.

Key risks include as found conditions (mainly concrete structure) different from assumed conditions for design; more adverse sub-surface condition than expected; potential flood flows above the construction design flood conditions and permit applications. Risks have been mitigated through site investigations, construction planning, allocation of contingency, and consultation with Indigenous communities.

Business Need

For Project Level A or B

The Frederick House Lake Dam was constructed in 1937-1938, on the Frederick House River, a tributary of the Abitibi River. The dam consists of nine [9] sluiceways and two [2] gravity wall sections that provides storage and controls the water at Frederick House Lake and Night Hawk Lake, to support downstream generating facilities including Abitibi Canyon GS and Otter Rapids GS.

After 85 years in service, the dam is exhibiting moderate to very severe deterioration. Concrete cracking and deterioration have exposed reinforcing steel at many locations on the piers. The existing sluice gains and steel gates are in very poor condition with deformation, significant corrosion, and loss of material. There is excessive leakage around the gains at most sluiceways. In the near term, there is a concern that further deterioration may jeopardize the safe and reliable operation of the dam, especially the removal and installation of stoplogs. Ultimately if left unchecked, the deterioration could lead to failure of the gains resulting in an uncontrolled release of water. In addition, it was confirmed that the dam does not meet current dam safety criteria for stability.

Preferred Alternative:	Dam Rehabilitation	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is to rehabilitate the Frederick House Lake Dam, to restore its operational reliability and structural integrity.

The scope of work will include:

- Rehabilitating the concrete sluiceways and gravity walls,
- Widening the South and North Gravity Wall and heightening the North Gravity Wall to improve access,
- Replacing the gains, sills, stop logs, steel gates, bridge deck, gain covers, rails, guardrails and fall arrest systems,
- Improving the dam stability to be compliant with current dam safety regulatory requirements,
- Replacing existing safety control measures on the dam (fencing and gates),
- Installing civil instrumentation and surveillance instrumentation to monitor the ongoing performance of the dam,
- Other associated work, including temporary cofferdams, access road improvements to facilitate construction, and site cleanup and restoration.

Deliverables:			
Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Class Environment Assessment in order to obtain permits	PMM		2022-12-15
Gate 3 Approval	Gate G3 Approval		2023-04-27
Engineering design	Detailed Design Complete		2023-04-30
Execution BCS approved	Execution Business Case Summary (Partial or Full) Approved		2023-05-17
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Phase I Substantial Completion	Available for Service and/or Ready For Service Completed		2024-10-31
Phase II Substantial Completion	Available for Service and/or Ready For Service Completed		2025-09-30
Project Close Out	Project Close Out Completed		2026-06-30
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Executing the Base Case option will not ensure safe and reliable operation of the Frederick House Lake Dam.

Concrete deterioration and corrosion of the sluiceway gains pose significant risk to the on-going safe operation of the discharge facilities. Furthermore, this alternative will not address the deteriorating concrete conditions.

As the dam is reaching the end of its reliable service life, this option is not recommended.

Pros:

- No project expenditures required.

Cons:

- There is a high operational risk if the discharge cannot be effectively controlled due to poor concrete, gain condition, and excessive leakage.
- The facility will not meet dam safety regulatory requirements.
- The structural integrity and longevity of the facility will not be addressed. This structure is 85 years old and has not been rehabilitated to-date. As the structure continues to age, the structure will continue to deteriorate, further increasing the cost to maintain, and ultimately rehabilitate the structure.
- Access is still constrained and safety is not improved.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

This alternative would delay the execution of this work by 5 years. Proceeding with this option poses similar risk as mentioned in the Base Case alternative.

The condition of the structure is such that there are significant risks to on-going safe operation of the discharge facilities due to concrete deterioration and deformation of the sluiceway gains. The dam is reaching the end of its reliable service life. Given the level of deterioration of the concrete and observed condition of the steel gains supporting the stop logs, there is effectively no 'interim' measures that would temporarily extend the service life and ensure reliable operation. Therefore, this option is not recommended.

Pros:

- Delays to project expenditure.

Cons:

- Safe and reliable operation of the dam will continue to deteriorate unabated.
- The costs to carry out the work would be expected to increase over time, the scope may increase, and the future cost will be higher.
- The facility will not meet dam safety regulatory requirements.

Alternative 4:	**Replace Dam**	For Project Level A, B

This alternative would ensure service life is extended beyond 50 years. However, the cost will be considerably higher than the Preferred Alternative. Also, demolition would unnecessarily waste the sound portions of the concrete structure that are still meeting the gravity dam design requirements. Finally, this alternative is also expected to require additional time to complete. Therefore, this alternative is not recommended.

Pros:

- Replacement of the dam will provide long term structural integrity, require less maintenance and continue to provide valuable operation and water storage to support downstream generation.
- Compliance with the current dam safety regulatory requirements.

Cons:

- Significant additional project cost and additional time expected to complete compared to the preferred alternative.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Technical	As found condition is different from the assumed conditions as shown on the design drawings.	Mitigate 58924 - OPG to review the condition during the execution to manage scope. 9/30/2025	Medium
Technical	Adverse geotechnical/geological conditions discovered are different from Geotechnical Baseline Report and Bathymetry Reports.	Mitigate 57969 - OPG/Owner's Engineer to review adverse conditions as they arise to manage scope increase. 9/30/2025	Medium
Environmental	Flood or Flow Management.	Mitigate 58920 - Flood management emergency plan will be prepared to pass flows above Construction Design Flood (CDF). 9/30/2025	Medium
Project Management	First Nations groups claim failure to Consult adequately which may impact future project permitting.	Mitigate 59671 - Project will continue to engage with Indigenous Relations and Regulators for timely permitting. 12/31/2023	Medium

Additional Risk Analysis — For Project Level A or B

An Execution Phase Risk Register has been developed and includes a quantitative risk assessment (i.e. Monte Carlo analysis). Cost contingencies were established based on the results of the Monte Carlo simulation with a 90% confidence level.

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Not required for Scale B Sustaining Project.

Qualitative Factors For Project Level A or B

The preferred alternative aligns with OPG's mission "to build a sustainable future powered by our electricity, ideas and people".

Social License:
Compliance with the current dam safety regulatory requirements will maintain good relations with regulatory agencies and maintain the dam in good operating condition limiting potential impacts to water levels and flows to surrounding stakeholders.

In addition, this work will provide employment and business opportunities to local and Indigenous communities during the construction phase.

Operational excellence:
Rehabilitation will provide long term structural integrity, improve reliability, safety and minimize future maintenance costs.

Project Excellence:
The Project has completed all required Planning Phase activities, under budget and on schedule. The detailed design and environment assessment are completed, and the Class 2 estimate and Level 3 Milestone schedule have been obtained. Therefore, the project is more defined to proceed to the execution phase.

Financial Strength:
The project will invest in an asset that will continue to provide valuable water storage for Abitibi Canyon GS and Otter Rapids GS by facilitating time shifting water flow to the generating stations.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2026-06-30

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
The dam is rehabilitated to meet current dam safety design standards and regulatory requirements.	The dam does not meet current dam safety design standards and regulatory requirement.	The dam is rehabilitated to meet current dam safety design standards and regulatory requirements.	OPG to review Owner's Engineer's Dam Safety Design Report, design, and technical specifications – which are to be prepared with sufficient detail to support Lake and River Improvement Act S-16 approval. The construction is to be carried out as per design, Owner's Engineer to prepare record drawings and a project completion report to document the construction meets design requirement.	Confirmation provided by Owner's Engineer to satisfaction of Dam Safety and Civil Engineering Management of the process by RG Projects

Extend the existing dam service life by 50 years.	The dam is reaching the end of its service life.	The dam is rehabilitated in accordance with the drawings and technical specification.	OPG to review Owner's Engineer's detailed design drawings, reports and technical specifications. The construction is to be carried out as per design, Owner's Engineer to prepare record drawings and a project completion report to document the construction meets design requirement. All quality related issues to be properly addressed as per Quality Management Plan and documented	Confirmation provided by Owner's Engineer to satisfaction of Dam Safety and Civil Engineering Management of the process by RG Projects
The new flow control components, including the gains, sills, stop logs, rails, and gain covers etc., are successfully tested and commissioned.	Due to corrosion of the steel and concrete deterioration, the operation is not reliable.	The new structure will provide reliable operation for another 50 years	Conduct dry and wet commissioning tests. Wet commissioning test to meet the requirement of Dam Safety Design Review in the sluiceways.	Confirmation provided by Owner's Engineer to satisfaction of Dam Safety, Northeast Operations and Civil Engineering Management of the process by RG Projects
Improve the access and safety	The access is limited, heavy equipment cannot access to the sluiceways.	The access is improved. New fall arrest, deck, and gain covers are new with proper loading capacity.	Organize Constructability, Operability and Maintainability and Safety Review (COMS) Review Workshop with Production and Operation stakeholders. and document the results. Design review with internal stakeholders. Field walk down during construction. Final commission tests, acceptance, and turnover.	Confirmation provided by Owner's Engineer to satisfaction of Dam Safety, Northeast Operations and Civil Engineering Management of the process by RG Projects
Social engagement	Engage indigenous communities in environment assessment process.	Continue engage indigenous in permit process. Additional engagement includes business opportunities, employment, training etc.	Follow the Social Engagement Plan (min. 5% spending in Indigenous goods and services, including employment and training of indigenous workers etc) in accordance with the agreement between OPG and the Contractor. The performance is tracked monthly.	Management of the Social Engagement by RG Projects, Indigenous Relations and Northeast Operations

Definitions and Acronyms	
PMM	Project Manager's Milestone

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	83194 - FREDERICK HOUSE LAKE DAM REHABILITATION						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**	**%**
0 - Cost Management		1,725	1,555	1,280					4,560	5
1 - Project Management	1,188	5,582	5,746	3,376	707				16,599	18
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	2,854	28,275	41,658	16,403	810				90,000	100
Removal Costs (incl. above)		758	2,645						3,403	4

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
83194	2024-10-31	Phase I Substantial Completion	34,507	44.5
83194	2025-09-30	Phase II Substantial Completion	42,119	53.0
83194	2026-06-30	Final completion	2,255	2.5
		Total:	**78,881**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Pranav Jindal Senior Manager Projects North East Projects	2023-05-19	Mike Martelli Chief Projects Officer Enterprise Projects	2023-05-23

ONTARIO POWER GENERATION

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OPG-FORM-0076-R006*

Business Case Summary

Project #	83495, 83371	**BCS Document Number**	NA9-BCS-08707-1658535
Project Title	83495 - SAU - G9 CAPITAL REFURBISHMENT 83371 - SAU - MECH/ELEC UNIT OVERHAULS		
Facility	SAU - RH SAUNDERS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES 62030 - OM&A - PROJECT
Release: Gate and Project Phase	G3 - Execution - (Superseding)	**Target Project Completion Date**	2026-Jun-29
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a bundled release of $7,302k, including [redacted] of contingency. This will bring the total release to-date to $59,802k including [redacted] of contingency.

Breakdown of each project specific release (including contingency) as follows:

SAU83495 (Capital): $7,302k, including $[redacted] of contingency bringing the total release to-date to $42,688k
SAU83371 (Non-Standard): Release remains unchanged and is included in this BCS for consistency, total release to-date to $17,114k including [redacted] of contingency.

The total project cost is now estimated at $59,802k, compared to $52,500k in the previous superseding release, including contingency. The additional funding is required to return G9 to service following an unexpected bearing failure that occurred during unit commissioning on October 26, 2024.

The scope of this superseding release includes:
-Disassembly/reassembly of G9 to replace the thrust bearing
-Procurement of new a new bearing, materials and associated equipment
-Project management and engineering oversight needed to support the work

These two projects are for the refurbishment/overhaul of Generator Unit 9 at R.H. Saunders Generating Station. This release will fund the remaining execution scope of work to restore the integrity, reliability, and long-term viability of this generator for approximately the next 25 years.

Investment Cash Flows

Project Number	83371 - SAU - MECH/ELEC UNIT OVERHAULS					**FAC**	62030 - OM&A - PROJECT		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	16,639	475							17,114
Currently Requested	0								0
Total released to date	16,639	475							17,114
Future required	0								0
Total Project Cost	16,639	475							17,114
Ongoing Costs	0								0

Project Number	83495 - SAU - G9 CAPITAL REFURBISHMENT	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

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Business Case Summary

$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total
Previous releases	33,620	1,766							35,386
Currently Requested		6,545	757						7,302
Total released to date	33,620	8,311	757						42,688
Future required									
Total Project Cost	33,620	8,311	757						42,688
Ongoing Costs									

Total OAR Approval	59,802.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicholas Pender SVP Renewable Generation& Energy Markets SVP RG & PM	Nicholas Pender	2025-05-15
I concur with the business decision as documented in this BCS.		
Finance Approval : Alec Cheng SVP Chief Controller & Acctng Offcr	Alec Cheng	2025-05-20
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Shelley Babin Chief Operations Officer	Shelley Babin	2025-05-20

EXECUTIVE SUMMARY – Project Overview

ONTARIO POWER GENERATION

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Business Case Summary

R.H. Saunders Generating Station (GS) is a “Flagship” asset in OPG’s fleet of hydroelectric stations, providing 1000MW of emissions free energy to Ontario. The objective of this project is to restore the integrity, long-term reliability and ensure the continued availability of the sixteen generating units at R.H. Saunders GS. The most recent mechanical and electrical overhauls of the turbine and generators (all 16 units) were completed during the 1990s and early 2000s. Components included and those not included in the last overhaul project are nearing end of life showing deteriorating condition and causing increased forced unit outages. These components and unit auxiliary electrical and mechanical systems require refurbishment or replacement in order to meet the project objectives of:

- Restore integrity, long-term reliability and ensure the continued availability of unit 9 at RH Saunders GS,
- Address deteriorating condition of the components,
- Re-establish rotor-stator air gap and runner-discharge ring clearances, and
- Reduce risk of thrust bearing failures.

The R.H. Saunders GS refurbishment program has been organized as unitized projects. Each generating unit will have a capital and non-standard release with individual project numbers. The capital refurbishment G9 (SAU83495) project scope will include system upgrades and new installations (major equipment refurbishment and replacement). The non-standard overhaul G9 (SAU83371) project scope includes significant cleaning and repair of generator and turbine components (major equipment maintenance).

The previous bundled releases funded project management, engineering design, construction, and commissioning and the following major project deliverables and milestones have been completed:

- Materials procurement,
- Unit disassembly,
- Discharge ring removal, draft tuber liner removal, and pivot ring removal,
- Stay ring machining and refurbishment including post stay ring machining measurements and adjustments,
- Turbine component re-machining,
- Pivot Ring and Outer Head Cover Line Boring,
- Lead paint abatement,
- Discharge ring installation, draft tube liner installation, and pivot ring installation,
- Unit re-assembly,
- Turbine runner installation,
- Servo motor installation,
- Completion of electrical and mechanical auxiliary systems final installation including turbine pit electrical and mechanical systems installation,
- Governor overhauls,
- Component re-alignment and unit re-assembly, and
- Electrical/mechanical auxiliary systems (e.g. oil piping, brake systems, unit control field devices and control panels, etc.) and governor commissioning

On October 26, 2024, during the first speed no-load run of commissioning, G9 was shut down due to high thrust bearing temperatures. Upon investigation the high temperature was caused by a thrust bearing wipe. As a result of this event, this new bundled release will be used to complete the work necessary to return G9 to service, including:

- Disassembly/reassembly of G9 to replace the thrust bearing
- Procurement of new bearings, materials and associated equipment
- Project management and engineering oversight needed to support the work.

Changes identified following the bearing failure to prevent the likelihood of a repeat failure include adjusting the new thrust bearing spring arrangement to allow for increased oil film thickness in addition to modifying the runner plate surface roughness to allow for better performance. Although PTFE bearing material is typically preferred, due to long procurement lead times, the new bearing will be of babbitt surface material which is what has been used in the past and historically, has proven to be reliable. A high-pressure oil lift system is also being installed (which is typical for babbitt type bearings) to ensure adequate oil between the bearing pads and the runner plate upon start-up.

Key Risks:

1. Thrust Bearing Failure Upon Start-up: This risk is being mitigated though the adjustment of the thrust bearing springs to allow for higher oil film thickness and by modification of the runner plate surface roughness to ensure better performance. The replaced bearing is babbitt type which Saunders GS has many years of operating experience without reliability concerns on General Electric units. A high pressure oil lift system is being installed to ensure that upon start-up there is adequate oil between the bearing pads and the runner plate.

Business Need For Project Level A or B

ONTARIO POWER GENERATION

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Business Case Summary

A hydroelectric generating unit requires a major electrical and mechanical overhaul approximately every 25 years. The most recent mechanical and electrical overhauls of the RH Saunders GS 16 units turbine and generator were completed during the 1990s and early 2000s. The turbine and generator components have experienced unique operational issues and structure damage for many years, such as reduced generating unit clearances, discharge ring deformation, concrete structure cracking, relative movement of structural members, and powerhouse water leakage. These issues are caused by Alkali-Aggregate Reaction (AAR), which is a chemical reaction that induces concrete growth. Impact of AAR is being addressed by other investments outside of this project.

A Pre-Overhaul Condition Assessment, which examined major water-to-wire electrical, mechanical, and civil equipment and structures to provide a basis for this project scope. From the technical condition assessment, the following major work was recommended on all units at R.H. Saunders GS:

• Turbine – major overhaul, new servomotors, replace discharge ring;
• Turbine Regulation – repair and rehabilitate Woodward Cabinet Actuators;
• Generator – major mechanical/electrical overhaul, re-wedge stator and re-shrink rotor as required, rehab field poles and field circuit components, replace CTs, replace neutral grounding system, replace surface air coolers, cooling system upgrades;
• Electrical Auxiliaries – replace, refurbish, upgrade systems as required including the online monitoring system;
• Scrollcase and Draft Tube – grouting and sealing;
• Turbine - new upgraded runner.

New runners are being procured under a separate Capital project SAU83104 and will be installed concurrently under this project during the refurbishment outage.

Preferred Alternative:	Complete G9 Refurbishment with additional budget	For Project Level A, B or C

Description of Preferred Alternative

It is recommended to proceed with the replacement of the G9 thrust bearing using additional budget to complete and return G9 to service after completing the approved scope of work. Executing the work will restore reliability to - end of life - components and systems and meet the stated project objectives.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Execution Partial Release	Gate G3A Approval		2020-12-16
Execution Full Release	Gate G3B Approval		2022-08-10
G9 Breaker Open	Start of Outage		2023-01-09
Reassembly Finish	Finish of Installation		2024-07-26
Superseding Release	Gate G3C Approval		2024-08-27
Turbine Pit Electrical/Mechanical Systems Installation Finish	Finish of Installation		2024-09-13

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Superseding Release	Gate G3D Approval		2025-05-30
Thrust Bearing Replaced & Unit Reassembly Complete	Finish of Installation		2025-06-27
Commissioning Complete	Commissioning Finished		2025-07-09
G9 Available for Service	Available for Service and/or Ready For Service Completed		2025-07-14
Project Closeout Report Approved	Project Close Out Completed		2026-06-29

Future Release: N/A

Business Case Summary

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
This alternative is not a viable option because G9 is not returned to service and funding is exhausted.		

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
This alternative is not a viable option because G9 is currently disassembled and needs to be reassembled, commissioned and returned to service to start producing electricity and place new capital assets in service to realize the benefits of the project objectives		

Alternative 4:	For Project Level A, B

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Technical	Thrust Bearing failure	Mitigate	Medium

Additional Risk Analysis — For Project Level A or B

Risks have been reviewed, modified, added to, and completed over the life of the project to date. Contingency for this release is based on remaining risks to the project.

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$K	Alternative	Base Case (No Project)	Delay Work	Alternative 4	Alternative 5
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation is not required for Scale B Sustaining Projects.

Qualitative Factors — For Project Level A or B

Execution of the preferred alternative will result in the following qualitative benefits:
- Restore integrity, long-term reliability and ensure the continued availability of the generating units at RH Saunders GS for another 25 years,
- Re-establish rotor-stator air gap and runner-discharge ring clearances,
- Reduce risk of thrust bearing failures,
- Implement component and system design improvements to improve health and safety and operational performance.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2027-06-29

ONTARIO POWER GENERATION

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Business Case Summary

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Cost Performance	$59,802k	$59,802k	Measured against the total bundled release based on the final project cost as reported on the Project Closure Report	Southeastern Operations Project Management
Schedule Performance	July 15, 2025	July 15, 2025	Measured through baseline variance schedule in P6	Southeastern Operations Project Management
Safety Performance	0 Lost Time Injury (LTI)	0 Lost Time Injury (LTI)	Safety Reporting through MyEHS	Southeastern Operations Project Management
Quality Performance	All NCRs Closed	All NCRs Closed	Monitored through NCR log	Southeastern Operations Project Management

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	83371 - SAU - MECH/ELEC UNIT OVERHAULS						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management										0
1 - Project Management	2,285	13							2,298	13
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	16,639	475							17,114	100
Removal Costs (incl. above)										0

Project Number	83495 - SAU - G9 CAPITAL REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management	230								230	1
1 - Project Management	5,502	1,219	46						6,767	16
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

Business Case Summary

Interest	[redacted]									
Other										
Total	33,620	8,311	757						42,688	100
Removal Costs (incl. above)	650	350							1,000	2

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**2.50**	**Interest Rate (going-forward)**	**3.96**

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
83495	2025-08-22	G9 Return To Service REIS	36,338	95.0
83495	2026-06-29	Project Closure Report In-Service	1,350	5.0
		Total:	**37,688**	**100**

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Codie Lonsberry Senior Manager Projects Saunders Projects	2025-05-09	Amanda Griener Director Asset & Project Mgmt Production Support	2025-05-12

Appendix B: Total Project Estimate Variance Analysis$K — **(Only required when more than one Execution Phase BCS)**

Phase Gate	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total
SAU83495 Superseding BCS September 2024	35,266	120							35,386
SAU83371 Superseding BCS September 2024	17,064	50							17,114
SAU83495 Superseding BCS 2025	33,620	8,311	757						42,688
SAU83371 Superseding BCS 2025	16,639	475							17,114

Total Project Estimate Variance Explanation

The superseding release approved in September 2024 was required due to unforeseen challenges and scope deviations. Initially estimated based on recent Eastern Region projects, the G9 refurbishment encountered significantly different as-found conditions, necessitating unexpected repairs. Larger components and unique project elements, not previously experienced, added complexity and discovery work, prompting design and construction changes. Lessons learned are being applied to future projects.

This superseding release additional funding is required to complete the project as a result of an unanticipated bearing wipe that occurred on October 26, 2024 during commissioning.

Appendix C: Financial Evaluation Assumptions — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

Key assumptions used in the financial model of the project are:

Not applicable -- project is a sustaining investment

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Business Case Summary

Project #	SLV83833 (SILF0037)	**Controlled Doc #**	P21-BCS-08707-0894517
Project Title	Surge Tank Replacement		
Facility	Silver Falls GS	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Choose an item. G0☐: Initiation ☐ Full G1☒: Planning		☐ Choose an item. G2☐: Definition ☐ Choose an item. G3☐: Execution
Estimate Class (overall project)	Class 5	**Target Project Completion Date**	December 2023

Recommendation

We recommend a release of $850K, including [redacted] of contingency.
The estimated total project cost range is between $10,000K and $30,000K.

This release is to complete planning phase activities including:

- Detailed project estimate
- Scope Development
- Technical Specifications
- Execution Release, etc.

Investment Cash Flows

$K	LTD	2021	2022	2023	2024	2025	2026	Future	Total
Previous releases									-
Current request	-	250	600						850
Total released to date	**-**	**250**	**600**	**-**	**-**	**-**	**-**	**-**	**850**
Future required	-		7,000	12,000	150				19,150
Total Project Cost	**-**	**250**	**7,600**	**12,000**	**150**	**-**	**-**	**-**	**20,000**
Ongoing Costs	-								
					Gate:	**G1**	**OAR Approval:**		$850 K

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Brian Dietrich Director Asset Management & Project Management – Production Support	Routed in Smart Form for Approval (ID#00611199)	
I concur with the business decision as documented in this BCS.		
Finance Approval: John Sim Controller – Western Region	Routed in Smart Form for Approval (ID#00611199)	
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: Dwayne Korchak Director of Plant Operations - East	Routed in Smart Form for Approval (ID#00611199)	

Project #: SLV83833 (SILF0037)
Project Title: Surge Tank Replacement
Document #: P21-BCS-08707-0894517

Business Case Summary

EXECUTIVE SUMMARY – Project Overview
Silver Falls Generating Station has a standpipe type differential surge tank that serves as a regulator of water flow and pressure for station's hydroelectric units. The Silver Fall Surge Tank was built in 1958, and since then, no major rehabilitation or repair work has been conducted for the tank. The Silver Falls Surge Tank is approaching the end of its service life. The surge tank is an essential component in the water conveyance system and its functionality is crucial to the operation of the generating station. Left as is, the issue would inevitable lead to more frequent and longer forced outages at the Silver Falls GS, and the surge tank would eventually become non-repairable, severely affecting generation and revenue. The 2019 Silver Falls Surge Tank Condition Assessment (Doc #: P21-REP-29800-1) was tasked with providing alternatives for asset investment options to ensure the generating station can continue its reliable and safe operation. Tank elimination, rehabilitation, and replacement were all assessed as alternative investment options within the report, but it was recommended to proceed with the replacement option (with a design life expectancy larger than 50 years) as it is the least financially risky choice and in the end will be the least costly of all the alternatives, providing the best value to Ontario ratepayers. This project release will be utilized to complete planning phase activities that will include detailed project estimates, further scope development, and identification of technical specifications to support the execution phase of the project.

Preferred Alternative:	**Surge Tank Replacement**	For Project Level A, B or C
Description of Preferred Alternative		
The preferred alternative to address the Surge Tank's end of service life is tank replacement. The 2019 Silver Falls Surge Tank Condition Assessment (Doc #: P21-REP-29800-1) performed a risk-benefit analysis that revealed the replacement option is twice more preferred than the rehabilitation option. The replacement options would result in a design life expectancy larger than 50 years. Given the uncertainty in the rehabilitation cost estimates, due to unforeseen variables that would affect rehabilitation efforts over a 50 year period, the risk associated with rehabilitation is not worth its cost benefit advantage. It is most likely that within the next 50 years, rehabilitation costs would be larger than the costs associated with the current replacement option. This does not even take into account the loss of revenue for unplanned shutdowns that would take place to execute rehabilitation efforts. The risk-benefit analysis performed for Aguasabon surge tank (Doc #: P27-REP-29800-0002) was used to derive the results for Silver Falls surge tank given the similarity between the two tanks. According to the risk-benefit analysis performed, it is recommended to proceed with the replacement option since it delivers the best risk benefit value for the money and for the ratepayer of Ontario.		

Deliverables:	**Associated Milestones (if any):**	**Target Date:**
Previous releases:		
N/A		
Current release:		
Planning Phase BCS	G1	Feb 2021
Future release:		
Execution Phase BCS	G3	Jun 2022
In-Service Turnover	G4	Dec 2023

Project #: SLV83833 (SILF0037)
Project Title: Surge Tank Replacement
Document #: P21-BCS-08707-0894517

Business Case Summary

Key Risk Assessment			For Project Level A, B or C	
Risk Class	**Description of Risk**	**Response Type/ Actions/Final TCD**	**For Additional Review**	**Residual Ranking**
Cost	The existing Class 5 estimates come with high project cost variances that may translate into cost overruns given the scale of the project expenditures.	Mitigate: Cost estimate will be supported by existing similar project that is about to beginning execution. **Final TCD: November 2022**	No	Low
Schedule	If engineering schedule experiences delays it could push back construction schedule.	Mitigate: • Maintain bi-weekly meeting and schedules updates with Engineering. Hold team members accountable for delivery dates. **Final TCD: November 2022**	No	Low

Post Implementation Review (PIR) Plan (refer to OPG-PROC-0056)			
Type of PIR Report	Choose an item.	**PIR Completion Date**	TBD at G3
☐ Detailed PIR KPIs will be provided in future BCS(s) when Choose an item. Phase BCS release is requested.			

PIR KPIs	**Current Baseline**	**Target Result**	**How to measure?**	**Who will measure?**

Definitions and Acronyms
[Delete this section if not needed. See Guidance]

Project #: SLV83833 (SILF0037)
Project Title: Surge Tank Replacement
Document #: P21-BCS-08707-0894517

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Business Case Summary

APPENDICES

Project Number:	SLV83833 (SILF0037)									
Project Title:	**Surge Tank Replacement**									
$K	**LTD**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Future**	**Total**	**%**
Project Mgmt		25	50	50	50				175	1%
Inspection										
Engineering										
Procurement										
Construction										
Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	**-**	**250**	**7,600**	**12,000**	**150**	**-**	**-**	**-**	**20,000**	**100%**
Removal Costs (incl. above)				1,000					1,000	5%

[redacted]

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	3.0%	**Interest Rate (going-forward)**	3.51%

Appendix A3: Summary of Estimate – In-Service Estimates

$K Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project #	Date (YYYY-MM-DD)	Description	Amount	%
SLV83833		Silver Falls GS - Surge Tank Replacement	TBD	0%
				0%
Total			-	0%

Prepared by:	**Reviewed and Endorsed by:**
Routed in Smart Form for Approval (ID#00611199)	Routed in Smart Form for Approval (ID#00611199)
Chad Tanner	Darryl Flank
Program Coordinator/Advisor Date	Section Manager - Projects Date

MyDocs Approvers

SUBMITTER	TARABOCK	02/16/2021	APPROVED	COMPLETE
PREPARED BY	TANNERC	02/16/2021	APPROVED	COMPLETE
REVIEWED BY	FLANKD	03/07/2021	APPROVED	COMPLETE
RECOMMENDED	DIETRICB	03/08/2021	APPROVED	COMPLETE
FINANCE APPR	SIMJOHN	03/18/2021	APPROVED	COMPLETE
LINE APPR	KORCHAKD	03/18/2021	APPROVED	COMPLETE

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Business Case Summary

Project #	BK1 84185	**Controlled Doc #**	NF20-PLAN-08707.021-0032
Project Title	SAB1 – G1/G2 Replacement		
Facility	Sir Adam Beck I G.S.	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Choose an item. G0☐: Initiation ☐ Choose an item. G2☐: Definition ☐ Choose an item. G1☐: Choose an item. ☒ Full G3☐: Execution		
Estimate Class (overall project)	Class 2	**Target Project Completion Date**	2022-12-31

Recommendation

We recommend the release of $87.7M, including $6M of contingency. A previous Development Phase BCS released $32.0M including $2.2 M of contingency, bringing the full project release to $119.7M, including $8.2M of contingency.

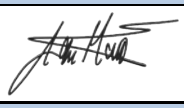
This release is to fund the procurement and installation of two new generating units (G1 & G2) at Sir Adam Beck I GS (SAB1), specifically:

- Installation of new generator, exciter, transformer, buswork, breakers, switches and protection & control systems for each unit.
- Replacement of all turbine components between the remaining embedded concrete draft tube and scrollcase.
  - New turbine, turbine shaft, headcover, stay vanes, discharge ring, turbine bearing, draft tube extension, wicket gates, gate arms, links and control ring and governor system for each unit.
- Refurbishment of the three G2 Headgates (refurbishment of G1 headgates was done in FEED phase to facilitate inspections of the penstocks).

The proposed units will have a nameplate of 56.4 MW each, for a total of 112.8 MW of new generation at SABI.

Investment Cash Flows

$K	LTD	2019	2020	2021	2022	2023	2024	Future	Total
Previous releases (Cap)		24,832	327						25,158
Previous releases (OM&A)		3,865							3,865
Current request (Cap)	-	(3,329)	45,815	40,611	7,498				90,595
Current request (OM&A)	-	90							90
Total released to date	**-**	**25,457**	**46,141**	**40,611**	**7,498**	**-**	**-**	**-**	**119,708**
Future required	-								-
Total Project Cost	**-**	**25,457**	**46,141**	**40,611**	**7,498**	**-**	**-**	**-**	**119,708**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$119,708 K

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Michael Martelli President, Renewable Generation		22 October 2019
I concur with the business decision as documented in this BCS.		
Finance Approval: John Mauti Chief Finance Officer & SVP Finance		22/10/19
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: Ken Hartwick President & Chief Executive Officer		Oct 23/19

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
Document #: NF20-PLAN-08707.021-0032

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Business Case Summary

EXECUTIVE SUMMARY – Project Overview

Business Need:

Execution of this project will increase the capacity of the SAB1 generating station's supply of clean, renewable, cost effective generation in accordance with the mandate of OPG and consistent with the 2017 Long Term Energy Plan. This is an opportunity to replace the G1 and G2 units and increase the peaking capacity of renewable energy in the Province prior to the closure of the Pickering Nuclear GS and the upcoming Sir Adam Beck2 GS overhauls. It will leverage existing facilities and infrastructure at the Beck Complex to provide increased operational flexibility at a lower cost alternative to constructing greenfield generation (i.e. new combined cycle thermal station).

Summary of Preferred Alternative:

- Removal of existing 25 Hz G1 and G2 units and all associated equipment.
- Installation of new generator, exciter, transformer and protection & control systems for each unit.
- Replacement of turbine components between the remaining embedded concrete draft tube and scrollcase (new turbine, turbine shaft, headcover, stay vanes, discharge ring, turbine bearing, draft tube extension, wicket gates, gate arms, links and control ring) and governor system for each unit.
- Procurement and site installation of headworks and tailrace stoplogs for isolation during G1/G2 construction.
- Refurbishment of G1 and G2 Headgates.
- Inspection and repairs of remaining embedded components (penstocks, scrollcase & draft tubes).
- Replacement of electrical and control components on the SAB1 Powerhouse cranes.

The project will be funded as Capital, with the exception of G1 and G2 removals, which will be funded as OM&A.

Current Project Status:

The project is currently in Definition phase. Detailed engineering design is 75% complete, and the existing G1/G2 units and associated equipment have been removed from SAB1. The penstock, scrollcase and draft tube inspections have been completed. Approximately $3.8M in long lead procurement has been authorized and was included in the $32.0M Definition phase release. The Target Price for execution phase was negotiated in Q1 2019 and based on additional information through Definition phase and discovery work on embedded components, is expected to increase by $13.8M. Overall project cost estimate is $119.7M.

Key Risks:

The project is completely replacing the G1 and G2 units but is relying on 100 year old embedded components. Specifically, penstocks, scroll cases and draft tubes. These components have been thoroughly examined during the Definition phase (after removal of the old G1/G2 units) and issues have been identified with the penstocks and scrollcase flanges. Repair estimates have been received and have been included as an allowance in the project estimate. The residual risk of discovery work is low.

SAB1 has limited workspace, and many planned and in-flight projects. The G1/G2 Project coordinates weekly integration meetings at the management level, as well as trades level, including contractors to minimize disruptions and interference between projects. Integration with other projects will continue to be a risk to the project in execution phase, but it will be mitigated in the same fashion.

The project is also dependant on the Hydro One (HONI) switchyard replacement project. This project is currently replacing the end of life switchyard (E-bus), which is fully within the generating station building envelope, as well as increasing ampacity on the circuits for the additional G1/G2 generation. Key milestones from the HONI project schedule have been incorporated into the overall G1/G2 schedule for integration and interface management.

Business Need

For Project Level A or B

Execution of this project will increase the capacity of the SAB1 generating station's supply of clean, renewable, cost effective generation in accordance with the mandate of OPG and consistent with the 2017 Long Term Energy Plan. Replacing SAB1 G1/G2 will increase the peaking capacity of renewable energy in the Province prior to the closure of the Pickering Nuclear GS and the upcoming SAB2 GS overhauls. The Project leverages existing facilities and infrastructure at the Beck Complex to provide increased operational flexibility at a lower cost alternative to constructing greenfield generation (i.e. new combined cycle thermal station). Outside of peaking, G1/G2 will also be able to use additional water which will be available at the SAB Complex during the 31 planned overhauls at SAB1, SAB2 and PGS between 2023 and 2041.

The energy and capacity at the SAB complex were modeled with and without G1/G2 and the Pump Generating Station (PGS) diffuser flaps available, using 100 years of historical rivers flows. The models also took into account winter and summer (tourist) flows diverted from the Niagara River to the Complex for generation (diversion flows).

G1/G2 peaking capacity can be utilized when diversion flows are above 1,600 cms (occurs approximately 50% of time during peak summer hours). In contrast, PGS Diffuser Flaps peaking capacity is available when diversion flows are less than 1,600 cms. When diversion flows are lower, the PGS diffuser flaps (currently being re-instated) will provide an additional 180 cms of flow to G1 & G2. The combination of replacing G1/G2 units and re-instating the PGS diffuser flaps (4

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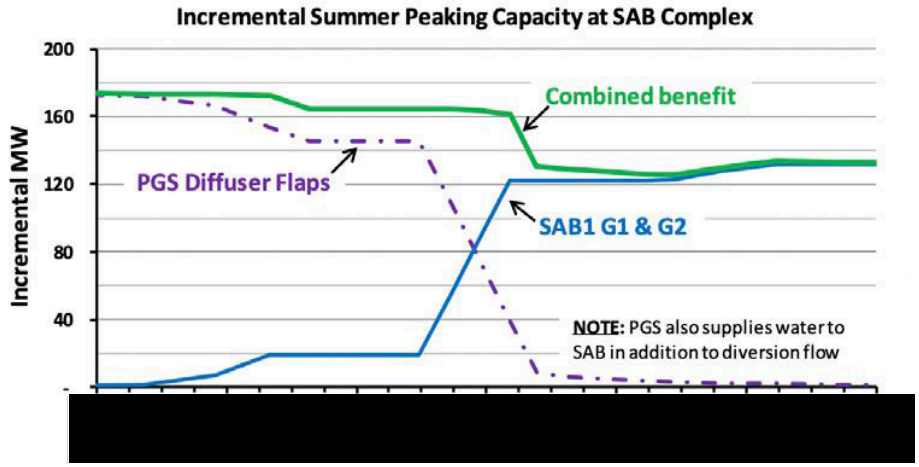
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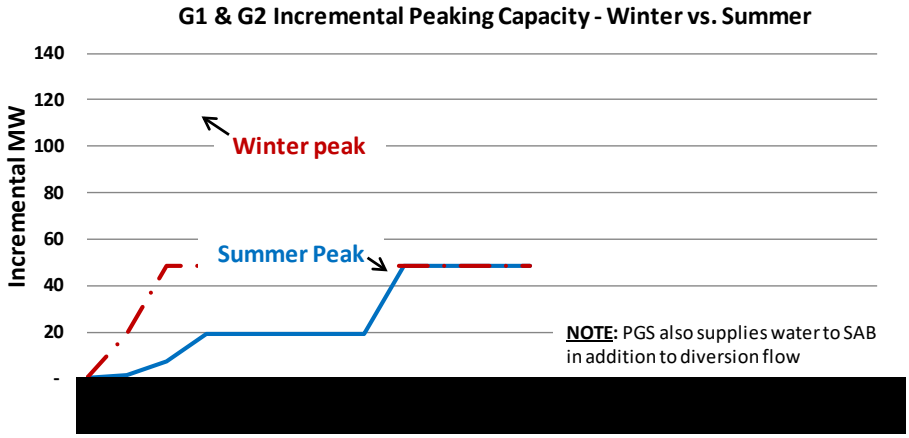
Business Case Summary

Business Need — For Project Level A or B

of 6 completed to-date) provides at least 125 MW of peaking capacity under all anticipated flow conditions. Based on the past 100 years of available summer diversion flows, G1/G2 will provide an average of 76 MW of peaking generation.

System Economic Values (SEVs) were used to value incremental energy and summer peaking capacity. Results show that G1/G2 in combination with the use of PGS Diffuser Flaps has a $144M net present value (NPV) over 75 operating years. See graphs below for the model output of the anticipated incremental summer peaking capacity at SAB complex.





[redacted]

[redacted]

Preferred Alternative:	**Convert G1 & G2 to 60 Hz 56.4 MW Units**	For Project Level A, B or C

Description of Preferred Alternative

The Preferred Alternative meets the business needs with the most effective MW output and provides reduced project risk and on-going maintenance costs. Restoring G1 and G2 to service will make use of existing assets and infrastructure at the Beck Complex and provide a source of low-cost green energy while increasing operational flexibility of the electricity system.

The preferred alternative includes the following scope:

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Business Case Summary

Preferred Alternative:	**Convert G1 & G2 to 60 Hz 56.4 MW Units**	For Project Level A, B or C

Description of Preferred Alternative

- Removal of existing 25 Hz units G1 and G2 and associated equipment.
- Installation of new generator, exciter, transformer and protections and control systems for each unit.
- Replacement of the turbine components between the remaining embedded concrete draft tube and scrollcase (new turbine, turbine shaft, headcover, stay vanes, discharge ring, turbine bearing, draft tube extension, wicket gates, gate arms, links and control ring) and governor system for each unit.
- Procurement of forebay and tailrace stop logs to provide isolation during the project, they will become station spares at the end of the project.
- Refurbishment of the six G1 & G2 headgates (3 per unit).
- Inspection and repairs of remaining embedded components (penstocks, scrollcase & draft tubes).
- Replacement of electrical and control components on the SAB1 Powerhouse cranes.

Contracting and Procurement Strategies were developed with the key objectives of controlling cost and schedule growth, sharing risks/opportunities with the Contractor and ensuring the Contractor will meet the Project deliverables within the project deadlines. The project consists of two phases:

Phase 1 (Previous Release):

- Phase 1 consists of the front-end engineering design (FEED), procurement of long lead time items, dismantling of the old units, and technical assessment of the water conveyance structures and existing concrete foundation of the stator to help mitigate the risk of discovery work during execution (Phase 2). The work started in December 2018 (with a Limited Notice to Proceed to the successful proponent) and will be substantially completed by March 2020.
- A fixed price or “lump sum” strategy was chosen mainly due to the well-defined project deliverables on the dismantling and design scope. The engineering design is considered core work for the Contractor.

Phase 2 (This Release):

- Phase 2 will consist of the fabrication and installation of new G1 & G2 units. The work is scheduled to start in July 2020, with in-service dates for G2 in Q4 2021 and G1 in Q1 2022.
- A blend of target and fixed price was selected for Phase 2, as it best meets the key objectives of controlling procurement costs of major equipment which has minimal risks under fixed price. Project scope with more substantial risk can be subjected to additional planning under a target price model. During execution, the Contractor will be incentivized to find cost effective project delivery methods and disincentivized to allow excessive cost grown. This approach has been used with success on many projects of similar size, scope and complexity across OPG.
- The installation of G1/G2 is expected to proceed as “Owner Only”, similar to the unit dismantling and removal work done in Phase 1.

A Project Management Plan (PMP) has been completed for the project and a Testing and Commissioning Plan will be completed by December 2019.

Regulatory Approvals

An Ontario Waterpower Association Class Environmental Assessment was completed for the project in February 2018. It was required due to the planned capacity upgrades exceeding the “grandfathered” capacity of the SAB1 GS.

Cultural Heritage Research and Cultural Heritage Recommendation Reports were completed in July 2018 for the SAB1 GS. Units 1 and 2 were listed as having Provincial heritage attributes due to the fact they were listed in the 1992 Federal heritage designation. A Strategic Conservation Plan (SCP) for SAB1 GS was initiated, and a Heritage Impact Analysis (HIA) was completed in March 2019 for the removal of the original G1 & G2 units. The HIA was accepted by Ministry of Tourism, Culture and Sport (MTCS).

Both a System Impact Assessment (SIA) and a Connection Impact Assessment (CIA) were completed in October 2015 for G1/G2. The SIA allows the IESO to assess the impacts of the new connection to the IESO Controlled Grid (ICG) and identify fault limits. The SIA was also needed for Hydro One to complete a CIA to incorporate SAB1 G1/G2 return to service into their projects. OPG signed a Connection Cost Recovery Agreement (CCRA) with Hydro One in May 2018 for $7.5 M. The CCRA released funding for Hydro One to perform ampacity upgrades attributed to G1 and G2 in the switchyard (E bus) and to connect G1 and G2 to the transmission grid.

Constraints:

- The SAB1 Powerhouse is only set up to manage one major overhaul at a time; coordination will be required with Production for the use of the overhead crane during execution and for laydown areas.
- Niagara Parkway is classified as a controlled access highway and requires a “Heavy or Oversized Load” permit when transporting heavy or oversized loads. Load restrictions may apply during spring seasons.

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Business Case Summary

Preferred Alternative:	**Convert G1 & G2 to 60 Hz 56.4 MW Units**	For Project Level A, B or C

Description of Preferred Alternative

- Entrance road to SAB1 (Glen Access Road) off Niagara Parkway has limitation on size and length of trucks due to space constraints.
- Coordination is required with Hydro One to ensure the required 115 kV "E" Bus upgrades are completed by Q1 2021 to avoid the critical path and allow for G1/G2 to be connected to the system.

Key assumptions and risks include:

- This project, combined with the PGS diffuser flaps project currently in execution, will provide the grid with 125 MW of reliable peaking capacity under all anticipated flow conditions.
- Major water conveyance and control structures (penstocks, scroll cases, draft tubes, headgates) will not require full replacements. $9M in allowances ($1M for penstock repairs and $8M for scroll case flange repair/replacement) has been included in the overall project estimates based on the results of the Definition phase engineering assessment of these components and budgetary estimates from suppliers for repairs.

Deliverables:	**Associated Milestones (if any):**	**Target Date:**
Previous Releases (for Phase 1):		
Runner and Turbine Development and Model Testing	Start Runner Design and Modelling Test Engineering design for runner (CFD) complete Runner modelling and testing complete	Complete Complete Complete
Early procurement of runner ($1.4 M)	Start procurement of runner	Complete
Procurement of headworks and tailrace sectional service gates to provide isolation during the project	Delivery of tailrace sectional gates Delivery of headworks sectional gates	Complete Complete
Dismantling and removal of existing 25 Hz Units 1 & 2	Completion of G2 removal Completion of G1 removal	Complete Complete
Inspection and refurbishment of G1 intake headgate	G1 intake gate refurbishment complete	Complete
Contractor submission of revised Target Cost (for Phase 2)	Contractor submission of revised Target Cost	Oct. 31, 2019
FEED Phase (Detailed Engineering) complete	Substantial completion - Phase 1 (FEED) milestone	Mar. 17, 2020
Current release (for Phase 2):		
SAB1 North and South Powerhouse Crane electrical and controls replacement	Powerhouse Crane electrical upgrades complete	Jul 31, 2020
Hydro One switchyard (E-Bus in the SAB1 GS) connection and ampacity upgrades for Units 1 and 2	G2 connection complete G1 connection complete	Oct. 31,2020 Apr. 30, 2021
Installation of new generator, exciter, transformer, buswork, breakers, switches, and protections and control systems for Unit 1 and Unit 2 Start of Installation	Contractor mobilization for Phase 2 Unit G2 Available for Service (AFS) Unit G1 Available for Service (AFS)	Jul. 6, 2020 Oct. 28, 2021 Mar. 7, 2022
Project Close out	Close out completed	Dec. 31, 2022

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Project Title: SAB1 – G1/G2 Replacement
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Business Case Summary

Alternative 2:	**Base Case – Cancel Project**	For Project Level A, B or Value-Enhancing

Not recommended. This alternative would close down the project.

Pros:

- None.

Cons:

- The alternative would require a write off of costs incurred to date.
- Does not improve peaking capacity in the Province.
- Cancelling the project would not align with water availability as a result of 31 planned overhauls at SAB1, SAB2 and PGS between 2023 and 2041. Beginning in 2022, OPG plans to refurbish one generating unit at SAB2 each year for 16 years. If the 25 Hz generators are converted to 60 Hz in that time, they will make up for the lost generation as the other generators are taken offline to be refurbished. This would reduce the overall production of hydroelectric power from the Niagara hydro stations during this overhaul period.

Alternative 3:	**Delay Work for Preferred Alternative (Replacing G1/ G2) until Pickering Closure 2025**

Not recommended. This alternative would delay the project with a re-start date of 2025. In-service would be delayed until 2028. This option used a Rate of Inflation Increase Calculation of 2%/Yr (The Bank of Canada inflation-control target range is 1 to 3 %).

Pros:

- The short-term costs of replacing the units could be deferred by delaying the work. Depending on the provincial demand for electricity in the early 2020s, the delayed approach may better align with the needs of the grid. The NPV for this alternative is lower than the recommended alternative ($53 M vs $62M), and this alternative would forgo the operating flexibility described below.

Cons:

- Delaying the work would not align with water availability as a result of planned overhauls at SAB1 and SAB2. From 2021/22 (proposed in-service in recommended alternative) to the proposed 2028 in-service date in this scenario, 8 overalls are planned at the SAB complex. Excess water not being used at SAB2, would be used by G1/G2 in the recommended alternative.

Alternative 4:	**Convert only one unit (G2) to 60 Hz 56.4 MW (MCR)**

Not recommended. This alternative would convert only Unit G2.

Pros:

- This approach would replace one generator unit and its associated components. OPG would deliver added value by proceeding with at least one unit.

Cons:

- This approach has a lower NPV ($36M vs $62M) versus replacing both units due to lose of economies of scale, and lower overall peaking capacity. Engineering, project management and many other base costs remain the same regardless if one or two units are replaced.
- Proceeding with only one unit prevents OPG from maximizing the hydroelectric power production from the SAB Complex during the overhaul period of 2022 to 2041.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Cost	Increase in project cost during Execution	Mitigate: • Contracting strategy uses Target Cost model with locked in labour and equipment rates, as well as disincentives for cost overruns • Auditing of submitted invoices • Water conveyance structures and unit foundations inspected during Phase 1	No	Low

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
Document #: NF20-PLAN-08707.021-0032

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Business Case Summary

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Schedule	Interference or delays from other projects (e.g. G5 overhaul, Hydro One) in the station and conflicts arising from shared space or resource equipment	Mitigate: • Project Site Manager to monitor potential impacts and provide coordination between work groups • Craning operations require transfer of control between work groups • Offsite storage of unit components. Will be local but arrive at site "just in time"	No	Medium
Quality	Upon final commissioning, the results yield less than acceptable vibrations due to hydraulic imbalances (e.g. roping or cavitation) or a large operational "rough zone" and must be corrected	Mitigate: • Detailed model testing was performed • Air emission allowance in specs • Operational zone clearly specified	No	Low
Schedule	Hydro One infrastructure not completed in time to allow G1 and G2 to connect to the system resulting in commissioning/operating delays	Mitigate: • CCRA signed with Hydro One with connections milestones 6 months ahead of when required for testing • OPG SPOC to monitor	No	Low
Quality	After model testing, contractual performance targets are not met during Gibson testing	Mitigate: • LDs, cost disincentive for not meeting the performance requirement.	No	Low
Industrial Safety	Injury to OPG or Contractor staff	Transfer: • Replacement of Units 1 and 2 will be "Owner-Only" where the Contractor shall perform all Work and shall fulfill the role of "Constructor" in accordance with the Ontario Occupational Health and Safety Act (OHSA) and its regulations. OPG will act as "Owner" as per the OHSA. • Standard construction risks, which are to be managed by following OHSA regulations	No	Low

Additional Risk Analysis — For Project Level A or B

The project is recommending using the P90 results from the Monte Carlo analysis for calculating the project contingency. ($5.9M in cost risk and $2.3M in schedule risks. $8.2M in total).

The project identified 10 discrete risks that were significant in nature. Three of those risks are related to the 100 year old embedded components (penstocks, scroll cases and draft tubes) that the project is planning to re-use. As part of the Definition phase, the penstocks and draft tubes were both inspected and will require minor repairs. However, based on detailed inspections, the scrollcase flanges will require significant repairs or replacement. These 3 risks were removed from the Monte Carlo Analysis and based on budgetary quotes, an allowance of $12M has been held in the project estimates ($3M allowance for Penstock repairs and $8M allowance for scrollcase flange replacements).

As a result of the Monte Carlo Analysis, $8,169K will be held in contingency for schedule delays, unknown unknowns and other discrete risks.

We are confident the remaining contingency is sufficient given the old G1/G2 units are fully removed, there are no remaining sub surface risks and engineering design is 75% complete.

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
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Business Case Summary

Financial Evaluation	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$M	Preferred Alternative Convert G1 & G2 to 60 Hz 56.4 MW Units	Base Case (Cancel Project)	Alternative 3 Delay Preferred Alternative to 2026 Start	Alternative 4 Convert ONLY G2 to 60 Hz 56.4 MW Unit
Project Cost	119.7	0	134.7	74.8
NPV (based on 76MW G1/G2 peaking only)	62	0	53	36

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Economic analysis performed by OPG Finance Investment Planning. Key findings include:

- All alternatives (except cancellation) have positive NPV, with the Preferred Alternative being the most economic.
- Peaking capacity value is the most critical component of NPV.

Qualitative Factors For Project Level A or B

- The project will increase available renewable energy to the Ontario grid, reducing the environmental impact of meeting Ontario's electricity demand.
- The project will leverage existing facilities and infrastructure at the Beck Complex to provide increased operational flexibility and a lower cost alternative to constructing greenfield generation.
- Complete replacement of the old units instead of retrofitting components provides increased unit reliability, easier integration with existing embedded components with less risk of design not working with existing equipment, and higher efficiencies with new technology.
- Outside of peaking capacity, G1/G2 will also be able to use additional water which will be available at the SAB Complex during the 31 planned overhauls at SAB1, SAB2 and PGS between 2023 and 2041.

Post Implementation Review (PIR) Plan (refer to OPG-PROC-0056)

Type of PIR Report	Comprehensive PIR	**PIR Completion Date**	Dec. 2022

PIR KPIs	Current Baseline	Target Result	How to measure?	Who will measure?
Unit Vibration and hydraulic stability	Industry Standards	Listed in detail in the technical specification and EPC with penalties to vendor for non-performance	Vibration testing during testing/commissioning	Machine Dynamics & Component Integrity (MDCI)
Turbine Power @ 91.0m net head	57,500 kW (per EPC)	57,500 kW	Performance testing during commissioning after in-service.	Engineering Technical Services - Performance & Testing Group (ETS P&T)
Transformer Losses	Per EPC – 192kW	192kW	Performance testing during commissioning after in-service.	Engineering Technical Services - Performance & Testing Group (ETS P&T)
Hydraulic Performance	57,500 kW at 68 m3/s. (per constraint in Tech Spec, and guaranteed output in EPC)	57,500 kW at 68 m3/s.	Gibson Test to be performed 6 – 1 year)	Specialized team including US Army Corps of Engineers and OPG Engineering

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
Document #: NF20-PLAN-08707.021-0032

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate - Total Project Cost										
Project Number:	**BK184185**									
Project Title:	**SAB1 G1 G2 Replacement Project**									
$K	**LTD**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Future**	**Total**	**%**
Project Mgmt		2,299	4,855	4,569	2,209				13,932	12%
Inspection		301							301	0%
Engineering		5,196	2,866	2,594	766				11,422	10%
Procurement		5,131	12,784	13,586	-				31,502	26%
Construction		10,881	18,440	10,935	512				40,768	34%
Commissioning									-	0%
Closeout									-	0%
Contractor Fee		244	3,004	3,144	1,008				7,400	6%
Subtotal	-	24,052	41,950	34,828	4,496	-	-	-	105,326	88%
Outside WBS									-	0%
Contingency		1,000	2,390	2,390	2,390				8,170	7%
Subtotal w/ Contingency	-	25,052	44,340	37,218	6,886	-	-	-	113,496	95%
Interest		406	1,801	3,393	613				6,212	5%
Other									-	0%
Total	**-**	**25,457**	**46,141**	**40,611**	**7,498**	**-**	**-**	**-**	**119,708**	**100%**
Removal Costs (incl. above)		3,955							3,955	3%

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	2%	**Interest Rate (going-forward)**	4.4%

Project #	Date (YYYY-MM-DD)	Description	Amount	%
BK184185	10/28/2021	Unit 2 in Service	56,855	49%
BK184185	3/7/2022	Unit 1 in Service	56,855	49%
BK184185	12/31/2022	Close-out	2,045	2%
Total			115,754	100%

Prepared by:		**Reviewed and Endorsed by:**	
Dave Bonell	11OCT19	Michael Martelli	October 22, 2019
Dave Bonell	Date	President Renewable Generation	Date
RG - PMO		Project Sponsor	
Project Manager			

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
Document #: NF20-PLAN-08707.021-0032

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Business Case Summary

APPENDICES (Continued)

Appendix C: Financial Evaluation Assumptions For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

Key assumptions used in the financial model of the project are:

Project Capital Costs:

(1) Estimate for construction based on competitive bids and historical records for similar work

(2) Contingency is 11.34% or $8.170 M for the remaining project estimate (minus allowances, contingency and interest) of $72.7M.

Financial/Economic:

(1) Corporate Tax Rate: 25%

(2) CCA Rate: 8% - assumes that full CCA benefit can be claimed in any given year

(3) After-tax WACC: 7% - estimate for OPG's long-term Weighted Average Capital Cost (WACC)

(4) Annual Escalation (CPI): 2%

Project Life:

(1) Unit G2 In-service by Oct. 2021

(2) Unit G1 In-Service by Feb. 2022

(3) Forecast length: 75 years

Energy Production:

(1) Station output modelled with linear cms to MW curves; different slopes used up to an efficiency point and up to max capacity

(2) Diffuser flaps rehabilitated on all 6 Pump Generation Station (PGS) units, increases output by 30 cms/unit and 4 MW/unit

(3) Station specifications assume G1 & G2 converted to 56.4 MW units, and assume all existing PGS, SAB1 and SAB2 units are operating

Operations, Maintenance & Administration (OM&A) Expenses and Sustaining Capital:

(1) Annual fixed OM&A: 0.15 $M/Unit ($2018)

(2) GRC: 14.4 $/MWh

(3) Major Overhaul Costs: 30 $M/Unit ($2018)

(4) Major Overhaul Frequency: 25 years – units are out of service for the full year during major overhaul

Station Outages:

(1) PGS unit outages: 365 day outage every 15 years – station outage schedule provided by Plant Operations, PGS unit outage more frequent due to pumping and generating functions

(2) SAB1 unit outages: 365 day outage every 25 years

(3) SAB2 unit outages: 365 day outage every 25 years

ONTARIO POWER GENERATION

Records File Information:
Retention Permanent

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Project Over-Variance Approval

Project #	BK1 84185	**Controlled Doc #**	NF20-PLAN-08707.021-0007
Project Title	SAB1 – G1/G2 Replacement		
Facility	Sir Adam Beck I G.S.	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]
Release: Gate and Project Phase	☐ Over-variance G0 : Initiation ☐ Over-variance G1 : Choose an item		☐ Over-variance G2 : Definition ☒ Over-variance G3 : Execution
Estimate Class (overall project)	Class 2	**Target Project Completion Date**	Dec-2022

Recommendation

The purpose of this submission is to request approval for an additional $8.2M to address the additional cost to replace the SAB1 G1 & G2 scroll cases while maintaining an adequate contingency to complete the Sir Adam Beck 1 (SAB1) G1 & G2 Replacement Project.

The full release BCS of $119.7M, including $8.2M of contingency was approved in November 2019. This variance release will bring the full project release to $127.9M, including $9M of contingency.

Investment Cash Flows

$K	LTD	2019	2020	2021	2022	2023	2024	Future	Total
Previous releases		25,457	46,141	40,611	7,498				119,708
Current request	-		8,200						8,200
Total released to date	-	25,457	54,341	40,611	7,498	-	-	-	**127,908**
Future required	-								-
Total Project Cost	-	25,457	54,341	40,611	7,498	-	-	-	**127,908**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$127,908 K

Project Overview

The project includes the replacement of two mothballed 25Hz generating units at Sir Adam Beck GS with two new 60 Hz units. The existing (100-year-old) embedded components including penstocks, scroll cases and draft tubes were intended to be re-used by the project.

Significant defects were discovered within the scroll cases once the units were disassembled. Over $4.7M of contingency was spent assessing the condition of the scroll cases and attempting to find a suitable in-situ weld repair, however, the casting defects were much worse than initially thought so the decision was made to abandon the repair option and replace the scroll case in each unit.

Total Project Estimate Variance Explanation

The original full BCS included $8.2M in contingency plus an $11M allowance for potential penstock and scroll case repairs. To date, $18.4M of this $19.2M has been committed to the following:

- penstock repairs estimated at $1M
- scroll case replacements is estimated at $10.2M
- $1.5M in engineering change requests during the design phase
- $1M in COVID-19 impacts
- $4.7M in the initial scroll case response

The G1 and G2 scroll case castings were made in 1919 using a "first of a kind" casting technology. Although there were defects in the castings, (voids 6" to 24" long) the scroll cases performed well without incident for

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Project Title: SAB1 – G1/G2 Replacement
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Project Over-Variance Approval

Total Project Estimate Variance Explanation

over 90 years. However, the capacity of the new units will increase from 40MW to 57M thereby subjecting this equipment to much higher stresses during normal operation and unit trips. With the number and size of defects in the cast steel, and the inability to effectively repair the defects to a high level of technical confidence, the decision was made to replace the scroll case in each unit thus providing a higher certainty of safe operation for the 75-year design life.

Return on Investment & Project Schedule

The full release BCS had a Net Present Value (NPV) of $62M based on a $119.7M release with an Internal Rate of Return (IRR) of 11.07%. With the requested increase in funding to $127.9M, the NPV of the project drops slightly to $57M assuming the entire release is spent, with an IRR of 10.58%.

The project has been re-baselined, to compensate for the install of the new scroll cases as well as significant (3-4 month) COVID-19 related delays on key components being manufactured in Brazil, Italy, Mexico and China.

- G2 in-service has moved from Oct 14, 2021 to March 11, 2022.
- G1 in-service has moved from Feb 25, 2022 to July 22, 2022.

Risk Analysis

- The adjusted full project cost of $127.9M will restore the P90 confidence based on execution phase risk included in the Monte-Carlo analysis.
- The discrete risks included in the calculation include;
  - site congestion
  - unit vibration
  - hydraulic imbalances
  - commissioning delays
  - turnover issues to operations
  - HydroOne estimate accuracy

Project #: BK1 84185
Project Title: SAB1 – G1/G2 Replacement
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Project Over-Variance Approval

Appendix A1: Summary of Estimate - Total Project Cost										
Project Number:	**BK184185**									
Project Title:	**SAB1 G1 G2 Replacement Project**									
$K	**LTD**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Future**	**Total**	**%**
Project Mgmt		2,299	4,855	4,569	2,209				13,932	11%
Inspection		301							301	0%
Engineering		5,196	2,866	2,594	766				11,422	9%
Procurement		5,131	12,784	13,586	-				31,502	25%
Construction		10,881	26,640	10,935	512				48,968	38%
Commissioning									-	0%
Closeout									-	0%
Contractor Fee		244	3,004	3,144	1,008				7,400	6%
Subtotal	-	24,052	50,150	34,828	4,496	-	-	-	113,526	89%
Outside WBS									-	0%
Contingency		1,000	2,390	2,390	2,390				8,170	6%
Subtotal w/ Contingency	-	25,052	52,540	37,218	6,886	-	-	-	121,696	95%
Interest		406	1,801	3,393	613				6,212	5%
Other									-	0%
Total	-	**25,457**	**54,341**	**40,611**	**7,498**	-	-	-	**127,908**	**100%**
Removal Costs (incl. above)		3,955	2,900						6,855	5%

Project #	Date (YYYY-MM-DD)	Description	Amount	%
BK184185	2022-03-11	Unit 2 in Service	59,504	49%
BK184185	2022-07-22	Unit 1 in Service	59,504	49%
BK184185	2022-12-31	Close-out	2,045	2%
Total			121,053	100%

Prepared by:		**Reviewed and Endorsed by:**	
Dave Bonell RG - PMO Project Manager	Aug 4, 2020 Date	Don Gagnon VP Eng & Technical Services Project Sponsor	Aug 28, 2020 Date

Approvals	**Signatures**	**Date**
Recommended by: Project Sponsor Michael Martelli President Renewable Generation		7 Oct 20.
Finance Approval: John Mauti Chief Finance Officer & SVP Finance		7 Oct /20
Line Approval per OAR 1.1: Ken Hartwick President & Chief Executive Officer		Oct 7/2020

Business Case Summary

Project #	CHE84494	**Controlled Doc #**	NA4-BCS-08707-0868953
Project Title	Limerick Island Sluiceway Hoist & Superstructure Replacement **Submission ID:** 00581807		
Facility	Chenaux GS	**Investment Classification**	Regulatory
Project Level (Scalability)	B **Financial Classification**	☐ OM&A ☒ Capital ☐ Capital Spare ☐ MFA ☐ CMFA ☐ Provision ☐ Others: [if applicable]	
Release: Gate and Project Phase	☐ Choose an item. G0: Initiation ☐ Choose an item. G1: Choose an item.	☐ Choose an item. G2: Definition ☒ Full G3 ☒ Execution	
Estimate Class (overall project)	Class 3	**Target Project Completion Date**	NOV-2024

Recommendation

We recommend a release of $32,526k, including [redacted] of contingency. This will bring the total released-to-date to $32,701k.

The total project cost is now estimated at $32,701k, compared to $11,449k in the previous release, including contingency. The Class 5 estimate in the previous release was based from a conceptual estimate and significantly refined through the definition stage. The estimate variance is primarily driven by:

- Original estimate baseline was derived using a budgetary quote and extrapolated over 6 gates, including escalation costs of 3% per year. This budgetary quote included controls, however this pre-dated the RG standard for a significantly more robust sluicegate control system. The baseline also did not account for the required staging and management of the scope next to an inter-provincial bridge/roadway;
- Additional scope, which included: replacement of power supply from the station to the Limerick sluiceway and from the Limerick sluiceway to the Portage log sluices;
- Maintenance improvements were also further defined during the definition stage such as enclosing the hoist house and adding a monorail hoist crane, as well as two stairways to the hoist enclosure; and
- Operational improvements to sluicegate heaters were added as well as the inclusion of two E-houses required to house the new electrical equipment associated with the power supply upgrades.

This release is to fund the execution phase for the Chenaux Sluice Gate Hoist Replacement project. This request is going to fund the Engineering, Procurement and Construction (EPC) contract, OPG project management and engineering, external QA/QC, commissioning and project closeout.

Investment Cash Flows

$K	LTD	2021	2022	2023	2024	2025	2026	Future	Total
Previous releases	102	73							175
Current request		11,027	13,888	7,290	321				32,526
Total released to date	**102**	**11,100**	**13,888**	**7,290**	**321**	**-**	**-**	**-**	**32,701**
Future required	-								-
Total Project Cost	**102**	**11,100**	**13,888**	**7,290**	**321**	**-**	**-**	**-**	**32,701**
Ongoing Costs	-								
					Gate:	**G3**	**OAR Approval:**		$32,701 K

Project #: CHE84494
Project Title: Limerick Island Sluiceway Hoist & Superstructure Replacement
Submission ID: 00581807
Document #: NA4-BCS-08707-0868953

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Business Case Summary

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Project Sponsor Alison Bradley Director, Asset & Project Management	SF Approvals Attached; can also be viewed in Power Search	Dec. 8, 2020 14:00
I concur with the business decision as documented in this BCS.		
Finance Approval: Bryan Shaddock Finance Controller	SF Approvals Attached; can also be viewed in Power Search	Dec. 8, 2020 15:45
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR 1.1: Nicolle Butcher SVP, Renewable Generation & Power Marketing	SF Approvals Attached; can also be viewed in Power Search	Dec. 10, 2020 10:34

EXECUTIVE SUMMARY – Project Overview

The Limerick Island control dam is part of the Chenaux Generating Station work centre and includes 6 motorized screw type sluice gates, 16 stoplog sluices, and 2 loglifters. The Limerick Sluice Hoist Assessment [NA4-REP-76130-0001], completed in 2019, recommends installing new wire rope hoists on a new superstructure. The hoists would be inside a protective enclosure with a monorail maintenance hoist.

There are currently 2 known bent screws at Chenaux, and very likely others due to previous operational practices whereby the gates were driven down using the screw hoist, buckling the screw. Between 2003 and 2011 a project was undertaken to modernize the sluiceway equipment [H-97-0153], however the hoists were not included in scope. Operational issues during the 2018/2019 winter identified the need to advance this project.

The Northwest Operations group in conjunction with Plant Engineering Services central completed an assessment of their screw hoist sluice gates after several years of unreliable operation [NWO-REP-29432-0001]. The assessment recommends replacing all the screw hoist with wire rope hoists to improve reliability, particularly in the winter. The assessment notes that the screw hoists were not designed for frequent operation. With surplus baseload generation and other sources of renewable generation, the gates are now operated upwards of 100 times per month, compared to 20 times per year prior to 2010.

Screw hoists are inefficient with up to 70% of the motor power required to overcome friction, where as wire rope can be 90 to 95% efficient and much better suited to frequent operation.

The preferred alternative is based on the recommendations of the Assessment to replace all screw type hoists, with wire rope, in addition a heated hoist house with stair access will be added atop a new superstructure as well as a monorail service hoist over the full length of the structure to service the hoist components. A new power supply will serve Limerick as well as Portage Control Dam, and upgraded controls will be installed throughout the sluiceway.

The investment in a new sluice hoists will increase reliability in operations of the sluice gates. The addition of a new hoist house and sluiceway superstructure will also address severe environmental conditions affecting the reliable operation of the sluice gates by protecting the hoists and associated controls, gearboxes and motors. Stairway access at each end of the superstructure will benefit staff in safe ingress/egress to and from the hoist house.

The project has currently completed the request for proposal for the Engineering, Procurement and Construction (EPC) of the sluiceway hoist replacement. This request is going to fund the EPC contract, OPG project management and engineering, external QA/QC, commissioning and project closeout.

Business Need

For Project Level A or B

The investment in a new sluice hoists will increase reliability in operations of the sluice gates. The exiting screw-type hoists have reached end of life and are no longer considered reliable. Furthermore screw-type hoists were designed to operate approximately 20 times per year. Due to surplus baseload generation the Chenaux gates have been operated over 100 times per year since 2011. The addition of a new hoist hoist house and sluiceway superstructure will also address severe Environmental conditions affecting the reliable operation of the sluice gates by protecting the hoists and associated

Project #: CHE84494
Project Title: Limerick Island Sluiceway Hoist & Superstructure Replacement Submission ID: 00581807
Document #: NA4-BCS-08707-0868953

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Business Case Summary

Business Need	For Project Level A or B
controls, gearboxes and motors. Stairway access at each end of the superstructure will benefit staff in safe ingress/egress to and from the hoist house.	

Preferred Alternative:	**Replacement of Sluiceway Hoists and Superstructure**	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is the replacement of the existing superstructure with one designed for wire rope hoists. Enclosure of the top of the structure will protect the hoisting equipment from the elements. The preferred alternative will include:

1. Replacement of the superstructure with new wire rope hoists and hoist enclosure
2. A monorail service hoist over the full length of the structure to service the hoist components
3. New controls and power supply to Limerick Sluices
4. New power supply to Portage Control Dam
5. Electrical vault rehabilitation

Pros:

- Most reliable option based on OPG experience
- Significant improvements to maintainability
- Equipment will have longest life due to removal of environmental conditions

Cons:

- New superstructure will need to interface with the existing to ensure dam safety requirements are met during execution

Deliverables:	**Associated Milestones (if any):**	**Target Date:**
Previous releases:		
Definition Phase Release	Release Approval	June 10, 2019
Dam Safety Outage Requirements	Formal Confirmation of Spillway Requirements	August 30, 2019
EPC Specification Complete	Approved Specification	September 20, 2019
Execution Phase Release	Approved Execution BCS	February 21, 2020
Material on Site	Delivery Confirmation	June 1, 2020
Installation & Commissioning	Successful Testing/In Service	July 29, 2022
Closeout	Project Closure Report (PCR)	December 23, 2022
Current release:		
Execution Phase Release	Release Approval	December 8, 2020
Material On Site	Delivery Confirmation	April 1, 2021
Installation & Commissioning	Successful Testing/In Service	November 30, 2023
Closeout	Project Closure Report (PCR)	November 30, 2024

Alternative 2:	**Base Case – No Project**	For Project Level A, B or Value-Enhancing

By not installing new hoists the operational reliability will continue to put risk on each sluice gate operation. With increasing amount of operations each year this has a significant impact on the health and safety of the assets, plant personnel and public safety.

Pros:

- Stimulates capital expenditure in future business needs

Cons:

- Low operational reliability
- Risk to assets, plant staff and public safety

Project #: CHE84494
Project Title: Limerick Island Sluiceway Hoist & Superstructure Replacement
Submission ID: 00581807
Document #: NA4-BCS-08707-0868953

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Business Case Summary

Alternative 3:	**Delay Work**	For Project Level A or B or Value-Enhancing

By delaying work the operational reliability will continue to decrease, similar to the Base Case – No Project alternative. This will cause the operational reliability of the gates to continue decrease the longer the project is delayed, thereby increasing risk to assets, plant personnel and public safety

Pros:

- Permits greater capital expenditure in near near-term and emergent business needs

Cons:

- Operational reliability continues to decrease with time
- Risks to assets, plant staff and public safety increases

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type/ Actions/Final TCD	For Additional Review	Residual Ranking
Cost	There is a risk that scope additions and discovery work could cause cost to exceed the release amount.	Mitigate: • A Design Build contract strategy has been implemented to mitigate potential for scope additions of items not captured in design. OPG Plant Engineering Services has detailed a Performance specification, which balance site needs and business needs. **Final TCD: NOV-2023**	No	Low
Schedule	There is a risk that the schedule does not include enough float and on site delays cause delayed in-service dates	Mitigate: • The execution work has been scheduled based on the RFP submissions and incorporates OPG timelines and schedule/contingency • F**inal TCD: NOV-2023**	No	Low
Quality	There is a risk that expected results will not be met	Mitigate: • The business needs were communicated through the provided specification, given to proponents, as well as attendance at multiple pre-bid site showings at the Limerick Island sluiceway **Final TCD: NOV-2023**	No	Low

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

Choose an item.	Preferred Alternative	Base Case (No Project)	Delay work	Alternative 4	Alternative 5
Project Cost					
NPV					
Other: (e.g., IRR)					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial evaluation was not conducted as the only other viable alternative (reuse of the existing superstructure) had approximately the same capital expenditure as the preferred alternative, however carried greater risk due to unknowns of embedded anchors and steel, and did not provide OPG with the same level of quality of a finished product.

Qualitative Factors — For Project Level A or B

Qualitative factors provided by the Preferred Alternative include:

- Increased operational reliability of wire rope hoists as opposed to the screw type hoists currently installed
- Subsequent lower health and safety risk to OPG assets, plant personal and the public associated with the more reliable hoist

Project #: CHE84494
Project Title: Limerick Island Sluiceway Hoist & Superstructure Replacement Submission ID: 00581807
Document #: NA4-BCS-08707-0868953

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Business Case Summary

Financial Evaluation	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

- Staff working condition improvements during winter months in a new enclosed and heated hoist house, not exposed to the environmental conditions
- The outcome of the hoist replacement at Chenaux will have a direct effect on determining the replacement program of screw type hoists at multiple stations within Eastern Operations.

Post Implementation Review (PIR) Plan (refer to OPG-PROC-0056)

Type of PIR Report	Project Closure Report (PCR)	**PIR Completion Date**	Nov-2024

☐ Detailed PIR KPIs will be provided in future BCS(s) when Choose an item. Phase BCS release is requested.

PIR KPIs	Current Baseline	Target Result	How to measure?	Who will measure?
N/A				

Project #: CHE84494
Project Title: Limerick Island Sluiceway Hoist & Superstructure Replacement
Submission ID: 00581807
Document #: NA4-BCS-08707-0868953

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate - Total Project Cost										
Project Number:	**CHE84494**									
Project Title:	**Chenaux Sluicegate Hoist and Tower Replacement**									
$K	**LTD**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**Future**	**Total**	**%**
Project Mgmt	34	110	110	100	10				364	1%
Inspection	[redacted]									
Engineering										
Procurement										
Construction										
Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	**102**	**11,100**	**13,888**	**7,290**	**321**	**-**	**-**	**-**	**32,701**	**100%**
Removal Costs (incl. above)		270	1,184	1,184					2,638	8%

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	N/A	**Interest Rate (going-forward)**	3.68%

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project #	**Date (YYYY-MM-DD)**	**Description**	**Amount**	**%**
CHE84494	11/30/2021	Electrical Supply Partial In-service	4,265	16%
CHE84494	11/30/2022	Hoist & Tower Partial In-service	11,000	57%
CHE84494	11/30/2023	100% In Service	11,448	100%
Total			26,713	100%

Prepared by:	**Reviewed and Endorsed by:**
SF Approvals Attached; can also be viewed in Power Search	SF Approvals Attached; can also be viewed in Power Search
Justin Farrell Project Leader Dec. 7, 2020 10:18 Date	John Peacock Project Manager Dec. 8, 2020 11:25 Date

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Business Case Summary

Project #	84901	**BCS Document Number**	NWO-BCS-08787-1479258
Project Title	84901 - NWO WORK CENTRE BUILDING		
Facility	NWO - NORTHWEST OPERATIONS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2028-Mar-24
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $41,992 K, including [redacted] of contingency. This will bring the total released-to-date to $44,407 K.

The estimated total project cost is $44,407 K, including [redacted] of contingency.

The Northwest Operations Work Centre (NWO WC) Project is for the construction of a new Work Centre that will provide adequate space for all Thunder Bay staff, as well as provide the necessary infrastructure to support operational and functional needs.

This release is to complete all site works, construction, commissioning, project management and closeout activities.

Investment Cash Flows

Project Number	84901 - NWO WORK CENTRE BUILDING					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	2,052	363							2,415
Currently Requested	0	5,284	31,516	5,183	9				41,992
Total released to date	2,052	5,647	31,516	5,183	9				44,407
Future required	0								0
Total Project Cost	2,052	5,647	31,516	5,183	9				44,407
Ongoing Costs	0								0

Total OAR Approval	44,407.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Brian Dietrich VP Regional Operations VP Western Ops	Brian Dietrich	2025-07-14
I concur with the business decision as documented in this BCS.		
Finance Approval : Maha Tam VP Ops & Projects Controllership	Maha Tam	2025-07-15
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : OAR Element : 1.1 Nicholas Pender SVP Renewable Generation& Energy Markets	Nicholas Pender	2025-07-15

EXECUTIVE SUMMARY – Project Overview

Ontario Power Generation (OPG) is undertaking the construction of a new Northwest Operations Work Centre (NWO WC) to amalgamate all Thunder Bay based staff into one centralized facility.

The Thunder Bay based staff stationed in Northwest Operations are divided between two different facilities within the city. The original and currently occupied Work Centre located on Burwood Road, includes a 17,800 square foot administration building, including a hydroelectric operating control centre required to be North American Electric Reliability Corporation (NERC) compliant, shop areas for trades staff and a 4,000 square foot detached cold storage warehouse used for storage and equipment. Mobile trailers are also dispersed on the 4 acre lot, serving various functions such as a backup control desk, general storage and workspace for staff. During 2001 and 2005, the main administration building underwent two expansion projects to increase the original footprint and accommodate the growing number of staff and various job functions. Production staff are dispatched daily from Burwood Road to service Kakabecka GS, Aguasabon GS and Silver Falls GS.

In 2018, the Burwood facility reached its maximum capacity, prompting the relocation of most Production Support and Engineering staff to an 11,000 square foot leased space on Premier Way. Continued expansion of OPG's Thunder Bay staff due to an increase in project unit refurbishment work, necessitated the leasing of an additional 10,900 square foot floor at the Premier Way location in 2023. Currently, OPG occupies two floors at Premier Way while still maintaining the OPG-owned Burwood facility.

Given the ongoing exposure to cost volatility and rate escalation associated with leasing, the recent growth of Northwest Operation's Thunder Bay staff, and the absence of a suitable Work Centre building, the preferred alternative is to design and construct a new 45,000 square foot facility to meet OPG's current and future business needs.

OPG's current real estate asset on Burwood Road is deteriorating, lacks space, and requires substantial and critical infrastructure repairs to fulfill NWO's operational and functional requirements. A new Work Centre will address these deficiencies and improve staff collaboration and efficiency by eliminating barriers between work groups currently operating in separate locations, as well as eliminating the risk of leasing administrative office space.

The Gate 2 release has successfully achieved its deliverables including the completion of the detailed architectural and engineering design, the technical specifications included in the Issued for Tender (IFT) package, updated Environmental Screening, the completion of the Construction RFP and determining a current evaluation for the Burwood Facility.

This Gate 3 release will fund the following activities:
- Permitting
- Site Development
- Construction of the new Work Centre
- Commissioning of new systems and equipment
- Completing services related to OPG's Owner's Engineering vendor to implement the design and building requirements
- Project Closeout

The key risks to the project are:

- Technical: Risk of redesign due to geotechnical discovery work. This risk has been accepted based on the geotechnical studies completed by 3rd party engineering firms and reviewed and incorporated by the design engineer. The extent of any additional geotechnical work cannot be determined until after the earthworks construction begins and as a mitigating measure, contingency is being carried by OPG.

- Stakeholder/Reputational: Local communities and stakeholders may not support the project. Mitigation includes meaningful engagement and project inclusion with the local communities and early engagement of stakeholders.

- Procurement/Materials: Potential increased material/equipment costs due to the amount and availability of specified products. There is a risk of an increase in cost to the current project budget due to supply chain challenges to obtain specified materials. Mitigation includes engaging OPG's design and construction partners to focus on products where substitutes are available for specified products that may not be available during construction.

Business Need

For Project Level A or B

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Business Case Summary

Northwest Operations (NWO) requires a consolidated workspace to ensure continued safe and effective operations. The new NWO Work Centre will act as a centralized hub for Northwest Operations and support functions, allowing for a central location for deployment of staff to OPG stations, as well as promoting more efficient management and coordination across various OPG departments and multidisciplinary projects.

The Thunder Bay area currently lacks a suitable Work Centre building and Northwest Control Room space for Northwest Operations, leading to staff relocations in 2018 and 2023 to short-term leased office spaces. There is a pressing business need to address these space deficiencies, and the significant risks associated with long-term leasing. Northwest Operations is experiencing the leasing risk firsthand at the Kenora Service Centre, where after serving as a long-term tenant, OPG is experiencing lease expiry without the option for renewal by the facility's owner, leaving the Kenora staff without a future suitable Service Centre option elsewhere. Previous Real Estate searches in the Thunder Bay area have also shown the area does not have other suitable leasing options for OPG's local workforce. Further expansion within the Premier Way facility is also not likely, as the third and final floor of the building is fully occupied by a long-term tenant. The NWO Work Centre project aims to consolidate OPG staff currently dispersed across an aging building in need of significant updates and a separate, leased facility that lacks long-term security and incurs rising rental costs.

The OPG-owned Burwood Road facility, which currently acts as the NWO Work Centre, has significant deficiencies putting OPG's operations and employee's health and safety at risk. These include items such as:
- operational space and less efficient layout of the Northwest Control Centre's supporting tasks
- backup power and data acquisition concerns, as the current Uninterruptible Power Supply (UPS) currently does not meet the requirements for the reliability standards outlined by the North American Electric Reliability Corporation (NERC)
- significant space limitations (Burwood facility representing only ~45% of the current OPG-Thunder Bay real estate square footage), which resulted in the leasing of a 10,500 sq ft main floor and a 11,000 sq ft second floor and at Premier Way
- lot limitations do not allow further expansion in any direction to the current Burwood footprint
- yard drainage issues causing heaving, sinkholes and pooling/ponding of water and ice resulting in slip, trip and fall hazards throughout the year
- an aging and undersized HVAC system due to various building additions, resulting in a less efficient and overworked system not meeting internal temperature or air circulation requirements
- exterior walkway deterioration, end of life vehicle/person gates causing employee pedestrian safety concern and access delays in the event of an emergency
- aging and at capacity septic system services the building

Preferred Alternative:	Construct a new NWO Work Centre	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative includes the development of a green-field site centrally located in the city of Thunder Bay, and the construction of a new main Work Centre building and three auxiliary buildings. The primary building (building A1) is designed as a 45,000 sq ft 2-storey Work Centre building, which includes staff workstation and meeting areas, trade staff workshops, and the attached Northwest Control Centre (NWCC). The accessory buildings include a 4,800 sq ft, semi-heated Warm Storage building (building A2), which includes pallet-rack storage, industrial mezzanine storage areas, and a vehicle wash bay; accessory building (building A3) being a 4,900 sq ft open and 3-sided, unheated Equipment Storage building, and; the 625 sq ft 1-storey unheated Waste Oil and General Storage Shed as accessory building (building A4).

Completing this entire scope of work allows the project to address the operational and functional challenges of Northwest Operations' currently undersized and aging Work Centre and the significant operational risk of having the majority of Thunder Bay based staff occupying leased office space. The project will increase collaboration to allow staff to more efficiently and safely manage local generating site operations, as well as supporting OPG's modernization of small hydro generating facilities through refurbishments of existing units, redevelopments of entire stations, and potential new northern Ontario hydroelectric generating sites (Made-in-Ontario Northern Hydroelectric Opportunities report, p.9).

The preferred alternative relative to the base case, shows that it is more cost effective to consolidate all staff in a single location, than to complete renovations at the existing facility and have staff spread across multiple work sites.

Activities funded under the project NWO84901 are as follows.

Site elements include:
- Fenced and paved Work Yard, with secure auto-access gates
- Paved Staff Parking area including lighting and curbing
- Two drainage ponds and underground storm drain system
- Bike Shelter
- Various site signage and landscaping/tree planting

Construction assemblies for Main Building (A1) include:
- Foundation: perimeter concrete strip footings, interior column pads, and interior slab on grade
- Wall Assemblies/Structure: steel building frame with wood infill walls, wood floors and roof
- Roof Assembly: primarily pre-engineered wood joists, fully adhered EPDM roof system
- Exterior wall assemblies with exterior insulation, metal and cement-fibre cladding panels, aluminum curtain walls and windows
- Interior spaces formed of gypsum partitions with aluminum store-front doors, sidelites and screens, wood/hollow metal doors in metal frames, and various floor, wall covering and ceiling finishes
- Variety of furniture types, furnishings and equipment/appliances throughout in accordance with OPG's Real Estate standards

Construction assemblies for Warm Storage Building (A2) include:
- Pallet-rack storage, mezzanine storage, and wash bay
- Foundation: perimeter concrete strip footings, and interior slab on grade
- Wall Assemblies/Structure: wood building frame, insulated stud cavities interior metal liner panels.
- Roof Assembly: pre-engineered mono-slope wood trusses, metal roofing
- Wood framed storage mezzanine with wire-mesh storage partitions

Construction assemblies for Equipment Storage Building (A3) include:
- Equipment/vehicle storage
- Sand storage bay
- Foundation: perimeter concrete strip footings, and interior slab on grade
- Wall Assemblies/Structure: wood building frame, partial steel frame, with pre-engineered mono-slope wood trusses

Construction assemblies for Waste Oil and General Storage Building (A4) include:
- Foundation: perimeter concrete strip footings, and interior slab on grade
- Wall Assemblies/Structure: light-gauge, fire retardant steel building frame and roof

Deliverables:

Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 1 - BCS Approved	Gate G1 Approval		2020-02-18
Conceptual Design Complete	Conceptual Design Complete		2022-03-11
Engineering Specifications Complete	Technical Specifications Complete		2022-12-14
Scope of Work Approved	Scope of Work Document Complete		2022-12-16
Gate 2 - BCS Approved	Gate G2 Approval		2023-04-14
Detail Design Contract Issuance	Award Contracts / PO Issued		2023-04-17
Labour Determination Complete	Labour Determination Completed		2023-09-08
Detailed Design Complete	Detailed Design Complete		2024-02-16
Issued For Tender Package Complete	Technical Specifications Complete		2024-02-24
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
(SOI) Start of Installation/Construction (Siteworks & Buildings)	Start of Installation		2025-07-09
(FOI) Finish of Installation (Buildings)	Finish of Installation		2026-12-18
(CMF) Commissioning Finished (Buildings)	Commissioning Finished		2027-01-29
(AFS) Available for Service (Buildings)	Available for Service and/or Ready For Service Completed		2027-02-26
(REIS) Report of Equipment In-Service (Buildings)	Report of Equipment in Service		2027-03-30
(AFS) Available for Service (Final Siteworks and Landscaping)	Available for Service and/or Ready For Service Completed		2027-07-23
(REIS) Report of Equipment in Service (Final Siteworks & Landscaping)	Report of Equipment in Service		2027-08-27
(PCO) Project Closeout Complete	Project Close Out Completed		2028-03-24
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2 "Base Case - No Project" would involve ceasing all remaining execution work and accept the risk associated with the majority of Thunder Bay-based staff occupying leased spaces. This alternative necessitates completing substantial infrastructure remediation efforts at the current Burwood facility, while maintaining a less efficient arrangement with staff spread across multiple work locations in Thunder Bay, which also presents an increased safety risk than the preferred alternative, due to frequent staff travel between locations. Also under this alternative, Northwest Operation's real estate facilities will operate at greater than maximum capacity unless space optimization renovations are completed to the leased spaces, estimated to be $1.9M and could only be completed with landlord approval.

Advantages:
• Less upfront capital expenditure

Disadvantages:
• Risk of occupying leased space
• Renovation cost required at Burwood that would still not address the main space utilization concerns or provide for future expansion potential
• Risk of still having to complete a new build of some form in the future
• Less efficient distribution of Thunder Bay-based work groups due to space limitations at Burwood
• Risk of leased facility landlord not approving or modifying space optimization required work
• Less efficient collaboration for cross-functional departments working on programs/projects from occupying 2 or more separate facilities
• Continuing to rely on less efficient building equipment and less than OPG-standard maintenance activities in the leased space

This alternative is not recommended. It will not optimally meet Northwest Operation's operational and functional requirements and would represent a lost opportunity to enhance OPG's ability to effectively operate NWO's facilities and more efficiently perform project work. It is also a less cost effective alternative.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 "Delay Work" would involve ceasing all remaining execution work and deferring the project to a future date. This alternative still necessitates completing substantial infrastructure remediation efforts at the current Burwood facility, while maintaining a less efficient arrangement of staff spread across multiple work locations in Thunder Bay. This alternative also continues to accept the risk associated with the majority of Thunder Bay-based staff occupying leased spaces on an interim basis.

Advantages:
• Less upfront capital expenditure
• Ultimately addresses the concerns related to the failing infrastructure at NWO's Burwood facility

Disadvantages:
• Risk of occupying leased space until Work Centre is constructed
• Increased cost to build in future due to escalation
• The duplication of spending capital dollars to sustain Burwood to then vacate the facility in the future
• Still requiring the space optimization work at Premier Way and accepting the risk of the leased facility landlord not approving required modifications
• Interim less efficient collaboration for cross-functional departments working on programs/projects from occupying 2 or more separate facilities
• Continuing to rely on less efficient building equipment and less than OPG-standard maintenance activities in the leased space
• Greater capital costs from completing Burwood remediation efforts as well as constructing the new NWO Work Centre

This alternative is not recommended as there are higher costs associated with completing remediation efforts to sustain OPG's operations at the Burwood facility in the interim, while deferring the construction of a new NWO Work Centre to a later date when compared to the preferred alternative.

Alternative 4:	**Construct a new Thunder Bay Service Centre and NWCC and keep existing leased space**	For Project Level A, B

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Business Case Summary

Alternative 4 "Construct a new Thunder Bay Service Centre and NWCC and keep existing leased space" would involve ceasing all remaining execution work on the new NWO Work Centre and completing new Definition and Execution Phase activities to construct a new Thunder Bay Service Centre and Northwest Control Room, estimated at $34.5M. This alternative would still maintain a less efficient arrangement with staff spread across multiple work locations in Thunder Bay require OPG to continue to accept the risk associated with the majority of Thunder Bay-based staff occupying leased spaces.

Advantages:
• Addresses the concerns related to the failing infrastructure at NWO's Burwood facility

Disadvantages:
• Significant risk of occupying leased space
• Risk of still requiring the space optimization work at Premier Way to maintain functional groups in the same work location and accepting the risk of the leased facility landlord not approving required modifications
• Less efficient collaboration for cross-functional departments working on programs/projects from occupying 2 or more separate facilities
• Continuing to rely on less efficient building equipment and less than OPG-standard maintenance activities in the leased space
• Greater financial cost over the asset life of the facilities when comparing to the preferred alternative

This alternative is not recommended as it will not fully meet Northwest Operation's operational and functional requirements and has a greater financial cost over the asset life of the facilities when comparing to the preferred alternative.

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Technical	Unknown stabilization performance of sub-surface soil	Accept	Medium
Procurement - Materials	Increased Material Costs based on current/forecasted commodity prices	Mitigate 71410 - Design new building with most cost effective materials and methods (ie. wood vs steel; siding vs brick; stick frame aux buildings vs pre-engineered); - Conduct value engineering exercise to determine feasible cost savings; - Obtain fixed price contract for construction to mitigate risk	Medium
Stakeholder/Reputational	Public Opposition may Delay Project Timeline	Mitigate 72857 - Early engagement of local communities; - Exploring local community business opportunities (if applicable); - Regular engagement with OPG Stakeholder Relations department throughout project lifecycle 10/30/2026	Medium

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
NPV	42,133	45,757	>42,133	47,024	
Analysis of Financial Evaluation – Key Assumptions and Key Results:					

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Business Case Summary

The Preferred Alternative "New NWO Work Centre" is based on a Class 3 estimate from a contractor submitted Fixed Price from the vendor.

Alternative 2 "Base Case - No Project", Alternative 3 "Delay Work" and Alternative 4 "Construct a new Thunder Bay Service Centre and NWCC and keep existing leased space" largely use prorated project costs for the required scope items, which are proportionally scaled based on known scope items from the Preferred Alternative or other OPG analogous project actuals.

Preferred Alternative Cost Estimate:
- Project Life:
1. Project in-service by: March 2027
2. Useful life: 55 years
3. Class 3 estimate based on vendor's fixed price contract for construction of new NWO Work Centre

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Alternative 2 - No Project:
- Project Life:
1. Project in-service by: Dec 2028
2. Useful life: 55 years
3. Class 5 estimate for required renovations at OPG's Burwood facility
4. Lease costs based on a 10-year term using base rent and additional rent model for Premier Way facility. Under the 10-year term, base rent is set for the first five years with a 15% adjustment in year six and additional rent is escalated by 5% annually

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Alternative 3 - Delay Project:
- Project Life:
1. Project in-service by: Dec 2032
2. Useful life: 55 years
3. Class 5 estimate for required renovations at OPG's Burwood facility
4. Class 3 estimate based on vendor's fixed price contract for construction of new NWO Work Centre
- Alternative 3 requires renovations at OPG's Burwood facility, a lease extension at the Premier Way facility and future construction of the new NWO Work Centre which makes Alternative 3 not feasible from a cost perspective
---

Alternative 4 - New Thunder Bay Service Centre & NWCC:
- Project Life:
1. Project in-service by: Dec 2029
2. Useful life: 55 years
3. Class 5 estimate for construction of a new Service Centre facility
4. Lease costs based on a 10-year term using base rent and additional rent model for Premier Way facility. Under the 10-year term, base rent is set for the first five years with a 15% adjustment in year six and additional rent is escalated by 5% annually.

Qualitative Factors — For Project Level A or B

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Business Case Summary

The NWO Work Centre Project aligns with OPG's core business goals and strategic commitments.

Health & Safety Improvements:
• Address slip and trip hazards due to lot drainage at Burwood facility
• Eliminate septic system maintenance at Burwood
• End reliance on inadequate third-party parking lot maintenance at Premier Way

Improved Operational Excellence:
• Upgrade Northwest Control Centre to meet NERC standards, enhancing safety and reliability with a functional space for UPS and backup generator
• Create an emergency-ready control centre with dedicated facilities for staff isolation and operator use
• Provide more efficient workspace for operators, which has increased collaboration and engagement space, with a separate Work Protection Room and support staff work areas

OPG's Climate Change Plan:
• Developed an energy model to determine the most economical and more efficient combination of building characteristics to minimize HVAC operating costs and GHG emissions
• Design of the NWO Work Centre incorporated measures to produce a net-zero building under Canada's Zero-Carbon Building Standards
• Incorporate energy-efficient HVAC systems requiring less equipment and install effort for heating and cooling, eliminating the need for onsite fossil fuel combustion
• Reduce embodied carbon footprint through material selection, such as: a wood-steel hybrid framing, specifying SCMs in concrete, using mineral wool insulation, plywood sheathing, cladding with recycled-content and low-embodied carbon flooring materials

OPG's Equity, Diversity, and Inclusion Strategy:
• A fully accessible work environment for individuals with disabilities, featuring accessible parking spaces, washrooms, elevators, greenspaces, and internal wayfinding signage.
• A variety of washroom styles including gender-neutral washrooms.
• A dedicated multipurpose "Quiet Room" designed to meet various staff needs.

OPG's Reconciliation Action Plan:
• Complete construction RFP under OPG's Vendor of Record Agreements to provide opportunities for Indigenous Businesses to bid of construction work
• Procure an Indigenously owned business to provide construction services throughout execution
• Design to incorporate local gifts and artwork from Indigenous partners within the region
• Provide a meeting space with upgraded HVAC to host Indigenous gatherings and to have the ability to conduct traditional practices within the Work Centre

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2029-03-24

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
All Thunder Bay-based staff occupying the new NWO WC	Occupying one OPG-owned facility and two floors of a non-OPG owned leased facility	All Thunder Bay-based staff occupying a single OPG-owned facility	OPG's real estate portfolio will decrease for Western Operations	OPG Real Estate

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	84901 - NWO WORK CENTRE BUILDING						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management	6								6	0
1 - Project Management	290	86	191	55					622	1
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	2,052	5,647	31,516	5,183	9				44,407	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.60	Interest Rate (going-forward)	4.39

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
84901	2027-02-26	Main and Auxiliary Buildings	34,702	87.0
84901	2027-07-23	Siteworks and Landscaping	5,210	13.0
84901	2028-03-30	PCR	9	0.0
		Total:	**39,921**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jeff Myllyaho Project Leader Northwest Project Management 2	2025-07-08	Laura Hurley Director Asset & Project Mgmt Western Region Production Support	2025-07-11

Business Case Summary

Total Project Estimate Variance Explanation
Definition, Gate 2 Estimate based on: - Historic project costs per sq/ft using best known data at the time - Estimate completed prior to detailed design, building specifications or auxiliary building requirements - Costs did not include contingency - Cost values used were a Class 5 estimate (-50 to +100%), but weren't displayed in the BCS with the appropriate range - Cost based on reduction of building footprint from initial conceptual design Execution, Gate 3: Estimate based on: - 100% fixed-price submission by vendors - Class 3 Estimate, including contingency - All scope items included (auxiliary buildings, interior fit-up) - Building footprint(s) expanded due to staffing increases during the design phase period

Appendix C: Financial Evaluation Assumptions	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing
Key assumptions used in the financial model of the project are:	
Preferred Alternative Assumptions: - OM&A Expenses & Sustaining Capital: 1. Annual Operating Costs: $81k (in 2027) escalated by 2.5%/year (same cost as current Burwood facility - reduced Natural Gas cost and increased Electricity cost due to design and larger footprint) 2. New Build Property Tax Rate (2027): current 4.203% escalated by 2.5%/year (all-encompassing adjustment as this considered both the potential MPAC increase in assessment value and any increase in the tax rate applied by the Municipality) 3. Total sustaining costs (over 55 year useful life): omitted as it is assumed to be the same over all scenarios (ie. roof replacements, window replacements, yard repairs, etc) Alternative 2 Assumptions: - OM&A Expenses & Sustaining Capital: 1. Annual Operating Costs: $81k (in 2027) escalated by 2.5%/year (similar costs as new NWO Work Centre facility - increased Natural Gas cost and decreased Electricity cost due to design and smaller footprint) 2. Premier Way Lease Costs: Includes current 1st and 2nd Floor Lease costs at Premier Way (based on RES estimated 10 year lease costs for 1st and 2nd floor at Pway) 3. Burwood Property Tax Rate (2024): current 4.203% escalated by 2.5%/year (all-encompassing adjustment as this considered both the potential MPAC increase in assessment value and any increase in the tax rate applied by the Municipality) 4. Burwood Property Tax Rate (2029): Valuation increasing to $5.968M after renovations. using same escalation factor from above for Property Tax Rate 5. Total sustaining costs (over 55 year useful life): omitted as it is assumed to be the same over all scenarios (ie. roof replacements, window replacements, yard repairs, etc) Alternative 3 Assumptions: - OM&A Expenses & Sustaining Capital: 1. Annual Operating Costs: $81k escalated by 2.5%/year (similar costs to current new NWO Work Centre facility - increased Natural Gas cost and decreased Electricity cost due to design and smaller footprint) 2. New Build Property Tax Rate (2033): current 4.203% escalated by 2.5%/year (all-encompassing adjustment as this considered both the potential MPAC increase in assessment value and any increase in the tax rate applied by the Municipality) 3. Total sustaining costs (over 55 year useful life): omitted as it is assumed to be the same over all scenarios (ie. roof replacements, window replacements, yard repairs, etc) Alternative 4 Assumptions: - OM&A Expenses & Sustaining Capital: 1. Annual Operating Costs: $81k escalated by 2.5%/year (same cost as current Burwood facility - reduced Natural Gas cost and increased Electricity cost due to design and slightly larger footprint) 2. New Service Centre Build Property Tax Rate (2030): current 4.203% escalated by 2.5%/year (all-encompassing adjustment as this considered both the potential MPAC increase in assessment value and any increase in the tax rate applied by the Municipality) 3. Total sustaining costs (over 55 year useful life): omitted as it is assumed to be the same over all scenarios (ie. roof replacements, window replacements, yard repairs, etc) 4. Premier Way Lease Costs: Includes current 1st and 2nd Floor Lease costs at Premier Way (based on RES estimated 10 year lease costs for 1st and 2nd floor at Pway)	

ONTARIO POWER GENERATION

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Business Case Summary

Project #	84907	**BCS Document Number**	FJ32-PLAN-28000-0002 R3
Project Title	84907 - OTTER PROJECT CAMP		
Facility	OTR - OTTER RAPIDS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2025-Jan-31
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $38.6 M including [redacted] of contingency for the execution of the Otter Project Camp.

This will bring the total released to date and total project cost to $ 39.5 M.

This full execution release will fund the engineering, procurement and construction of the temporary Otter Rapids Project camp, including the camp facilities such as Otter Rapids office trailers, Hydro One, ONTERA and sewage works connection. The temporary camp will accommodate contractors during overhauls scheduled from 2024-2033 and may support other projects in the future. Additionally, the camp is mobile and capable to support other site locations should the need arise. Operation and maintenance costs will be funded by the projects utilizing the camp. Due to the potential for future accommodation needs and the possibility to extend the use of the camp beyond 2033, decommissioning and site rehabilitation costs will be covered under a separate future project

The previous release provided support for Indigenous Relations Consultation, regulatory permitting processes, the development and award of the Camp RFP, as well as establishing the terms and conditions and assumptions. The previous release also supported geotechnical studies, survey work, design work, ordering long lead items and hiring an owners engineer to review the camp designs.

Investment Cash Flows

Project Number	84907 - OTTER PROJECT CAMP					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	877								877
Currently Requested	294	32,871	5,430						38,595
Total released to date	1,171	32,871	5,430						39,472
Future required	0								0
Total Project Cost	1,171	32,871	5,430						39,472
Ongoing Costs	0								0

Total OAR Approval	39,472.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Bruce Robertson VP Regional Operations Eastern Region	Bruce Robertson	2023-04-04
I concur with the business decision as documented in this BCS.		

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Business Case Summary

Finance Approval : **Maha Tam** **VP Controllership**	Maha Tam	2023-04-04
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Paul Seguin** **SVP Renewable Generation**	Paul Seguin	2023-04-06

EXECUTIVE SUMMARY – Project Overview

Background:
There are several planned projects at Otter Rapids Generating Station (ORGS) scheduled for execution from 2024 to 2028 as well as planned projects scheduled for execution at Abitibi Canyon Generating Station (ACGS) from 2028-2033. These projects will require a high number of construction contractors and trades on site, the estimated scope and timing of these projects is listed below:

Otter Rapids Generating Station (2024 to 2028)
1. Four (4) Runner replacements
2. Four (4) Breaker and Exciter Replacements
3. Four (4) Unit Overhauls
4. Four (4) Sluice Gate Replacements;
5. Four (4) Penstock Grouting
6. Tailrace Piers/Gain Repairs

Abitibi Canyon Generating Station (2028-2033)
1. Sluice Gate Hoist Replacement
2. East/West Dyke Riprap
3. Four (4) Headgates Replacement
4. Four (4) Unit Overhauls
5. Main Dam Concrete Repair
6. Spillway Dam Liner and Grout
7. Sewage System Upgrades

Problem:
The ORGS is approximately two hours from the nearest community and the ACGS is one hour away, requiring significant travel time for workers to and from site. The extended commute increases safety risk for workers travelling to site in Northern Ontario weather conditions, as well as increases carbon emissions to the environment.

Furthermore, the Abitibi Canyon staff house and the northern small towns of Cochrane and Smooth Rock Falls cannot accommodate all workers during the execution of the aforementioned projects. With limited accommodation in the surrounding area and the unknown future possibility of economic demand in the area, the small towns are not justifiable or reliable options. To address this problem, the proposed solution is to install a temporary project camp near the Abitibi Canyon Generating Station.

Business Need

For Project Level A or B

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Business Case Summary

It is recommended that a temporary construction camp be established in close proximity to ACGS in order to reduce employee and project risks during the planning work listed above. The execution of this project will ensure that the camp design and installation are ready to accommodate the many workers who will be executing the Otter and Abitibi projects listed above. Additionally, the camp is designed to be able to move and possibly support other locations beyond the projects listed above. The camp will provide the following benefits:

• Reduce travel time for workers
• Reduce highway safety risk for workers i.e. weather, wildlife and traffic burdens
• Increased benefit for the environment i.e. less carbon emissions
• Increased productivity and ability for resource availability to meet the base requirements
• Support future project locations beyond 2033

The camp will also support meeting the Employee Standards Act daily and weekly hours of work limits, understanding that traffic and weather conditions can impact travel time in these remote areas of Northern Ontario.

Lastly, the temporary camp will support OPG's Strategic Objectives:
- Value through Innovation and Efficiency, the Camp will reduce travel safety risks for workers and reduce associated travel costs, while allowing the many Otter and Canyon projects to be completed within their allotted schedules. The camp project team has engaged with Hydro One to ensure cleaner and more reliable energy source to support our OPG Leadership Targets for Climate Change.
- Putting Customers and Communities First, the Camp will support OPG's Climate Change Strategy as well as our Indigenous Relations and Indigenous Business and help meet OPG's Reconciliation Action Plan with local Indigenous business.
- Energy Industry Leader, the entirety of projects this camp supports drives sustainable generation for Ontario.

Preferred Alternative:	Design, install, operate and maintain a construction camp located in close proximity to ORGS	For Project Level A, B or C
Description of Preferred Alternative		

The preferred alternative is to install a temporary camp to house construction contractors and Abitibi Canyon staffhouse overflow staff during the construction activities from the list of projects identified in 'Executive Summary' above. The camp will be located at Abitibi Canyon and can house a total of 120 people, and is expected to be used from 2024 to 2033 at minimum.

The project team will utilize a design build contract strategy to execute this work and it will be an owner only project. The operation and maintenance costs for the camp, including transportation and road maintenance will be funded by the projects that utilize the camp after construction. Decommissioning and restoration costs are not included in our costs, as the end date or final location beyond 2033 for this temporary camp is not currently contemplated; therefore, these will be covered under a separate projects cost. The camp is designed to be mobile and can move to other sites with a design life of up to 25 years.

The Abitibi Canyon camp location meets the Business Need based on the comparative travel time calculations. Abitibi Canyon was compared to having no camp operating over a 10-year duration. Below is the comparison between Abitibi Canyon camp and having no camp, the reductions are:
• Average Individual Employee Travel Time reduced by 11,370 hrs, and
• Average Total Employee Travel Time reduced by 1,670,880 hrs
See Attachment A for comparing average employee and total employee travel time

The temporary camp will support reduced time travelling and safety risks for the workers, lessen uncertainty with accommodation demands in small communities, as well as lessen the impact on the environment due to less travel and potentially support future projects that require accommodation.

The Definition Phase Funding work complete to date includes:
- Consultation with regulators, ONR, Hydro One, ONTERA and local First Nations
- RFPQ and RFP evaluations
- Contract Negotiations
- Geotechnical Investigations and Survey
- 60% Engineering Camp Designs
- Hire Owner's Engineer to review designs
- Indigenous Community Engagement Planning

The Full Execution funding release will support:
- Finalizing the Civil, Mechanical, Electrical detailed design of camp, and Otter Rapids trailers
- Shop fabrication of camp and Otter Rapids trailers
- Site preparation activities
- Mobilize, Install and Commission the camp and Otter Rapids trailers
- HONI, ONTERA and sewage works connections
- Finalize Indigenous Relations Engagement Plan
- Regulatory approval (if applicable)
- Onboarding of Owner's Engineer

Lessons Learned / Experiences:
OPG has built camps at multiple remote locations in the past, including: Peter Sutherland Senior, Little Long Dam Safety Project and Lower Mattagami Redevelopment Project. OPG will utilize Lessons Learned from these projects.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Definition Phase BCS for Camp	Gate G2 Approval		2021-05-05
Technical Specification	Bids Received		2021-11-04
Contract Negotiation	Contracts Awarded		2022-06-15
Issue RFP for Owner Engineer (design review)	Contracts Awarded		2022-12-09

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Full Execution BCS	Gate G3 Approval		2023-03-17
Installation of office trailers and washcars	Start of Installation		2023-05-29
Installation of office trailers and washcars	Finish of Installation		2023-06-11
Office Trailers and Washcar in service	Available for Service and/or Ready For Service Completed		2023-06-11
Installation of camp facilities	Start of Installation		2023-07-06
Installation of camp facilities	Finish of Installation		2024-04-01
Commission construction of camp facilities	Commissioning Finished		2024-04-01
In Service / Ready for Accommodation	Available for Service and/or Ready For Service Completed		2024-04-07
Lessons Learned after construction	Lessons Learned Compiled		2024-12-06
Close Out	Project Close Out Completed		2025-01-31
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
Executing the Base Case option will significantly increase the contractors travel hours, which in turn has a higher transportation health and safety risks. The transportation risks include more exposure to roadway hazards such as fluctuating northern weather, traffic accidents, and wildlife encounters. The increased traffic will also have a negative impact on our nearby community residents and our first nation community members.		
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
Delaying the work has many associated risks listed above which would cause for higher chance of project delays during the execution of the multiple projects taking place at both Otter Rapids and Abitibi Canyon. As highlighted in Alternative 2 above, OPGs projects are located a considerable distance away from nearby communities that cannot accommodate the number of contractors needed to support our projects.		
Alternative 4:		For Project Level A, B

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Other	Sufficient water availability	Transfer 59133 - Hire contractor 1/31/2024	Low
Stakeholder/Reputational	Local First Nations Challenges Land Use and Employment Structure	Mitigate 53710 - Local First Nations may challenge the contract award. 4/28/2023	Low

Additional Risk Analysis	For Project Level A or B

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Business Case Summary

Risks are registered in the online risk tool ePRM. A Monte Carlo model analysis was performed resulting in a recommended P90 cost contingency of [redacted]

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects.

Qualitative Factors — For Project Level A or B

Execution of the preferred alternative will result in the following qualitative benefits:
- reduce travel time for workers
- reduce highway safety risk for workers i.e., weather, wildlife and traffic burdens
- support future project locations beyond 2033
- support meeting the Employee Standards Act daily and weekly hours of work limits, while understanding the traffic and weather conditions can impact travel time in these remote areas of Norhtern Ontario
- support less roadway use which in turn supports safe road conditions, in turn support our stakeholders' relations and First Nation Community who utilization of this roadway for their traditional uses

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2025-01-31

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	84907 - OTTER PROJECT CAMP						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**	**%**
0 - Cost Management										0
1 - Project Management	461	229	285						975	2
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	1,171	32,871	5,430						39,472	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
84907	2023-06-11	Office trailer and washcars in service	2,504	6.7
84907	2024-04-07	Camp in Service and ready for accommodation	35,064	93.3
		Total:	**37,568**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Wendy Cudmore Project Leader PM Group 1	2023-03-14	Brad Bacvar Director Asset & Project Mgmt Production Support	2023-03-20

ONTARIO POWER GENERATION

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Business Case Summary

Project #	86364	**BCS Document Number**	NF20-BCS-08707.021-0038
Project Title	86364 - SAB1 STATION SERVICE UPGRADE		
Facility	BK1 - SIR ADAM BECK 1	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - b (Full)	**Target Project Completion Date**	2031-May-23
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $10,531 K, including [redacted] of contingency. This will bring the total released-to-date to $12,148 K, including [redacted] of contingency.

The estimated total project cost range is between $30 M and $45 M.

The scope of this project is to upgrade the SAB1 AC station service including the replacement/installation of MV & LV switchgears, transformers, ATS, AC panels, reactors, 120/208 panels, and lightings. The major equipment will be installed on 6th floor of SAB1 station.

This release is for Definition phase activities including detail design completion, electrical equipment procurement, and RFP for Installation.

Investment Cash Flows

Project Number	86364 - SAB1 STATION SERVICE UPGRADE					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	961	618	38						1,617
Currently Requested	0		6,619	2,958	954				10,531
Total released to date	961	618	6,657	2,958	954				12,148
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	12,148.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Kent Keeler Director Asset & Project Mgmt Production Support Manager	Kent Keeler	2023-06-30
I concur with the business decision as documented in this BCS.		
Finance Approval : Melissa Hannon Director Controllership	Melissa Hannon	2023-07-06

ONTARIO POWER GENERATION

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Nicholas Pender** **VP Regional Operations**	Nicholas Pender	2023-07-06

EXECUTIVE SUMMARY – Project Overview

The AC Station Service System at SAB1 has an original infrastructure to station which has exceeded its reliable operating life due to age, condition, and capacity. Majority of components within the infrastructure were last replaced in 1983 and have also exceeded their reliable operating life.

The preferred alternative will replace and relocate the equipment associated with the AC Station Service System (e.g. transformers, switchgears, disconnects, distribution panels, cables) and provide another 30 years of equipment life. This alternative has a minimal impact to operations (outages), reduces on-going maintenance, reduces environmental risks and provides improvements to operability.

The following work was completed in the previous Definition Phase (Gate 2A) release: award Engineering contract to conduct the phase one and two definition work including Electrical Design Studies, Electrical Equipment Specifications, issuing of RFP for Long Lead Electrical Equipment, and completion of 30% of the detail design.

This Full Definition Phase (Gate 2B) release will fund: completion of the detail design for phase one and two, procurement of long lead equipment, RFP for installation contractor and OPG project management and engineering activities.

The $10.5 M requested includes: $6.8 M for the RFP for installation contractor, long lead equipment procurement, and installation & commissioning documentation/specification; $1.5 M to continue the scope from previous release for the detail design, OPG Project management & engineering activities completion. The remaining requested funds will cover interest and contingency.

The project key risks include:
• Inadequate engineering resources during the definition & execution phase of the project.
• Discovery work for out-of-scope engineering during design phase and equipment removal and installation work.

Business Need

For Project Level A or B

To provide a reliable station service system that will effectively meet the needs of SAB1 over the next 30 years and minimize the current safety concerns regarding visible contacts.

Preferred Alternative:	Full System Replacement	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative will relocate and replace the AC Station Service equipment in two-phases.
Phase 1: Replace 13.8 kV to 600 V distribution equipment.
Phase 2: Replace 208/120V distribution equipment and station lighting.

The electrical equipment that is included in this scope of work is:
• Replace and Relocate 13.8 kV Transformers, 15 kV Motorized Disconnects, Switchgear, and 600 V Distribution Panels, current limiting reactors.
• Replace and Relocate Lighting Transformers, 208/120 V Distribution Panels, and Station Lighting.
• All cabling between equipment.

The execution strategy is to install the new system in parallel, cutover from old to new, then remove the existing system.

Advantages:
• Less outage time required for future maintenance work.
• Reduction of environmental risks associated with the new electrical equipment.
• Reduced exposure to live equipment and arc flash potentials.
• Compliance with current codes & standards.
• Mitigation of end of life and obsolescence issues.

Disadvantages:
• High capital cost
• Longest schedule compared to the other alternatives

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
G1BCS Approval	Gate G1 Approval		2020-12-20
G2A BCS approval –Studies & Specifications	Gate G2A Approval		2021-03-17
RFP for Engineering design contract award	ESMSA_ RFP Package Issued to Vendors		2021-04-14

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
G2B BCS approval	Gate G2B Approval		2023-07-28
RFP for LLM Equipment	LLM_RFP Issued		2023-08-29
PO for Long Lead Equipment	LLM_Contract Awarded PO Issued		2024-02-06
Detailed Engineering Complete	Detailed Design Complete		2025-08-15
RFP for Installation Contractor	ESMSA_ RFP Package Issued to Vendors		2026-04-08

Future Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
G3 BCS approval	Gate G3 Approval		2026-11-11
Start of Installation	Start of Installation		2027-08-23
Finish of Installation	Finish of Installation		2029-11-08
Available for Service (AFS)	System AFS Complete		2030-04-24
REIS Approval	Report of Equipment in Service		2030-05-22
PIR Approval	Post Implementation Review		2031-05-23
PCR Approval	Project Close Out Completed		2031-05-23

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
This alternative would force the continued use of current system components and limit the availability of electric heating within the station. With the north and south load centers in suspect condition, it will lead to increase OM&A costs or the critical failure of a load center. This has the high potential to force generators out of service. This alternative does not meet the business need of providing reliable station service.		
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
This alternative would delay the execution of Phase 2 portion of the project. As highlighted in preferred alternative above, the Station Service components are nearing the end of their service life and require replacement as recommended in the Initiation Phase. By delaying the phase 2 scope the risk of component failure will continue to increase. The life cycle cost will also increase due to increased maintenance of the component failure, loss of work efficiency not doing work phase 2 at same time, increase cost associated for future project, and escalation from deferring.		
Alternative 4:		For Project Level A, B
N/A		

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Resources	Internal Resource Constraint (Engineering, Project, PWU)	Mitigate External engineering and project support contracts will be set up to support project execution and engineering work. - Create WO to reserve the PWU support - Discussion with Engineering to reserve Final TCD: Apr/24/2030	Medium
Procurement - Materials	Delay on issuing the POs of Long Lead Equipment	Mitigate Allow float in schedule for RFP process. Final TCD: Feb/06/2024	Medium
Health and Safety	Potential hazardous materials exposure to lead & asbestos during construction	Mitigate Perform hazardous materials testing prior to construction work starts. Final TCD: May/27/2027	Low
Licensing & Regulatory	Outage- IESO acceptance on unit outages	Mitigate Early submission of iTOA slips to reserve outage time. Final TCD: Nov/05/2026	Medium
Technical	Discovery work during equipment removal, equipment installation	Mitigate Perform a thorough site survey to gather missing information. Validate engineering documents. Establish and follow a clear change management procedure for the project. Allocate enough contingency to deal with potential changes during design and execution of work. Final TCD: Apr/24/2030 12/10/2025	Medium
Technical	Design changes / Addition in scope	Accept Manage through scope change process. Allocate enough contingency to deal with potential changes during design Final TCD: Aug/15/2025	Low

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Business Case Summary

Additional Risk Analysis	For Project Level A or B
Risks are registered in the online risk tool ePRM. A Monte Carlo model analysis was performed for the Definition Phase scope resulting in a recommended cost contingency of [redacted].	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for Sustaining Projects.

Qualitative Factors	For Project Level A or B

Execution of the preferred alternative will result in the following qualitative factors:
- Restore integrity, long-term reliability and ensure the continued availability of the SAB1 Station Service components
- Reduce risk of forced outage due to component failure
- Implement component and system design improvements to improve health and safety and operational performance

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2031-05-23

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
to be defined at G3 phase				

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86364 - SAB1 STATION SERVICE UPGRADE						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2023	2024	2025	2026	2027	2028	Future	Total	%
0 - Cost Management										0
1 - Project Management	190	125	226	179	186				906	7
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	961	618	6,657	2,958	954				12,148	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	4.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
		TBD - During EXE Phase		
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Manan Patel Project Leader SAB I & II Projects	2023-06-27	Kent Keeler Director Asset & Project Mgmt Niagara Production Suppor	2023-06-28

ONTARIO POWER GENERATION

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Business Case Summary

Appendix C: Financial Evaluation Assumptions	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing
Key assumptions used in the financial model of the project are:	
N/A	

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OPG-FORM-0076-R006*

Business Case Summary

Project #	86372	**BCS Document Number**	NF20-BCS-08707.021-0056
Project Title	86372 - BK1 G6 G8 REFURBISHMENT		
Facility	BK1 - SIR ADAM BECK 1	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - (Full)	**Target Project Completion Date**	2030-Dec-12
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 4

Recommendation

We recommend a release of $33,693K, including [redacted] of contingency.

This will bring the total released-to-date to $44,081K, including [redacted] of contingency.

The estimated total project cost range is between $220M and $300M.

This project is to refurbish SAB1 G6 & G8 units in order to ensure their reliable operation for the next 25-30 years, including:
- Inspection and remedy for the civil systems;
- Electrical systems refurbishment (generator, and other electrical equipment);
- Mechanical systems refurbishment; and
- Replacement of end-of-life components, including Main Output Transformer (MOT), runner, head cover, wicket gates, protection and control (P&C), governor systems, excitation system, and replacement of unit breaker.

This release will fund Definition Phase activities, including project management, detailed engineering, supply chain activities and procurement of long lead items.

Investment Cash Flows

Project Number	86372 - BK1 G6 G8 REFURBISHMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0	1,567	7,333	1,489					10,389
Currently Requested	0		2,336	17,676	7,868	4,321	1,491		33,692
Total released to date	0	1,567	9,669	19,165	7,868	4,321	1,491		44,081
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	44,081.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicole Fabbro VP Regional Operations VP Niagara Operations	Nicole Fabbro	2025-05-20

ONTARIO POWER GENERATION

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Business Case Summary

I concur with the business decision as documented in this BCS.		
Finance Approval : **Maha Tam** **VP Ops & Projects Controllership**	Maha Tam	2025-05-22
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Nicholas Pender** **SVP Renewable Generation& Energy Markets**	Nicholas Pender	2025-05-29

EXECUTIVE SUMMARY – Project Overview

The Sir Adam Beck 1 (SAB1) hydroelectric power station, consisting of 10 units, has been operational since the 1920s.

The last major refurbishment on these units were in 1990 for G8 and 1995 for G6. These are the last two SAB1 units requiring refurbishment. Major hydroelectric unit refurbishments are typically required every 25 to 30 years to maintain reliability. Recent condition assessments have confirmed that the reliability of both units is decreasing due to normal wear and aging. Given these reliability issues, there is a lack of available spare parts since the Original Equipment Manufacturer (OEM) no longer makes or supports the existing parts leading to prolonged outages for repairs. This project is to ensure long-term reliable operations for a minimum of 25-30 years for SAB1 G6 & G8, while modernizing the generating unit and increasing its capacity by an estimated 4.9MW per unit.

The preferred alternative is to complete a unit refurbishment on G6 & G8 (major refurbishment - refurbish and replacement of some components). The project consists of performing a mechanical and electrical refurbishment of the generating unit. Obsolete and end of life equipment (protection and controls equipment, Main Output Transformer, etc.) will be replaced to ensure cost effective, clean and renewable electricity production.

This project aligns with the Energy Minister's announcement on April 15, 2024, stating that "Niagara Hydro Stations are set to be refurbished, securing about 1,700 MW of clean power for another 30-plus years". It also supports the Provincial Government's "Powering Ontario's Growth Plan", released on July 10, 2024, in response to public consultation on the Independent Electricity System Operator's Pathway to Decarbonization, which aims to achieve a net-zero economy by 2050.

OPG plans to work with the OEM vendor partner under the RG Programmatic Collaborative Agreement (PCA), employing a Design Build Contracting Strategy and Target Pricing structure to provide engineering, procurement, and construction services for the project. Vendor partners from the G4 Major Refurbishment and the SAB2 Refurbishment Program will be engaged to incorporate lessons learned, ensure equipment consistency and designs, and to drive programmatic efficiency.

The contracting and procurement strategy on the SAB Refurbishment Program includes:
1) A primary OEM vendor partner that is engaged to engineer, procure components, and construct in alignment with the planned schedule, and
2) Specialized suppliers for P&C equipment and MOTs (T6 & T8).

The previously approved scope was released for the Development Phase (Gate 1) and completed:
- Detailed scope of work and project labour determination.
- Project management plan and quality plans for the work.
- Site assessments and functional specifications.
- Procurement and contracting strategies.
- Initial RFP packages for detailed design and long-lead components.
- Purchase of the T6 MOT.
- OEM runner development, front-end engineering design (FEED), project management, and long lead procurement.

This Definition Phase (Gate 2) release will include: project management, project engineering, supply chain management and procurement of long lead materials, and related project activities for the detailed mechanical design of the new runner and progressing through 30% and 60% design stages for various turbine and generator components along with their associated systems.

This released funds will be used to complete the following:
1) Engineering (detailed design completion to 60%).
2) Procurement of long lead items.
3) Contract release for P&C design and long lead procurement.
4) Purchase of the T8 MOT.

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Business Case Summary

A future Execution Phase (Gate 3) release will include: completion of 100% design for mechanical, civil and electrical balance of plant (BOP), procurement of all remaining equipment and material, and full execution for the construction, commissioning and project closeout.

The key risks for this project include equipment costs, procurement and resourcing.

The equipment costs are a key factor in the overall project costs, and any substantial changes would have a direct impact. The mitigation efforts include leveraging the PCA with the OEM to secure capacity and early cost estimates for key long lead items such as Runners, Circuit Breakers, and Transformers.

The risk of procurement challenges may result in significant delays or cost increases. This could delay engineering activities and the procurement of long-lead materials, impacting the equipment delivery timelines and critical path milestones. This is being mitigated by working with vendors on cost and schedule reductions and planning local supply of components where possible.

There is a risk of limited resources and potential challenges with work group integration which may delay schedule and project milestones. These schedule delays include the possibility of engineering delays caused by the availability of engineering design drawings and calculations which could require additional equipment condition assessments. The mitigation efforts include use of resource allocation plans, implementing early engagement of key resources and adopting a collaborative approach between teams.

Business Need	For Project Level A or B

The business objective is to ensure the reliable and safe operation of the SAB1 Unit G6 & G8 for the next 25-30 years. The last major refurbishment on these units were in 1990 for G8 and 1995 for G6. Engineering assessments have indicated a decline in unit reliability due to normal wear and aging equipment. G6 & G8 are currently subject to operating restrictions due to degraded equipment performance and the lack of availability of obsolete spare parts. Unit maintenance outages often require extensive repairs. Adhering to the scheduled refurbishment is crucial to achieving the project's objectives.

This project will achieve the business need in the following ways:
1) Minimize the risk of forced outages due to unexpected equipment failure and replacement of obsolete parts.
2) Eliminate known safety hazards to ensure safe operation of the unit.
3) Ensure reliable and safe operation for the next 25-30 years.
4) Increase capacity by an estimated 4.9MW and improve runner efficiency.
5) Upgrade equipment to meet current regulatory requirements.

It has been 30+ years since the last refurbishment. If the current situation persists, unit reliability is expected to decline due to unexpected equipment failure occurring at a high frequency outside of regular scheduled maintenance outages. This could lead to longer outages and a reduction in the amount of electricity capable of being generated.

Preferred Alternative:	Refurbishment and upgrade to a higher capacity	For Project Level A, B or C

Description of Preferred Alternative

ONTARIO POWER GENERATION

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Business Case Summary

In January 2024, OPG executed a strategic 15-year PCA with the OEM to secure engineering, procurement, and construction services utilizing the Target Pricing Structure for the SAB Refurbishment Program. These units will be executed under this partnership agreement.

The preferred alternative consists of refurbishing the units and replacing components where economical or required by regulation.

The unit is planned to be uprated with a new runner and other major work scope which includes:
1) Convert the generator floating rim to a shrunk design, corn blast and re-wedge stator, replace surface air coolers, replace bearing cooling coils, refurbish brake assembly with new seals and pads;
2) Replace generator main output bus, insulators, and switches;
3) Replace MOT and exciter;
4) Replace 115 kV disconnects, voltage transformers and lightning arrestors;
5) Upgrade governor and protections and control systems;
6) New major turbine components: rotating components (runner, turbine shaft) and tower assembly (head cover, bottom ring, operating ring, and wicket gates);
7) Replace valves and piping.

Advantages:
1) Generator issues (vibration and operational constraints) are addressed proactively.
2) Capacity increase by an estimated 4.9MW per unit.
3) Reliable unit operation for the next 25-30 years.
4) Long term PCA with OEM which provides transparent pricing structure, resource stability, cost minimization, optimal project solutions, and equipment consistency.

Disadvantages:
1) Warranty on replaced components only.
2) More complex outage coordination to complete refurbishment activities.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 1 approval and BCS signed by OAR	Gate G1 Approval		2024-05-30
Contract award for OEM Engineering 30%	Design Contract Awarded/PO Issued		2024-06-28
Contract award for MOT Engineering T6	Award Contracts / PO Issued		2025-01-08

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 2 BCS Approval	Gate G2 Approval		2025-05-21
Contract Award for OEM Phase 2 Worksheet	Award Contracts / PO Issued		2025-05-30
Contract Award for P&C Upgrade Sub-Ph.1abc	Award Contracts / PO Issued		2025-05-30
OEM PO for Long Lead items Issued (Ph. 2)	Procurement Contracts Awarded/PO Issued		2026-02-02
Contract Award for OEM Engineering (60%)- Ph. 2	Detailed Design Complete		2026-02-28
Contract award for T8 MOT	Award Contracts / PO Issued		2026-03-31

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 3 approval and BCS signed by OAR	Gate G3 Approval		2026-01-09
Start of Installation / Outage G6	Start of Installation		2027-03-08
Finish of Installation G6	Finish of Installation		2028-05-09
Start of Installation / Outage G8	Start of Installation		2028-08-08
Available for Service G6	Available for Service and/or Ready For Service Completed		2028-08-10
G6 Report of Equipment	Report of Equipment in Service		2028-09-08
Finish of Installation G8	Finish of Installation		2029-09-27
Available for Service G8	Available for Service and/or Ready For Service Completed		2029-12-12
G8 Report of Equipment	Report of Equipment in Service		2029-12-24
Project Close Out	Project Close Out Completed		2030-12-12

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2 is not recommended. The base case involves the status quo, continue to maintain and repair on an as-needed basis. The equipment and structures would only be replaced or rehabilitated if either fail and unit safety concerns would not be sufficiently addressed. This alternative is impractical as an operational strategy as it would result in unscheduled significant forced outages for major maintenance and repairs in an uncoordinated and inefficient manner.

Advantages:
1) No commitment of funds.

Disadvantages:
1) No capacity increase.
2) A number of G6 & G8 components are at or nearing the end of their estimated reliable life and the failure of any of them will result in extended forced outages.
3) Mid and long-term reliability of G6 & G8 at risk.
4) Continued operating restrictions on G6 & G8.
5) Obsolete spare part availability will impact unit availability negatively.
6) Higher incidental costs to address failures as they occur in comparison to a planned refurbishment program.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 is not recommended because delaying the refurbishment does not address any issues identified with G6 & G8. Delaying the work will increase equipment risks and safety concerns. Delaying work, maintaining and repairing as needed would only address equipment after failure, causing unplanned forced outages. This project is part of a major refurbishment program with sequential execution of unit refurbishments. Following a sequential execution minimizes demobilization costs, retains experienced staff, and ensures predictability for long lead time suppliers. Thus, this alternative is not practical as an operational strategy, will result in unscheduled costly forced outages, and disrupt the program and supply chain.

Advantages:
1) Deferring large capital commitments.

Disadvantages:
1) Maintenance and repair costs due to aging components will continue and increase as equipment wears faster.
2) Several G6 & G8 components approaching the end of reliable lifespan, with failure potentially resulting in forced outages.
3) Continued operating restrictions on G6 & G8
4) Disruption to refurbishment program and supply chain partnerships.

Alternative 4:	**Full Unit Replacement**	For Project Level A, B

Alternative 4, full unit replacement, is not recommended due to higher costs with minimal incremental benefit over the preferred alternative, based on engineering assessment. Niagara Operations would undertake a project similar to the G1/G2 Replacement project and install completely new units to replace the current end-of-life G6 & G8. Unlike G1/G2, which required new generators for frequency conversion, G6 & G8 do not as they are already designed for 60 Hz.

Major work would consist of:
1) Removal of existing G6 & G8 unit and all associated equipment.
2) Installation of new generator, exciter, transformer and protection & control systems.
3) Replacement of turbine components between the remaining embedded concrete draft tube and scroll case (new turbine, turbine shaft, headcover, stay vanes, discharge ring, turbine bearing, draft tube extension, wicket gates, gate arms, links and control ring) and governor system.
4) Inspection and repairs of remaining embedded components (penstocks, scroll case, and draft tubes).

Advantages:
1) Generator issues are addressed proactively.
2) Capacity increase.
3) Re-using design elements from prior unit replacement.
4) Reliable operation for the next 25-30 years. All new components including generator (unlike preferred Alternative).
5) Warranty on the full unit.
6) Potential for shorter outage duration for installation.

Disadvantages:
1) Higher costs than the Preferred Alternative.
2) Longer planning window compared to an unit refurbishment (frequency of unit replacement projects is much lower than refurbishment projects); increasing reliability and safety risks in the interim.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Commercial (Contract/Legal)	Cost increase of equipment due to external factors	Mitigate Receive early estimates and lock in costs for Runners, Circuit Breakers, Transformers, and all long lead items that can be prioritized. Work with programmatic partners / OEM on cost reductions. 6/30/2025	Medium
Procurement - Materials	Equipment procurement / material delays due to external factors	Mitigate Current schedule has execution in 2027-2029 time frame. Runners, Circuit Breakers, Transformers are long lead items that need to be prioritized to meet 2027 delivery. Plan local supply of equipment when possible. 6/30/2025	Medium
Resources	External resource constraints of qualified vendors and technical trades available	Mitigate Initiating early planning and engaging potential vendors and Business Agents (BAs) at the union hall in advance. Early planning to allow OEM core team to be dedicated to the project and only subject matter experts (SMEs) will be shared. Strategy should be crafted during Definition phase to account for time working on the overhaul through the OEM and time working for OPG. 6/30/2025	Medium

Additional Risk Analysis — For Project Level A or B

Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards.

ONTARIO POWER GENERATION

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Business Case Summary

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial analysis is not required for Sustaining Projects.

Qualitative Factors — For Project Level A or B

Qualitative factors provided by the Preferred Alternative are listed below:

1) Ensure OPG continues to provide a reliable renewable source of emissions-free energy while reducing the environmental impact of meeting Ontario's electricity demand.
2) Allow unrestricted operation of G6 & G8, removing any operating constraints currently in place.
3) Address identified safety hazards by implementing enhancements like ergonomic improvements to generator excitation and enhanced grounding.
4) Expected decrease in the frequency and intensity of maintenance requirements.
5) Drive project excellence by leveraging the insights gained from the SAB1 G4 and G5 refurbishments, as well as other refurbishments throughout the province (SAB2, Otto Holden GS and Saunders GS), to enhance the performance of this refurbishment.
6) Refurbished generator components (stator and rotor) are expected to be in good condition, no added value in replacing them with new. G4 refurbishment stator testing to be used to support G6 G8 expectations.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2031-12-12

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
KPIs will be determined prior to Execution Phase.				

Definitions and Acronyms

KPI	Key Performance Indicator
MOT	Main Output Transformer
MW	Mega Watts
OEM	Original Equipment Manufacturers
PWU	Power Workers' Union
P&C	Protection and Control
SAB	Sir Adam Beck

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86372 - BK1 G6 G8 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management		13	251	685	213	151	1		1,314	3
1 - Project Management		391	2,584	828					3,803	9
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		1,567	9,669	19,165	7,868	4,321	1,491		44,081	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.13	Interest Rate (going-forward)	4.56

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jeff Dancy Senior Project Leader SAB1 Refurbishment Program	2025-05-16	Kevin Kaczmarczyk Project Director Refurbishment Programs	2025-05-16

Business Case Summary

Project #	86386	**BCS Document Number**	P5-BCS-40000-1398938

Project Title	86386 - KAKABEKA FALLS GENERATING STATION REDEVELOPMENT PROJECT		
Facility	KAK - KAKABEKA FALLS	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2029-Mar-30
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $474,363 K, including [redacted] of contingency. This will bring the total released-to-date to $519,000 K.

The estimated total project cost is $519 M, including [redacted] of contingency.

The Kakabeka Falls Generating Station (KFGS) Redevelopment Project will redevelop and ensure continued operation of the KFGS, addressing public safety risks and mitigating environmental impact to the shoreline and fish spawning through the elimination of the overflow surge discharge pipe over a 50 m cliff, while increase generating capacity by an estimated 12% (3 MW) and energy production by an estimated 24% (33 GWh/yr).

This release is to complete the detailed engineering, demolition of existing structures, construction, commissioning, and turnover of the redeveloped station to Northwest Operations.

Investment Cash Flows

Project Number	86386 - KAKABEKA FALLS GENERATING STATION REDEVELOPMENT PROJECT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	5,334	39,305							44,639
Currently Requested	0		181,732	212,294	74,584	4,951	800		474,361
Total released to date	5,334	39,305	181,732	212,294	74,584	4,951	800		519,000
Future required	0								0
Total Project Cost	5,334	39,305	181,732	212,294	74,584	4,951	800		519,000
Ongoing Costs	0								0

Total OAR Approval	519,000.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer		
I concur with the business decision as documented in this BCS.		
Finance Approval : Aida Cipolla CFO & Corporate Services Officer		

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.

Line Approval per OAR : **OAR Element : 1.1** **Ken Hartwick** **President & Chief Executive Officer**		

EXECUTIVE SUMMARY – Project Overview

Ontario Power Generation (OPG) is undertaking the redevelopment of the Kakabeka Falls GS (KFGS) to revitalize the aging hydroelectric station as a priority due to its condition and service life. It is a four-unit hydroelectric station located 40 km west of Thunder Bay on the Kaministiquia River, with an installed capacity of approximately 24.4 MW. The turbine-generator (T/G) units are original and were placed into service from 1906 to 1914.

Kakabeka Falls GS utilizes a surge tank facility to provide surge protection for the 2 km aqueduct during station load rejections. The surge tank facility is over 100 years old and has undergone numerous repairs and modifications over the years to the reinforced concrete water retaining portions of the substructure. A failure of the facility could result in an uncontrolled release of water, posing a significant risk to the public and the environment. The KFGS requires a new replacement surge facility designed for the hydraulic and operational characteristics of the turbine generator system.

The current method of energy dissipation during a load rejection is for the water to be directed through the water overflow surge pipe, discharging over a 50 m cliff to the river shoreline below. Although OPG has restricted access, large quantities of water can spill over in as little as 14 seconds. The new design for dissipating the energy requires decommissioning of the existing system and installing equipment which discharges the water through the existing powerhouse and into the tailrace area. This design addresses public safety concerns and environmental impacts (such as reducing shoreline erosion and impacts to fish spawning).

The existing turbine generators are nearing the end of their service life, the estimated remaining life on the ~100 years old turbine generator system was assessed in 2021 to be approximately 5 years. The turbine inlet valves are ~100 years old, with no spare parts available due to obsolescence and repairs require custom-designed parts. There is damage on the runners, head cover and bearings on all 4 turbine units and 2 units have undergone broken wicket gate repairs, which was assessed to have a risk to fail in the next 5 years based on the forementioned assessment. In addition, there is material loss and pitting in all 4 penstocks along with localized deformations and leaks with cracked penstock supports. which do not meet all stress criteria.

The need for a new replacement surge facility, the current state of turbine generators, and the condition of the penstocks, provide an opportunity to redevelop the KFGS and increase power generation at the site. The project is consistent with the Province's request that OPG modernize small hydro generating facilities to improve existing generating capacity, uncover additional efficiencies, and in some cases rehabilitate an entire site (Powering Ontario's Growth report, p. 53), and its incremental generation output will contribute to meeting Ontario's increasing electricity demand. The redeveloped KFGS is expected to be in service by Q2-2028.

Being the second oldest station in OPG's fleet, delaying the work will lead to increased costs and risks due to the deteriorating condition of critical components as described above, and require the facility to be permanently shut down within the near term. Given the safety risks to the public related to the surge discharge arrangement, deterioration of the surge tank foundation concrete, and the state of the current turbine generators, addressing the deficiencies improves public safety, reduces environmental impact, and secures incremental generation capacity and efficiency.

The preferred alternative includes replacing the surge tank building and penstocks, removing the existing turbine generators and associated balance of plant equipment, constructing an additional building on the upstream side of the generating station to house two new turbine generator units, and repurposing the existing building to house the new balance of plant equipment, draft tube gates, spare parts storage, maintenance facility and control room. As a locally significant heritage site, the external appearance of the original powerhouse will be maintained.

The Gate 2 release has successfully achieved its deliverables, including issuing contracts for the Turbine Generator Supplier and Design Build Contractor (DBC), completion of value engineering, preliminary design, and environmental planning, among others. The project secured additional funding through Gate 2B to award long lead procurement items.

This Gate 3 release will fund the following activities:
• Completion of detailed design.
• Demolition of existing surge tank building and penstocks.
• Construction of a new building to house new turbine generator units.
• Installation and commissioning of new equipment & systems (e.g., turbine-generator units, control systems, auxiliaries, switchgears, transformer, energy dissipating system and overhead crane).
• Transfer of control to Northwest Operations.

The key risks to the project are:

- Technical: Risk of redesign due to geotechnical discovery work. This risk has been accepted based on the additional geotechnical

study completed by DBC. The extent of any additional geotechnical work cannot be determined until after the earthworks construction begins, as a mitigating measure contingency is being carried by OPG.

- Stakeholder/reputational: Local Indigenous communities and stakeholders may not support the project. Mitigation includes early meaningful engagement with local Indigenous communities and stakeholders.

- Regulatory: Delay in obtaining required construction permits from regulators. Mitigation includes early engagement and consultations with stakeholders, Indigenous communities, and regulators.

Business Need	For Project Level A or B

The Kakabeka Falls Generating Station, after over a century of operation, needs a significant investment to be able to continue operating safely and effectively. A project to ensure and optimize continued electricity generation at the site is consistent with the Province's request that OPG modernize small hydro generating facilities to improve existing generating capacity, uncover additional efficiencies, and in some cases rehabilitate an entire site (Powering Ontario's Growth report, p. 53).

Critical components, including the surge tank facility, penstock and turbine inlet valves, penstocks, turbines and generators, are nearing the end of their safe operating lifespan. There is a business need to address risks posed by the aged infrastructure. The project will also improve public safety by removing the existing surge overflow pipe, which poses a public safety risk with its discharge over a 50 m high cliff during station trips.

During a station trip, the water is diverted through the overflow pipe which eliminates water flow through the powerhouse affecting fish habitat areas just downstream of the station while increasing waterflows upstream of the powerhouse where the overflow pipe discharges. Significant fluctuations in water flow over short time durations can damage fish habitat and increase public safety risks. Historically, the force of water during load rejection events has caused ongoing erosion of the cliff and shoreline.

Further challenges can arise in the event of a station trip if Operations is unable to restore generation within 20 minutes. The headgates would need to be lowered to prevent continued overflow discharge and the sluiceway must be operated to divert the flow from the powerhouse over the falls, upstream of the station. It can take up to 80 minutes to return the river flow levels downstream of the powerhouse, to the same conditions as prior to the station trip. This extended flow interruption can be detrimental to fish habitat below the falls and increase public safety risk. One of the public safety risks pertains to the public beach located downstream of the sluiceway. A station trip requiring flow diversion through the sluiceway exposes bathers to a river flow change of up to 55 cubic meters per second.

In addition to effectively reducing public safety risks and mitigating environmental impacts, the project will increase the capacity from 24.4 MW to an estimated 27.4 MW while maintaining levels and flows in accordance with the existing Water Management Plan. The redeveloped facility is expected to provide clean, renewable generation for another approximately 90 years, at a time when a significant rise in Ontario's electricity demand is projected. According to the IESO's recently released 2025 Annual Planning Outlook forecast, electricity demand is projected to grow by 75 percent by 2050.

As a rate regulated facility, the recovery of prudently incurred costs and return on investment for the project will be enabled through the Ontario Energy Board rate setting process. Subject to finalization of the federal legislation, eligible project expenditures are expected to benefit from the 15% Clean Electricity Investment Tax Credit (ITC), which will reduce the project's net cost to ratepayers.

Preferred Alternative:	Repurpose Existing Powerhouse and Integrate New Turbine-Generator Units	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative includes replacing the surge tank building and penstocks, removing the existing four turbine generators and associated balance of plant equipment, constructing an additional building on the upstream side of the generating station to house two new turbine generator units, and repurposing the existing building to house the new balance of plant equipment, draft tube gates, and other uses including spare parts storage, maintenance facility and control room. As a locally significant heritage site, the external appearance of the original powerhouse will be maintained. Completing this entire scope of work allows the project to improve public safety, reduce environmental impact to shoreline erosion and fish habitat, and optimize the entire system and increase efficiency of the generating station by optimizing the river flows usage, resulting in increased capacity at estimated 12% or 3 MW and increased energy output at estimated 24% or 33 GWh/yr. Over the approximate life of 90 years for the redeveloped facility, the levelized cost of energy (LCOE) of this alternative relative to the base case is estimated at approximately $90/MWh (2024$), including project costs to date. On a forward-looking cost basis, the LCOE of the alternative is approximately $80/MWh (2024$) relative to the base case. OPG's analysis shows that this redevelopment will provide positive economic value to the province's electricity system.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Contract Issued For T/G Supplier	Procurement Contracts Awarded/PO Issued		2023-12-14
Contract Issued For Design Build Contractor	Procurement Contracts Awarded/PO Issued		2023-12-18
FEED Phase Design Complete	Preliminary Design Complete	86386M1345	2024-08-15
Gate G3 Approval	Gate G3 Approval	86386M3001	2024-11-15
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Available For Service	Available for Service and/or Ready For Service Completed	86386M3030	2028-05-05
Project Complete	Project Close Out Completed	86386M3040	2029-03-30
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Not recommended. If no project were to progress, the station would need to be permanently shut down and safe stated in a controlled manner within the near term with a view to address the risks and condition of the aging infrastructure as described above. The KFGS and support infrastructure would need to be decommissioned and demolished. This process would require permanently sealing the intake gates, removing and remediating critical infrastructure such as the surge building, aqueduct, penstocks, and securing the powerhouse. These decommissioning efforts would require incremental expenditures, estimated at $170M - $210M, and there would continue to be ongoing costs to maintain site infrastructure and water control structures, without any power generation.

This alternative would represent a lost opportunity to maintain and enhance the clean hydroelectric generation provided by the Kakabeka Falls GS, and a lost opportunity to help meet the Province's energy transition goals and objectives of the Province's Powering Ontario's Growth Plan.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3: Unit Overhauls and Replace Aging Infrastructure [Note: Please note that the title of this Alternative 3 Delay Work cannot be modified in the above field due to restrictions within the BCS Form, and hence the correct title is specified within this description].

Not recommended. Given that current major components, including the surge tank, penstock inlet valves, turbine inlet valves, penstocks, turbines, and generators are approaching end of life and pose safety and operational risks, the scope of work and activities required to continue safe and effective operation of the generating units for Kakabeka Falls GS without increasing capacity is significantly different than a typical unit overhaul. It would require many of the same improvements to the existing infrastructure that are identified in the preferred alternative such as replacement of surge tank building, penstocks, penstock inlet valves, and replacement of turbine inlet valves for G1, G2, G3. Without the new powerhouse addition behind the existing station for a 2-unit configuration, there would be no extra draft tubes available to install an energy dissipation system as identified in the preferred alternative and a more complex solution would be required to divert and control the energy associated with the overflow discharge on a station load rejection and to eliminate the public safety concerns associated with the surge water overflow discharge. Executing this scope of work is estimated to incrementally cost $335M - $375M and provide a life extension of the assets for 20-25 years, to be followed by a decommissioning or redevelopment. The LCOE of this alternative over the life extension period relative to the base case is estimated to exceed the LCOE of the preferred alternative.

Alternative 4:	**Construction of a New Generating Station**	For Project Level A, B

Not recommended. The project team considered the option of constructing a new powerhouse largely based on the design of the Peter Sutherland Sr. Generating Station that OPG recently constructed, due to the similarity in water flow and head conditions at each site. For this option, the existing dam, sluiceways, intake and aqueduct would not require any modifications. A new larger powerhouse would be constructed adjacent to the existing powerhouse and contain all new T/G units, all balance of plant equipment, offices, control room, parts storage and staff services required. The existing powerhouse would be maintained as a heritage building, most of the old equipment would be removed, and the space could potentially be used for cold storage.

The review of this option by the Owner's Engineer revealed that a new GS would cost a minimum of an additional $75M over the preferred alternative with no increase in capacity or energy over the preferred option.

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**

Stakeholder/Reputational	Local Indigenous communities and stakeholders may not support the project	Mitigate 53051 - FN meaningful engagement 67350 - Public engagement 7/30/2027	Medium
Licensing & Regulatory	Delay in obtaining required construction permits from regulators	Mitigate 59233 - Early engagement and consultations with stakeholders 6/30/2025	Medium
Technical	Risk of redesign due to geotechnical discovery work	Accept 68319 - Perform additional geotechnical investigation 12/20/2025	Medium

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$K	Alternative	Base Case (No Project)	Delay Work	Alternative 4	Alternative 5
Project Cost	$519M	~$185M - $225M	~$350M - $390M	>$519M	
Other: (e.g., IRR)	Estimated LCOE (net of ITCs) ($2024) ~$90/MWh (incl. costs-to-date) ~$80/MWh (forward looking costs)	N/A	Estimated LCOE (net of ITCs) ($2024) > $90/MWh (incl. costs-to-date) > $80/MWh (forward looking basis)	Estimated LCOE (net of ITCs) ($2024) > $90/MWh (incl. costs-to-date) > $80/MWh (forward looking costs)	

Analysis of Financial Evaluation – Key Assumptions and Key Results:

The Base Case (No Project) alternative, Alternative 3 and Alternative 4 project costs are based on Owner's Engineer estimate.

The preferred alternative cost is based on EPC Contract Class 3 estimate.

	Preferred Alternative	Alternative 3
Financial/Economic:		
1. Corporate tax rate:	25%	25%
2. CCA rate:	30%	30%
3. Discount rate:	6.5%	6.5%
4. Annual escalation – Operating costs:	2%	2%
5. Clean Electricity ITC eligibility:	~80% excl. interest	~80% excl. interest
Project Life:		
1. Project in service by:	Jun. 2028	Jul. 2027
2. Operating life:	90 years	25 years
Energy Production:		
1. Total station capacity:	27.4 MW	24.4 MW
2. Annual energy production:	173 GWh	133 GWh
OM&A Expenses & Sustaining Capital:		
1. Annual OM&A ($2024): (1)	$0.6 M	$0.6 M
2. GRC:	~$5.5/MWh	~$5.5/MWh
3. Total sustaining capital costs ($2024): (1)	$43 M	$9 M
4. Major overhaul frequency:	25 years	N/A

(1) $0.3M for Base Case

Qualitative Factors — For Project Level A or B

The Kakabeka Falls GS Redevelopment Project aligns with OPG's business imperatives.

Improved Operational Excellence
• Modernized facilities are expected to bring improvements to safety and reliability, along with reduced operation and maintenance costs.
• Optimized use of water is expected to result in improved generating efficiency while maintaining levels and flows as defined in the Water Management Plan.

Supports OPG's Social License
• Hydroelectric redevelopment demonstrates OPG's commitment to clean, renewable power and is in-line with OPG's Climate Change Plan, which includes opportunities for redevelopment of hydroelectric generating stations (Climate Change Plan, page 45).
• The project supports economic development in the communities and provide opportunities for Indigenous and ED&I businesses, in support of OPG's Reconciliation Action Plan and ED&I Strategy.

The increase in hydroelectric generation capacity from the project aligns with the Ontario government's goal to reduce emissions and Powering Ontario's Growth strategy. The project will also enable OPG to secure a connection agreement with Hydro One, ensuring that the required capacity on the distribution lines is maintained.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2030-03-29

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Actual turbine/generator output	Total capacity of 24.4 MW with units 1 to 3 at 5.25 MW each and unit 4 at 8.7 MW	Total capacity of 27.4 MW with units 1 and 2 at 13.7 MW	Actual turbine/generator output will be compared to the performance guarantees in the Agreement. Performance testing will be conducted to verify flow and output.	OPG Performance and Testing

Definitions and Acronyms

DBC	Design-Build Contractor
DFO	Department of Fisheries and Oceans
CCA	Connection Cost Agreement
CIA	Connection Impact Assessment
EPC	Engineering, Procurement and Construction
FEED	Front End Engineering Design
GS	Generating Station
HONI	Hydro One Networks Inc.
IESO	Independent Electricity System Operator
OWA	Ontario Waterpower Association
RFP	Request For Proposal
SIA	System Impact Assessment (IESO)
OE	Owner's Engineer
VOR	Vendor of Records

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86386 - KAKABEKA FALLS GENERATING STATION REDEVELOPMENT PROJECT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**	**%**
0 - Cost Management	27	1,960	3,128	129	129				5,373	1
1 - Project Management	1,898	4,058	2,792	2,792	1,543	220			13,303	3
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	5,334	39,305	181,732	212,294	74,584	4,951	800		519,000	100
Removal Costs (incl. above)			3,158	2,708					5,866	1

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.35

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
86386	2025-08-03	Access Road	10,036	2.1
86386	2025-09-21	Permanent Storage Facility	1,947	0.4
86386	2026-10-26	Overhead Crane	10,559	2.2
86386	2027-05-13	Powerhouse	127,044	26.4
86386	2027-07-24	Surge Building	60,828	12.6
86386	2027-07-26	Penstocks	95,244	19.8
86386	2028-04-21	Unit 1 In-Service	80,937	16.8
86386	2028-05-05	Unit 2 In-Service	80,937	16.8
86386	2029-03-30	Final In-Service	13,789	2.9
		Total:	**481,321**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Tranal Chow Senior Manager Projects LLDS	2024-10-31	Subo Sinnathamby Chief Projects Officer Enterprise Projects	

References	For Project Level A or B
Powering Ontario Growth: Ontario's Plan for a Clean Energy Future, Powering Ontario's Growth | ontario.ca, retrieved 30 August 2024, Page 53 (https://www.ontario.ca/page/powering-ontarios-growth)	

ONTARIO POWER GENERATION

Records File Information:
Retention Permanent

OPG Confidential
OPG-FORM-0076-R006*

Business Case Summary

Project #	86387	**BCS Document Number**	FT1-BCS-40000-1506313
Project Title	86387 - MATABITCHUAN GS		
Facility	MAT - MATABITCHUAN	**Investment Classification**	Value Enhancing
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2029-Apr-23
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend the release of $171,066K, including [redacted] of contingency. This will bring the total released-to-date to $190,000K.

The estimated total project cost is $190M, including [redacted] of contingency.

The project will redevelop and ensure continued operation of the Matabitchuan Generating Station (GS), which is approaching end-of-life, while increasing its total generation capacity from 7.5 MW to 12 MW. This funding release is required for the construction, testing, commissioning, and turnover of a redeveloped station to Northeast Operations. The scope of the redevelopment includes decommissioning and demolition of the existing powerhouse, and the construction of a new powerhouse foundation, substructure and superstructure in the same approximate building footprint. Two new 6 MW turbine and generator (TG) units will be installed in the station along with new balance of plant mechanical and electrical systems. New protection and control equipment will be supplied in a prefabricated e-house. The redeveloped station is expected to operate for approximately 90 years. The project does not include any work on the headworks dam or main control dam.

Investment Cash Flows

Project Number	86387 - MATABITCHUAN GS					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	11,715	7,219							18,934
Currently Requested	0	49,403	56,239	52,036	13,185	203			171,066
Total released to date	11,715	56,622	56,239	52,036	13,185	203			190,000
Future required	0								0
Total Project Cost	11,715	56,622	56,239	52,036	13,185	203			190,000
Ongoing Costs	0								0

Total OAR Approval	190,000.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Shelley Babin Chief Operations Officer Chief Operations Officer	Shelley Babin	2025-03-18
I concur with the business decision as documented in this BCS.		

ONTARIO POWER GENERATION

Records File Information:
Retention Permanent

Business Case Summary

Finance Approval : **Aida Cipolla** **CFO & Corporate Services Officer**	Aida Cipolla	2025-03-20
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Nicolle Butcher** **President & Chief Executive Officer**	Nicolle Butcher	2025-03-20

EXECUTIVE SUMMARY – Project Overview

Ontario Power Generation (OPG) is undertaking the Matabitchuan GS Redevelopment Project as the condition of the existing station is rapidly approaching end-of-life.

The Matabitchuan GS is 115 years old and operates with the original turbine and generator units, which have been maintained through various overhauls. Most of the equipment in the station is now approaching, or has reached, end of service life, including the building structure itself, and redevelopment of the station is required to prevent imminent loss of its generating capacity. Currently, the station experiences operations challenges resulting in increased maintenance and more frequent station outages. The project is expected to enable OPG to utilize available river flows more efficiently and optimize power generation at the site, increasing the total capacity of the station to approximately 12 MW and extending continued operation of the station for approximately 90 years.

The preferred alternative for the Matabitchuan GS is to design, construct and commission a new 12 MW generating station. This will entail the decommissioning and demolition of the existing powerhouse, tailrace improvements, replacement of the lower bifurcated penstock section, and replacement of the Bailey bridge for site access. The new station will have two new horizontal Francis turbine-generator units and balance of plant mechanical and electrical systems. New protection and control equipment for the station will be supplied in a prefabricated e-house (i.e. a walk-in modular structure that houses electrical equipment). The redeveloped Matabitchuan GS is expected to be in service by Q3 2028. In the absence of a redevelopment, the station would reach end-of-life and be permanently shut down.

The project is consistent with the Province's request that OPG modernize small hydro generating facilities to improve existing generating capacity, uncover additional efficiencies, and in some cases rehabilitate an entire site (Power Ontario's Growth report, p. 53), as its incremental generation output will contribute to meeting Ontario's increasing electricity demand.

The Gate 2 release has successfully achieved its deliverables: completing the technical specifications, value engineering, constructability reviews, long-lead item procurement, cofferdam design, permit applications, Environmental Assessment screening and continuing consultation with Indigenous communities. This requested Gate 3 release will fund the construction, testing, commissioning, available for service (AFS) declaration, close-out, and OPG oversight on these activities for the project.

The key risks identified for the project are as follows:
- Unanticipated Geotechnical Conditions: Uncertainty of subsurface conditions under the powerhouse represents a risk of more extensive demolition requirements, unexpected soil conditions and geotechnical challenges associated with installation of secant wall supports. Contingency is carried for this risk.
- Design Growth or Changes to Permanent Designs: The 90% design used for the Class 3 estimate may not fully capture the final scope, potentially leading to additional work and rework. Early coordination between the Owner, Design Engineer, and Constructor, and a clear change management process, mitigate this risk.
- Engineering Delays Impacting Procurement and Planning: Delays in engineering deliverables, such as E-house specifications, could disrupt procurement. Schedule tracking and an escalation process ensure timely handover to Kiewit mitigate this risk.

Business Need

For Project Level A or B

The Matabitchuan GS is a 7.5 MW station that was built in the early 1900's and put into service in 1910. Engineering assessments have concluded that the station is approaching end-of-life.

The powerhouse building is the original concrete structure constructed on a clay foundation. The building exhibits ongoing differential settlement manifested in extensive cracking and spalling of the concrete structure and formation of voids under the building substructure. In 2012, aluminum cladding was added to the building façade to mitigate rainwater intrusion through wall cracks. Interior spalling of the concrete walls has resulted in falling debris and presents an ongoing safety hazard at the site. The differential settlement has also resulted in misalignment of critical equipment. The elevation of the overhead crane rails differs by approximately 100mm and has resulted in decreased load capacity and restricting maintenance of heavy equipment. Also, ongoing turbine and generator alignment issues have resulted in excessive bearing wear and failure, requiring repair or replacement every 2 - 3 years and resulting in increased outages.

The station still operates with the original turbine and generator units which have been maintained through several turbine overhauls and generator rewinds. Recent inspections indicate the insulation resistance of the generator stators and rotors are very low, no longer passing dielectric tests during maintenance. The continued deterioration of these original units requires more frequent maintenance and station outages; they need replacement.

Given the overall age and asset condition, it is likely that Matabitchuan GS would be permanently shut down within the next several years in the absence of redevelopment. The penstock section from the headworks to the powerhouse bifurcation was replaced in 2012, as was the headgates and hoist. These investments were made assuming the station would continue operating.

The redeveloped facility is expected to provide clean, renewable power for approximately 90 years, at a time when a significant rise in Ontario's electricity demand is projected. According to the IESO's recently released 2025 Annual Planning Outlook forecast, electricity demand in Ontario is projected to grow by 75 percent (%) by 2050.

As a rate regulated facility, the recovery of prudently incurred costs and return on investment for the project will be enabled through the Ontario Energy Board rate setting process. Subject to meeting the eligibility criteria, project expenditures would benefit from the 15% federal Clean Electricity Investment Tax Credit (ITC), if legislated, which will reduce the project's net cost to ratepayers.

Preferred Alternative:	Redevelopment of the Matabitchuan GS	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative for Matabitchuan GS is redevelopment, which comprises the following scope of work:

- Removal and replacement of the station access bridge.
- Installation of a sheet pile cofferdam in the existing tailrace.
- Installation of ice mitigation equipment and remote water level monitoring equipment at the headworks for continued dam safety operations.
- Decommissioning and demolition of the existing powerhouse, including substructure.
- Construction of a new powerhouse concrete substructure and steel superstructure on a stone column/raft foundation.
- Installation of two 6 MW horizontal Francis turbine and generator units, turbine inlet valves and skid-mounted auxiliaries.
- Replacement of the bifurcated penstock section downstream of the thrust block to align with new turbines.
- Installation of a new overhead powerhouse crane and balance-of-plant mechanical and electrical equipment.
- New protection and control systems supplied in a prefabricated e-house.
- Installation of a new station service transformer and revenue metering system.
- Upgrade of existing main output transformers for reuse at the new station.

By completing this scope of work, the new Matabitchuan GS will have a total capacity of up to 12 MW and provide approximately 59 GWh of annual energy for an estimated 90 years of service life. The levelized cost of energy (LCOE) of this alternative relative to the base case is estimated at approximately $125/MWh (2024$), including project costs to date. On a forward-looking cost basis, the LCOE of the preferred alternative is approximately $115/MWh (2024$) relative to the base case (~$15/MW higher in the absence of the ITC) OPG's analysis shows that this redevelopment will provide positive economic value (including carbon displacement attributes) to the province's electricity system.

Since this preferred alternative is expected to allow for more efficient use of the available river flows, the project is expected to yield an increase in power generation at this station while continuing to operate at the same flow rate in compliance with the existing Water Management Plan. Environmental and socioeconomic aspects of the project have been assessed in consultation with the Timiskaming First Nation, Matachewan First Nation, Temagami First Nation, Kebaowek First Nation, Wolf Lake First Nation, Métis Regional Council 3, and Timiskaming Métis Community Council. The Constructor has attended EA Screening meetings with OPG and three of the First Nation communities to develop a plan to provide employment opportunities during the execution of the project, which supports OPG's Reconciliation Action Plan goals. All required terrestrial, aquatic, heritage, and archaeological assessments have been completed to demonstrate the project can be screened out of the Class EA process.

Deliverables:			
Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Preparation of Gate 3 documents, cost estimates, updated LCOE estimate, risk register, and updated project schedule	Gate G3 Approval	Proceed to Execution Phase	2025-03-06
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Units In-Service	Available for Service and/or Ready For Service Completed	86387M0037	2028-08-07
Project Complete	Project Close Out Completed	86387M0014	2029-04-23
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Not recommended. If the project were not to progress, Matabitchuan GS may continue to generate electricity in the immediate term until a critical component failure forces the units offline or the building structure poses unsafe operating conditions. However, engineering assessments estimate that the station will reach end-of-life within the next several years, at which point it would require decommissioning to ensure it does not pose a risk to public safety, including sealing off the penstock intake with concrete. The decommissioning efforts would require incremental expenditures, estimated at $10M to $15M, in addition to the ongoing costs to operate and maintain the remaining headworks dam and main control dam for water management, environmental and public safety obligations.

This alternative would represent a lost opportunity to maintain and enhance the clean hydroelectric generation provided by Matabitchuan GS, and a lost opportunity to support the Province's energy transition targets and objectives of the Province's Powering Ontario's Growth strategy.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Not recommended. The station will reach end-of-life within the next several years. At that point, the station would cease operation and be forced into an extended shutdown while the redevelopment project is re-initiated. By the time the redevelopment project is ready again for execution, the project costs would be higher due to escalation. There is also a risk that lead times for equipment would be longer due to increased demand. Due to the additional loss of generation, increased project cost and schedule risk, this alternative is not recommended.

Alternative 4:	**Refurbishment Alternative**	For Project Level A, B

Not recommended. This alternative would involve the replacement of the turbines and generators with 'like-for-like' units, replacement of the bifurcated penstock section, and replacement of mechanical and electrical balance of plant equipment within the existing powerhouse structure. This alternative is not feasible since it would not adequately address ongoing structural deterioration and foundation settlement issues of the existing powerhouse, which would continue to pose a significant risk to the ongoing safety and reliability of the station. This alternative would be subject to the following issues and constraints:

- Continued alignment issues with the overhead crane rails and new turbine and generator units due to ongoing differential settlement of the powerhouse foundation.
- Existing draft tubes would restrict placement and limit performance of new units; new draft tubes would be required to accommodate this alternative.
- The superstructure may not be salvageable based on the required modifications to accommodate crane upgrades and roof hatches for installation of new units.
- Existing superstructure is not designed for modern snow loading.
- Alignment of penstock would require complicated inlet pipe geometry to provide flow to units in locations that remain within existing footprint and accessible under the crane.
- Continued scouring of tailrace due to high velocities.

The issues and constraints of this alternative are ultimately expected to lead to the need for redevelopment in order to ensure continued safe and reliable operation of the station.

Business Case Summary

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Environmental	Unanticipated Geotechnical Conditions	Accept 69968 - Settlement Analysis and Construction Planning 11/30/2025	High
Technical	Design Growth or Changes to Permanent Designs	Accept	High
Procurement - Materials	Engineering Delays Impacting Procurement and Planning	Mitigate 70120 - Proactive Engineering Deliverable Tracking and Procurement Alignment 3/31/2025	Medium

Additional Risk Analysis	For Project Level A or B
None at this time.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
Project Cost	$190M	$10M - $15M	N/A	N/A	
Other: (e.g., IRR)	Estimated LCOE (net of ITCs) ($2024): ~$125/MWh (incl. costs to date) ~$115MWh (forward looking costs)	N/A	N/A	N/A	
Analysis of Financial Evaluation – Key Assumptions and Key Results:					

Key Assumptions:

The Base Case (Alternative 2) assumes decommissioning of Matabitchuan GS within the next several years. The associated cost is based on Owner's Engineer estimate.

The Preferred Alternative cost is based on a Constructor's Class 3 estimate.

Financial/Economic:
1. Corporate tax rate: 25%
2. CCA rate (preferred alternative): 30%
3. Discount rate: 6.5%
4. Annual escalation – Operating costs: 2%
5. Clean Electricity ITC (preferred alternative): ~80% excl. interest

Project Life – Preferred Alternative:
1. Project in service by: Q3 2028
2. Operating life: 90 years

Energy Production – Preferred Alternative:
1. Total stations' capacity: 12 MW
2. Annual energy production: 59 GWh

OM&A Expenses & Sustaining Capital:
1. Annual OM&A ($2024)1: $0.27 M
2. Gross Revenue Charge (preferred alternative): ~$5/MWh
3. Total sustaining capital costs ($2024) (preferred alternative)2: $46 M
4. Major overhaul frequency (preferred alternative):

1 $0.05M for base case
2 $7M for base case 25 years

Qualitative Factors For Project Level A or B

The Matabitchuan GS Redevelopment Project aligns with OPG's business imperatives.

1. Social License – Sustainable Energy Development
Hydroelectric redevelopment demonstrates OPG's commitment to clean, renewable power and is in-line with OPG's Climate Change Plan, which includes opportunities for redevelopment of hydroelectric generating stations (Climate Change Plan, page 45).

2. Operational Excellence – Improved Asset Reliability
The project addresses operational reliability and safety concerns related to the aging structure and equipment on site. The new building will be safer, both structurally and operationally, with all aspects up to current Ontario Building Codes, and new equipment will be more reliable and safer to operate. The new station will also increase generation efficiency by optimizing the use of available river flows.

3. Social License – Local Community and Indigenous Relations
The project has opportunities throughout Definition and Execution Phases to engage, consult and build relationships with the local Indigenous Communities. The project team will continue to maintain a strong working relationship with local First Nations during subsequent phases, supporting OPG's Reconciliation Action Plan. The project will also be seeking and identifying Execution Phase subcontracting opportunities for First Nations businesses.

4. Operational Excellence – Environmental Considerations
The project will maintain the existing flows in accordance with the Water Management Plan, and the new TG units will allow for more efficient use of the available flow to generate power. Improvements to the tailrace will also provide an opportunity to minimize long-term erosion.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2030-04-23

Business Case Summary

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Actual turbine/generator output	Matabitchuan GS is currently operating at approximately 7.5 MW but units and building structure are at end-of-life.	Matabitchuan GS upgraded to a 12 MW station	Actual turbine/generator output will be compared to the performance guarantees in the turbine and generator Contract. Performance testing will be conducted to verify flow and output.	OPG Performance and Testing (P&T)

Definitions and Acronyms	
CCA	Connection Cost Agreement
CIA	Connection Impact Assessment
DBB	Design Bid Build
EA	Environmental Assessment
GS	Generating Station
HONI	Hydro One Networks Inc.
LD	Liquidated Damages
OE	Owner's Engineer
LNTP	Limited Notice to Proceed
RFP	Request For Proposal
T/G	Turbine/Generator
DERM	Distributed Energy Resource Management

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86387 - MATABITCHUAN GS						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management	30	514	606	609	269				2,028	1
1 - Project Management	2,468	3,560	2,783	2,796	2,028				13,635	7
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	11,715	56,622	56,239	52,036	13,185	203			190,000	100
Removal Costs (incl. above)		2,281	120						2,401	1

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.39

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
86387	2025-08-29	Matabitchuan Bailey Bridge	4,209	2.5
86387	2027-10-11	Matabitchuan Powerhouse Crane	2,759	1.7
86387	2028-02-04	Matabitchuan Powerhouse	85,716	51.4
86387	2028-08-01	Matabitchuan Unit 1 In-Service	36,696	22.1
86387	2028-08-07	Matabitchuan Unit 2 In-Service	36,696	22.1
86387	2029-04-23	Matabitchuan Project Complete	277	0.2
		Total:	**166,353**	**100**

Prepared by	Reviewed and Endorsed by (Execution Authority)

Hamed Hasanharati Senior Manager Projects HALO 3	2025-03-07	Subo Sinnathamby Chief Projects Officer Enterprise Projects	2025-03-17

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Business Case Summary

Project #	86570	**BCS Document Number**	NF20-BCS-08707.021-0053
Project Title	86570 - BK1 G4 REFURBISHMENT		
Facility	BK1 - SIR ADAM BECK 1	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2028-Sep-08
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $89,462K, including [redacted] of contingency.

The estimated total project cost is $109,129K, including [redacted] of contingency.

The OM&A scope is removal, disposal, and inspection costs estimated at $2,319K. These costs will be accounted for under project BK182416 during the Execution Phase.

This project is to refurbish SAB1 G4 Unit in order to ensure reliable operation for an estimated 25-30 years. This Execution Phase release will provide funding for the refurbishment of the unit including material purchasing, equipment procurement, completion of engineering, construction, commissioning and project management for the generator, governor, electrical balance of plant, mechanical balance of plant, civil works, auxiliary systems, and inspect and repair headgate gains with stainless steel overlay, remove sill and lintel beam and install with new.

Investment Cash Flows

Project Number	86570 - BK1 G4 REFURBISHMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	267	8,665	10,735						19,667
Currently Requested	0		38,669	47,043	3,463	287			89,462
Total released to date	267	8,665	49,404	47,043	3,463	287			109,129
Future required	0								0
Total Project Cost	267	8,665	49,404	47,043	3,463	287			109,129
Ongoing Costs	0								0

Total OAR Approval	109,129.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer	Nicolle Butcher	2024-12-03
I concur with the business decision as documented in this BCS.		

ONTARIO POWER GENERATION

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Business Case Summary

Finance Approval : Aida Cipolla CFO & Corporate Services Officer	Aida Cipolla	2024-12-09
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Ken Hartwick President & Chief Executive Officer	Ken Hartwick	2024-12-10

EXECUTIVE SUMMARY – Project Overview

The Sir Adam Beck 1 (SAB1) hydroelectric power station, consisting of 10 units, has been operational since the 1920s.

The G4 unit was last refurbished in 1984 and is currently subject to operating restrictions due to degraded equipment performance. G4 is the first of the three remaining SAB1 units requiring refurbishment. Major hydroelectric unit refurbishments are typically required every 25 to 30 years to maintain reliability. Recent condition assessments have confirmed that unit reliability is decreasing due to normal wear and aging. The unit is facing reliability issues and there is a lack of readily available spare parts since the OEM no longer makes or supports the existing parts leading to prolonged outages for repairs. This project is to ensure long-term reliable operations for a minimum of 25-30 years for SAB1 G4, while modernizing the generating unit and increasing its capacity by 2MW.

The preferred alternative is to complete a unit refurbishment on G4 (major refurbishment and replacement of some components). The scope includes replacing obsolete and end of life equipment (protection and controls equipment, Main Output Transformer, new turbine runner, etc.) to ensure cost effective, clean and renewable electricity production.

This project aligns with the Energy Minister's announcement on April 15, 2024, stating that "Niagara Hydro Stations are set to be refurbished, securing about 1,700 MW of clean power for another 30-plus years". It also supports the Provincial Government's "Powering Ontario's Growth Plan", released on July 10, 2024, in response to public consultation on the Independent Electricity System Operator's Pathway to Decarbonization, which aims to achieve a net-zero economy by 2050.

OPG plans to work with a selected OEM through the RG Programmatic Collaborative Agreement, employing a Design Build Contracting Strategy and Target Pricing structure to provide engineering, procurement, and construction services for the project.

The contracting and procurement strategy on the SAB Refurbishment Program includes:
1) A primary OEM vendor partner that is engaged to engineer, procure components, construct in alignment with the planned schedule, and
2) Specialized suppliers for:
- Protection and Controls (P&C) equipment
- Main Output Transformer (MOT)
- New runner

The previously approved scope was for the Development Phase (Gate 1) and Definition Phase (Gate 2) activities. Developing a detailed project scope, completing engineering specifications, conducting site inspections and contracting/procurement strategies are now complete. Detailed design, procurement of long lead equipment and final selection of the construction contractors for associated work are in progress. The previous funding covers costs for pass-through expenses, project management, project engineering, runner design, supply chain management, legal services, procurement, and related project activities for the detailed design progressing through 30% and 60% design stages for various turbine and generator components along with their associated systems.

Since unit G4 is the first to be refurbished under the RG Programmatic Collaborative Agreement, the upfront costs to complete the selection of suppliers and contractors required for all SAB1 refurbishment projects are included in the G4 project cost and will not be incurred for the subsequent units. This scope includes selecting a contractor for the large OEM scope, selecting contractors for quality assurance and control (QA/QC), engineering, and project support; and issuing a PO for P&C design & supply. These activities are expected to be completed by Q1 2025.

The project mainly consists of capital refurbishment/replacement. The current known OM&A scope is $2.3M and includes removal cost.

The Execution Phase funding in this release will encompass the full execution costs for the construction phase, including commissioning and project closeout. A fully integrated, resource-loaded schedule has been developed based on the assumption that a project-level labour agreement will be reached. If no agreement is finalized, the schedule will adapt to existing collective agreement terms to ensure effective coordination and resource allocation throughout the outage period.

The released funds will be used to complete the following:
1) Engineering (detailed design completion 100%)
2) Finalize contract with OEM for the project lifecycle

3) Procurement of all materials
4) Release contracts for P&C supply and installation
5) Release Worksheet to OEM partner under the RG Programmatic Collaboration Agreement (RGPCA) for the execution and close out phases
6) QA/QC for all materials, equipment and construction
7) Commissioning of unit and in-service

The key risks for this project include resourcing, procurement and complexity. There are limited resources and potential challenges with work group integration which may delay schedule and project milestones. These schedule delays include the possibility of engineering delays caused by the availability of engineering design drawings and calculations which could require additional equipment condition assessments. The mitigation efforts include use of resource allocation plans, implementing early engagement of key resources and adopting a collaborative approach between teams.

Procurement challenges may result in significant delays or cost increases. This could delay engineering activities and the procurement of long-lead materials, impacting the equipment delivery timelines and critical path milestones. This is being mitigated by working with vendors on cost and schedule reductions and planning local supply of components where possible.

The refurbishment is complex due to system integration of the major equipment, including protection and control systems, main output transformers, excitation systems, governor systems, and related equipment. This could delay the interconnection assessments with Hydro One and Independent Electricity System Operator (IESO) and negatively impact the in-service date. The mitigation efforts include directly managing these stakeholder interfaces, co-locating the team on-site, and providing early oversight and monitoring of key integration risks.

Business Need

For Project Level A or B

The business objective is to ensure the reliable and safe operation of the SAB1 Unit G4 for the next 25-30 years. This unit was last refurbished in 1984. Engineering assessments have indicated a decline in unit reliability due to normal wear and aging equipment. G4 has reliability concerns due to turbine vibration, the lack of availability of obsolete spare parts and wicket gate deterioration leading to the inability to stop waterflow when required. Unit maintenance outages often require extensive repairs. Adhering to the scheduled refurbishment is crucial to achieving the project's objectives.

This project will achieve the business need in the following ways:

1) Minimize the risk of forced outages due to unexpected equipment failure and replacement of obsolete parts.
2) Eliminate known safety hazards to ensure safe operation of the unit
3) Ensure reliable and safe operation for the next 25-30 years.
4) Increase capacity by 2MW and improve runner efficiency.
5) Upgrade equipment to meet current regulatory requirements.

It has been 40 years since the last refurbishment. If the current situation persists, unit reliability is expected to decline due to unexpected equipment failure occurring at a high frequency outside of regular scheduled maintenance outages. This could lead to longer outages and a reduction in the amount of electricity capable of being generated for the grid.

Preferred Alternative:	Refurbishment and upgrade to a higher capacity	For Project Level A, B or C

Description of Preferred Alternative

Business Case Summary

In January 2024, OPG executed a strategic 15-year Programmatic Collaboration Agreement with the OEM to secure engineering, procurement, and construction services utilizing the Target Pricing Structure for the SAB Refurbishment Program. G4 will be the first unit to be executed under this agreement.

The preferred alternative consists of refurbishing the unit and replacing components where economical or required by regulation.

The unit is planned to be uprated to 55 MW (MCR) with new runner and other major work, which scope includes:
1) Convert the generator floating rim to a shrunk design, corn blast and re-wedge stator, replace surface air coolers, replace bearing cooling coils, refurbish brake assembly with new seals and pads;
2) Replace generator main output bus, insulators, and switches;
3) Replace main output transformer and exciter;
4) Replace 115 kV Disconnects, voltage transformers and lightning arrestors;
5) Upgrade governor and protections and control systems;
6) New major turbine components: rotating components (runner, turbine shaft) and tower assembly (head cover, bottom ring, operating ring, wicket gates.)
7) Replace valves and piping

Advantages:
1) Generator issues (vibration and operational constraints) are addressed proactively.
2) Incremental capacity increase of 2 MW, based on Maximum Continuous Rating (MCR)
3) Reliable unit operation for the next 25-30 years
4) Long term programmatic partnership agreement with key OEM provides transparent pricing structure, resource stability, cost minimization, optimal project solutions, and equipment consistency.

Disadvantages:
1) Warranty on replaced components only.
2) More complex outage coordination to complete refurbishment activities

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate G1 approval	Gate G1 Approval		2022-05-20
Contract award for MOT engineering	Award Contracts / PO Issued for EPC or Non LLM Contracts		2023-12-23
Contract award for OEM engineering 30%	Award Contracts / PO Issued for EPC or Non LLM Contracts		2024-02-02
Contract award for P&C engineering 60%	Award Contracts / PO Issued for EPC or Non LLM Contracts		2024-02-06
Limited Notice to Proceed for Runner	Award Contracts / PO Issued for EPC or Non LLM Contracts		2024-03-13
Gate G2 approval	Gate G2 Approval		2024-05-31
RFP of long lead items by OEM	Request for Proposals for EPC or Non LLM Contracts		2024-10-12
Detailed design engineering by OEM 60%	Detailed Design Complete		2024-12-31

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate G3 Approval	Gate G3 Approval		2024-12-08
Start of Outage (SOO)	Start of Outage		2025-07-08
Design Engineering by OEM 100% completed	Conceptual Design Complete		2025-09-22
Start of Installation (SOI)	Start of Installation		2025-10-08
Finish of Installation (FOI)	Finish of Installation		2027-01-08
Finish of Outage (FOO)	End of Outage		2027-03-08
Available for Service (AFS)	Available for Service and/or Ready For Service Completed		2027-06-08
Close Out	Project Close Out Completed		2028-03-08
Post Implementation Review (PIR)	Post Implementation Review		2028-09-08
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2 is not recommended. The base case involves the status quo, continue to maintain and repair on an as-needed basis. The equipment and structures would only be replaced or rehabilitated if they either fail and unit safety concerns would not be sufficiently addressed. This alternative is impractical as an operational strategy as it would result in unscheduled significant forced outages for major maintenance and repairs in an uncoordinated and inefficient manner.

Advantages:
1) No commitment of funds

Disadvantages:
1) No capacity increase
2) A number of G4 components are at or nearing the end of their estimated reliable life and the failure of any of them will result in extended forced outages
3) Mid and Long-term reliability of G4 at risk
4) Continued operating restrictions on G4
5) Obsolete spare part availability will impact unit availability negatively
6) Higher cost to address failures as they occur in comparison to a planned refurbishment program

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 is not recommended because delaying the refurbishment does not address any immediate issues identified with G4. Delaying the work will increase equipment risks and safety concerns. Delaying work, maintaining and repairing as needed would only address equipment after failure, causing unplanned forced outages. This project is part of a major refurbishment program with sequential execution of unit refurbishments. Following a sequential execution minimizes demobilization costs, retains experienced staff, and ensures predictability for long lead time suppliers. Thus, this alternative is not practical as an operational strategy, will result in unscheduled costly forced outages, and disrupt the program and supply chain.

Advantages:
1) Deferring large capital commitments.

Disadvantages:
1) Maintenance and repair costs due to aging components will continue and increase as equipment wears faster.
2) Several G4 components approaching the end of reliable lifespan, with failure potentially resulting in forced outages.
3) Continued operating restrictions on G4
4) Disruption to refurbishment program and supply chain partnerships.

Alternative 4:	**Full Unit Replacement**	For Project Level A, B

Alternative 4, full unit replacement, is not recommended due to higher costs with minimal incremental benefit, based on engineering assessment. Unlike G1/G2, which required new generators for frequency conversion, G4 does not as it already designed for 60 Hz. Niagara Operations would undertake a project similar to the G1/G2 Replacement project and install completely a new unit to replace the current end-of-life G4.

Major work would consist of:
1) Removal of existing G4 unit and all associated equipment.
2) Installation of new generator, exciter, transformer and protection & control systems
3) Replacement of turbine components between the remaining embedded concrete draft tube and scrollcase (new turbine, turbine shaft, headcover, stay vanes, discharge ring, turbine bearing, draft tube extension, wicket gates, gate arms, links and control ring) and governor system.
4) Inspection and repairs of remaining embedded components (penstocks, scrollcase & draft tubes).

Advantages:
1) Generator issues are addressed proactively
2) Capacity increase of 2MW.
3) Re-using design elements from prior unit replacement
4) Reliable operation for the next 25-30 years. All new components including generator (unlike preferred Alternative).
5) Warranty on the full unit, reducing maintenance costs
6) Potential for shorter outage duration for installation.

Disadvantages:
1) Higher costs than the Preferred Alternative
2) Longer planning window compared to a unit refurbishment (frequency of unit replacement projects is much lower than refurb projects); increasing reliability and safety risks in the interim.

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Procurement - Materials	Delay and cost increase of equipment due to external factors (Commodity price increase, supply chains, general inflation, etc)	Mitigate 63592 Execution schedule is 2025-2027. New Circuit breaker delivery was in 2026, update plan for breaker refurbishment. Plan local supply for the distributor. Work with the OEM / vendors on cost and schedule reductions. 12/15/2024	Medium
Integration	Challenges with Work Group Integration	Mitigate 56382 Contract with the OEM early and involve both the PWU and OEM in design meetings. Co-locate teams on-site to foster integration and eliminate silos. Implemented lessons learned from Darlington Refurb by adapting the "OneTeam" approach with shared goals and integrated work groups. Appoint a dedicated Project Engineering Manager (PEM) at the OEM and another Engineering Supervisor dedicated to refurbishments at OPG to manage interfaces effectively. 12/15/2024	Medium
Resources	Internal resource constraints	Mitigate 68593 Develop a Resource Allocation Plan, prioritize resource needs with leadership, engage external resources when PWU unavailable, complete regular resource reviews, cross-train staff to cover gaps, establish a clear escalation process, use flexible scheduling, implement early engagement of resources, monitor resource utilization and secure dedicated resources. 3/31/2025	Medium

Resources	External Resource Constraints	Mitigate 56384 Early planning, contractor core team is dedicated to the project, only SME will be shared. Team should mitigate this risk by early planning and recruiting from the BTU halls. An execution strategy will be crafted to account for time working on the overhaul through the OEM and time working for OPG (Temps). 7/25/2025	Medium
Technical	Crane resources and Elevator availability	Mitigate 63575 Engineering is ensuring the crane and elevator meet regulatory requirements. The crane was inspected and overhauled in 2020 and recertified. Today, there are no outstanding issues or known concerns. An Engineering inspection is scheduled in Q1, 2025 per normal maintenance requirements. 12/31/2024	Medium
Commercial (Contract/Legal)	Programmatic Collaboration Agreement	Mitigate Mitigate 63578 Adopt the 'OneTeam' approach (Lessons Learned from Darlington Refurb), focusing on open communication, transparency, and respect. A dedicated commercial contract manager will support issue resolution through a clear escalation process. The Central Team, meeting monthly, will handle early-stage issues, allowing execution teams to stay focused. Unresolved matters escalate to the Senior Executive Team, with disputes proceeding to adjudication or arbitration if necessary (see Section 15, Programmatic Collaboration Agreement) . 12/31/2024	Medium
Quality	Quality management	Mitigate 63579 Onboard of third-party QA/QC vendor. The OEM submitted a quality management plan which will be reviewed and integrated with the QA/QC. OPG will align and link third party involvement. 1/31/2025	Low
Technical	Discovery work - Civil, Stator core, rotor field pole & embedded components	Mitigate 63584 Allowance included for the OEM discovery work. Utilize the early outage to review essential civil where possible. Increase effort in early execution planning to reduce discovery work schedule/cost impact, using scope/schedule balancing to identify execution critical path. 7/28/2025	Medium

Additional Risk Analysis	For Project Level A or B
Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards.	

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Business Case Summary

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial analysis is not required for Sustaining Projects.

Qualitative Factors — For Project Level A or B

Qualitative factors provided by the Preferred Alternative are listed below:

1) Ensure OPG continues to provide a reliable renewable source of emissions-free energy while reducing the environmental impact of meeting Ontario's electricity demand.
2) Allow unrestricted operation of G4 such as removing operating constraints currently in place and allowing it to be fully dispatchable.
3) Address identified safety hazards by implementing enhancements like ergonomic improvements to generator excitation and enhanced grounding
4) Decrease the frequency and intensity of maintenance requirements.
5) Drive project excellence by leveraging the insights gained from the G5 refurbishment to enhance the performance of this refurbishment.
6) Refurbished generator components (Stator & Rotor) in good condition, no added value in replacing them with new

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2029-09-08

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
MCR (MW)	53 MW (MCR).	55 MW (MCR) or higher.	Post-refurbishment Gibson Test	SAB1 Production
Operating Restrictions	Unit is held at a specific speed and rate, due to issues with the unit outside of that set point.	Operating Window consistent with other SAB1 Units. Range 85% to 100% of maximum flow.	Visual inspection	Niagara Operations and SAB1 Production
Runner Efficiency	Full Load Efficiency [redacted]	Full Load Efficiency [redacted]	Post-refurbishment Gibson Test	Niagara Performance Engineering

Definitions and Acronyms

SAB	Sir Adam Beck
P&C	Protection and Control
OEM	Original Equipment Manufacturers
PWU	Power Workers' Union
MV	Medium Voltage
MOT	Main Output Transformer
QA	Quality Assurance
QC	Quality Control

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86570 - BK1 G4 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management	10	122	4,060	3,450	390				8,032	7
1 - Project Management	142	2,008	5,083	4,977	161	69			12,440	11
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	267	8,665	49,404	47,043	3,463	287			109,129	100
Removal Costs (incl. above)			1,955	364					2,319	2

Appendix A2: Summary of Estimate – Notes

Escalation Rate	1.90	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
86570	2027-06-08	Unit G4 In-Service	96,511	100.0
86570	2028-03-08	Project Close Out	212	0.0
		Total:	**96,723**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jeff Dancy Senior Project Leader SAB1 Refurbishment Program	2024-11-20	Nicolle Butcher President & Chief Executive Officer President	2024-11-28

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Business Case Summary

Project #	86587, 86593	**BCS Document Number**	NA9-BCS-08707-1283034
Project Title	86587 - SAU-G16 CAPITAL REFURBISHMENT 86593 - G16 OVERHAUL		
Facility	SAU - RH SAUNDERS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES 62030 - OM&A - PROJECT
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2026-Aug-07
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a bundled execution release of $31,553k, including [redacted] of contingency. This will bring the total release to-date to $41,316k, including [redacted] of contingency. This is the second release of these two projects. Project specific release (including contingency) include:

SAU86587 (Capital): $23,279k, including [redacted] of contingency
SAU86593 (Non-Standard): $8,275k including [redacted] of contingency

The total bundled project cost is $41,316k, including [redacted] of contingency.

These two projects are for the refurbishment/overhaul of Generator Unit 16 at R.H. Saunders Generating Station. This release will fund the execution scope of work to restore the integrity, reliability and long-term viability of this generator for the next 25 years. Scope includes the following:

- Complete material and system procurement,
- Removal, refurbishment, construction/installation and commissioning activities,
- Execution engineering oversight and quality control deliverables,
- Project and site management,
- Project closeout.

Investment Cash Flows

Project Number	86587 - SAU-G16 CAPITAL REFURBISHMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	2,409	4,692							7,101
Currently Requested	0	1,873	18,609	2,797					23,279
Total released to date	2,409	6,565	18,609	2,797					30,380
Future required	0								0
Total Project Cost	2,409	6,565	18,609	2,797					30,380
Ongoing Costs	0								0

Project Number	86593 - G16 OVERHAUL	**FAC**	62030 - OM&A - PROJECT

Business Case Summary

$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total
Previous releases	437	2,225							2,662
Currently Requested		495	7,605	174					8,274
Total released to date	437	2,720	7,605	174					10,936
Future required									
Total Project Cost	437	2,720	7,605	174					10,936
Ongoing Costs									

Total OAR Approval	41,316.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Bruce Robertson VP Regional Operations VP Eastern Operations	Bruce Robertson APPROVED IN EBX	2024-05-01
I concur with the business decision as documented in this BCS.		
Finance Approval : Maha Tam VP Controllership	Maha Tam APPROVED IN EBX	2024-05-01
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Paul Seguin SVP Renewable Generation	Paul Seguin APPROVED IN EBX	2024-05-07

EXECUTIVE SUMMARY – Project Overview

Business Case Summary

R.H. Saunders Generating Station (GS) is a “Flagship” asset in OPG’s fleet of hydroelectric stations, providing 1000MW of emissions free energy to Ontario. The objective of this project is to restore the integrity, long-term reliability and ensure the continued availability of the sixteen generating units at R.H. Saunders GS. The most recent mechanical and electrical overhauls of the turbine and generators (all 16) were completed during the 1990s and early 2000s. Components included in the last overhaul project are nearing end of life and require refurbishment or replacement in order to meet the project objectives of:

- Restore integrity, long-term reliability and ensure the continued availability of the generating units at RH Saunders GS
- Address deteriorating condition of the components (discussed in detail below)
- Re-establish rotor-stator air gap and runner-discharge ring clearances
- Reduce risk of thrust bearing failures

The R.H. Saunders GS refurbishments/overhauls have been organized as unitized projects. Each generating unit will have a capital and non-standard release with individual project numbers. The non-standard overhaul G16 (SAU86593) project scope includes significant cleaning and repair of generator and turbine components. The capital refurbishment G16 (SAU86587) project scope will include system upgrades and new installations.

The previous definition phase release funded detailed engineering design and major long lead procurement activities, including design, fabrication, testing and delivery of the new discharge ring, pivot ring, and servo motors from the OEM.

Status of definition phase release: -

- Electrical design is in-progress and on track for completion with float
- Long lead procurement is in progress and on track for delivery as planned
- Estimate at completion under budget

This execution phase release will fund the remaining material procurement as well as labor costs for construction/installation and commissioning activities for both mechanical and electrical portions of the overhaul. This will include unit disassembly, discharge ring replacement, pivot ring replacement, turbine component re-machining, lead paint abatement, auxiliary system replacement (e.g., cooling water system), re-alignment, re-assembly and commissioning.

Key Risks:

1. Stay Vane Recoating Issues (Mitigate): G9 overhaul experienced delay associated with rust removal on stay vane and while re-coating could not get the dew point right. The project team has established mitigation strategies based on the lessons learned from G9; however, as this will be the first time these strategies have been utilized, residual risk remains.

2. Unit G9 Overhaul Compared to Unit G16 Overhaul Schedule (Mitigate): Unit G9 actuals to date have been used as a basis for the G16 project schedule. Any potential schedule impacts to the G9 project after the date of this BCS will not have been captured in the basis of schedule. This risk will be mitigated through the use of schedule float and estimate contingency.

3. Material Procurement Delay (Mitigate): Potential material delivery delays due to legacy supply chain disruption as a result of the COVID-19 pandemic, global conflict and shipping blockages. Project team is mitigating this by keeping an updated list of potential long lead time items using Unit G9 experience and actively procuring in advance.

Business Need For Project Level A or B

Business Case Summary

A hydro-electric generating unit requires a major electrical and mechanical overhaul approximately every 25 years. The most recent mechanical and electrical overhauls of the G16 turbine and generator were completed during the 1990s and early 2000s. The turbine and generator components have experienced unique operational issues and structure damage for many years, such as reduced generating unit clearances, discharge ring deformation, concrete structure cracking, relative movement of structural members, and powerhouse water leakage. These issues are caused by Alkali-Aggregate Reaction (AAR), which is a chemical reaction that induces concrete growth. Impact of AAR is being addressed by other investments outside of this project.

A Pre-Overhaul Condition Assessment was finalized in 2016 (NA9-REP-01550-0001), which examined major water-to-wire electrical, mechanical and civil equipment and structures to provide a basis for this project scope. From the technical condition assessment, the following major work was recommended on all units at R.H. Saunders GS:

• Turbine – major overhaul, new servomotors, replace discharge ring,
• Turbine Regulation – repair and rehabilitate Woodward Cabinet Actuators,
• Generator – major mechanical/electrical overhaul, re-wedge stator and re-shrink rotor as required, rehab field poles and field circuit components, replace CTs, replace neutral grounding system, replace surface air coolers, cooling system upgrades,
• Electrical Auxiliaries – replace, refurbish, upgrade systems as required including the online monitoring system,
• Scrollcase and Draft Tube – grouting and sealing,
• Turbine - new upgraded runner.

New runners are being procured under a separate Capital project, SAU83104 and will be installed concurrently with this project in the refurbishment outage.

Preferred Alternative:	For Project Level A, B or C

Description of Preferred Alternative

It is recommended to proceed with the mechanical and electrical refurbishments/overhauls at R.H. Saunders GS. Executing the overhauls will address deteriorating component condition and restore reliability to end of life components and systems and meet the stated project objectives.

The full execution phase (Gate 3) scope of work includes:

Components and activities funded under the non-standard overhaul SAU86593 SOW:
- Unit disassembly,
- Scroll case refurbishment,
- Turbine embedded component maintenance,
- Turbine non-embedded and non-rotating component refurbishment,
- Governor component maintenance including Permanent Magnet Generator (PMG),
- Generator mechanical and electrical component refurbishment.

Components and activities funded under the capital refurbishment SAU86587 SOW:
- Replace thrust bearing with new polytetrafluoroethylene (PTFE) bearing,
- Install new discharge ring,
- Re-insulate/refurbish field poles,
- Generator & bearing cooling system replacements,
- Install stator push-pull system,
- Install new main shaft seal,
- Install new runners,
- Servomotor replacement,
- Install new neutral grounding resistor cabinet and instrumentation and control cabinets,
- Install new monitoring and diagnostic (M&D) center online monitoring system,
- Unit reassembly and commissioning.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Project Start/BCS for Gate 2 Approved	Gate G2 Approval		2022-06-01
Notice to Proceed Original Equipment Manufacturer Contractor	Award Contracts / PO Issued		2022-06-15
BCS for Gate 3 Approval	Gate G3 Approval		2024-05-03

Business Case Summary

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
NTP General Contractor (GC)	Award Contracts / PO Issued		2024-06-17
Engineering Complete	Detailed Design Complete		2024-06-25
Start of Outage & Installation (SOO)	Start of Outage		2024-09-09
Start of Construction (SOC)	Construction Start		2024-11-28
Reassembly Finish (FOI)	Finish of Installation		2025-09-08
Start of Commissioning	Commissioning Start		2025-10-13
Commissioning Finished	Commissioning Finished		2025-11-14
Available for Service (AFS)	Available for Service and/or Ready For Service Completed		2026-01-09
Project Complete	Project Close Out Completed		2026-08-07
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
Executing the Base Case option (i.e. no project) will not ensure the reliable, safe operation of R.H. Saunders sixteen generating units, including G16. The generator and turbine components are reaching the end of their service life as the last overhaul was completed in the 1990s and 2000s. It is not recommended to exceed component design life as forced outages will result. Recent major forced outages have been experienced at R.H. Saunders, including a generator bearing wipe in 2019 which resulted in a seven-month forced outage. As a flagship asset, R.H. Saunders provides 1000MW of emissions free energy for Ontario Continued forced outages will jeopardize the generating station's ability to contribute clean, reliable energy to the market. Forced outages will also result in increased maintenance costs as components begin to fail and require replacement.		
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
This alternative would delay the execution of the overhauls by 3 years. As highlighted in Alternative 2 above, the generator and turbine components are nearing the end of their service life and require replacement as recommended in the Pre-Overhaul Condition Assessment (NA9-REP-01550-0001). In order to maximize the benefits of the Saunders overhauls, the Pre-Overhaul Condition Assessment recommended completing slot cutting to relieve internal stresses caused by AAR. This recommendation was accepted and executed through a project SAU83086 from 2017-2019. Delaying the start of the overhauls would diminish the added benefits the concrete slot cutting will provide to the Saunders overhauls. As well, the risk of forced outages increases with the delay.		
Alternative 4:		For Project Level A, B

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Technical	Stay vane rust removal may be more difficult to remove than planned	Mitigate 61919 - Develop detailed plan for this scope including backup plans in the event that the primary plan is not being successful. Include in that plan specific details regarding access (scaffold, personnel lifts etc) and how that will be implemented. 4/30/2024	Medium
Technical	Forced outage occurring to another unit during the overhaul. Note this risk is assessed as a total risk for the Overhaul program, not this individual overhaul.	Accept	Medium
Technical	Discharge Ring may be incorrectly installed	Accept	Medium

Quality	Potential discharge Ring misalignment	Accept	Medium
Resources	300T gantry crane may not be available during critical path scope requirements	Accept	Medium
Project Management	Discharge ring installation, Pivot ring installation, reassembly & commissioning schedule timelines may be extended beyond plan.	Mitigate 61900 - Update G16 Baseline schedule upon completion of G9 Overhaul and implement all schedule Lessons Learned 10/31/2024	Medium
Technical	Outer Headcover seat seal leaks upon re-assembly. Unit will need to be disassembled again.	Accept	Medium
Procurement - Materials	Potential material delivery delays	Mitigate 56497 - Prepare an updated list for potential long lead time items using G9 experience & actively procure in advance 1/31/2024	Medium
Technical	Equipment as found/concealed conditions may not be as expected.	Accept	Medium
Resources	Tailrace gates may not seal and the draft tube and scroll case can not be dewatered	Accept	Medium
Integration	Engineering design may not account for field constraints (eg. cable tray routing, piping routing, component conflicts etc.)	Mitigate 56461 - GC completes COMS review of Westinghouse designs in advance prior to outage to verify feasibility and documents outcome of COMS review. 6/28/2024	Medium
Health and Safety	Potential hazardous materials exposure during construction	Mitigate 56501 - Perform hazardous materials testing prior to outage. 6/28/2024	Medium
Technical	May need to replace primary concrete during installation of the discharge ring	Accept	Medium
Resources	Coordination between scope of work assigned BTU and PWU may fail	Accept	Medium
Technical	Overhead door may require maintenance repair or replacement in order to restore access the erection bay	Accept	Medium
Commercial (Contract/Legal)	Potential excessive material and labour inflation	Accept	Medium
Commercial (Contract/Legal)	There may be insufficient funding available for fabrication/procurement activities	Accept	Medium
Project Management	Sufficient engineering/project management hours may not be enough to support the project	Accept	Medium
Technical	Engineering documentation of critical path tasks may not be available when required such as refurbishment recommendations, site design changes, quality acceptance etc. This may occur more often during periods of night shift construction schedule.	Accept	Medium

Quality	Technical Non-conformances may be found after Equipment FAT	Accept	Medium
Technical	The pivot ring integration with surrounding concrete and anchors may not be possible	Accept	Medium
Technical	During wet commissioning, dynamic thrust shoe loading data may require re-work including dismantle and re-assembly	Mitigate 56499 - Create a decision tree to assist team to make a decision on impact 9/30/2024	Medium
Technical	Upon as-found inspection, turbine components may be found with significant issues (e.g. cracks in outer head cover)	Accept	Medium
Technical	Turbine component may require removal, repair & re-installation	Accept	Medium

Additional Risk Analysis — For Project Level A or B

Risks are registered in the online risk tool ePRM. An EMV was performed resulting in a recommended cost contingency of [redacted].

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$K	Alternative	Base Case (No Project)	Delay Work	Alternative 4	Alternative 5
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects.

Qualitative Factors — For Project Level A or B

Execution of the preferred alternative will result in the following qualitative benefits:
- Restore integrity, long-term reliability and ensure the continued availability of the generating units at RH Saunders GS for another 25 years,
- Re-establish rotor-stator air gap and runner-discharge ring clearances,
- Reduce risk of thrust bearing failures,
- Implement component and system design improvements to improve health and safety and operational performance.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	PIR Completion Date	2027-08-07

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Cost Performance	$41.3M	$41.3M	Measured against the total approved release (G2+G3)	Project Control Officer
Schedule Performance	16 months outage	16 months outage	Measured through baseline variance schedule in P6	Project Control Officer
Safety Performance	0 years with an LTI (Lost Time Injury)	0 year with an LTI (Lost Time Injury)	Through safety reporting / weekly project update	Project Site Manager
Quality Performance	All NCR closed	No open NCR at project close	Through an NCR Log	Third Party Quality Control

Definitions and Acronyms	
OEM	Original Equipment Manufacturers
NTP	Notice to Proceed
GS	Generating Station
EMV	Expected Monetary Value
PWU	Power Workers' Union
SOW	Scope of Work
PMG	Permanent Magnet Generator
AAR	Alkali-aggregate Reaction
GC	General Contractor
PCR	Project Close-out Report
LTI	Lost Time Injury
NCR	Non Conformance Report

ONTARIO POWER GENERATION

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86587 - SAU-G16 CAPITAL REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management	320	1,133	2,759	358					4,570	15
2 - Inspection										
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	2,409	6,565	18,609	2,797					30,380	100
Removal Costs (incl. above)										0

Project Number	86593 - G16 OVERHAUL						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management	148	99							247	2
2 - Inspection										
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

Business Case Summary

Interest	[redacted]									
Other										
Total	437	2,720	7,605	174					10,936	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**2.50**	**Interest Rate (going-forward)**	**4.00**

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
86587	2026-01-09	Unit Return to Service	26,240	100.0
		Total:	**26,240**	**100**

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Zain Chaudhry Senior Project Leader Madawaska Project Managem	2024-04-10	Amanda Griener Director Asset & Project Mgmt Production Support	2024-04-12

ONTARIO POWER GENERATION

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Business Case Summary

Project #	86595	**BCS Document Number**	NA9-BCS-08707-1087662
Project Title	86595 - SAU-LSD CAPITAL PROGRAM (JW)(NYPA)		
Facility	SAU - RH SAUNDERS	**Investment Classification**	
Project Level (Scalability)	D	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2033-Dec-31
Estimate Class (Current Request)		**Estimate Class (Overall Project)**	

Recommendation

We recommend a release of $3,822k (net), including [redacted] of contingency.

The estimated total project cost range is to be determined upon Gate 2 Definition Phase BCS release along with the approval to proceed to the Definition Phase.

This is a NYPA managed project under the OPG/NYPA Joints Works Agreement, which requires OPG to contribute 50% of the total project cost.

This release is to complete the following G3 Execution Phase work:
• NYPA Project Management and Oversight,
• NYPA Engineering Assessment to identify and recommend cost effective remediation, repair, removal and replacement of mechanical, civil and electrical systems and structures at the Long Sault Dam.
• NYPA Conceptual Design and Engineering Oversight to for the recommended upgrades.

Investment Cash Flows

Project Number	86595 - SAU-LSD CAPITAL PROGRAM (JW)(NYPA)					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	2,402	1,420						3,822
Total released to date	0	2,402	1,420						3,822
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	3,822.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Scott Gagnon Director Asset & Project Mgmt Production Support	Scott Gagnon APPROVED IN EBX	2023-02-15
I concur with the business decision as documented in this BCS.		

ONTARIO POWER GENERATION

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Business Case Summary

Finance Approval : **Martin Rupnik** **Finance Controller**	Martin Rupnik APPROVED IN EBX	2023-02-21
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Shaun Hinds** **Director Plant Operations.**	Shaun Hinds APPROVED IN EBX	2023-03-01

EXECUTIVE SUMMARY – Project Overview

The New York Power Authority (NYPA) has a control dam called Long Sault Dam (also referred to as a spillway), which is located in Massena New York. NYPA is currently undergoing an assessment and capital program evaluation of the systems and structures at Long Sault Dam to extend its design and operating life. The scope of the assessment and evaluation is outlined below. The outcome will be the identification of system and structural risks and issues along with recommended cost-effective remediation, repair, removal, and replacement of mechanical, civil, and electrical systems and structures at the Long Sault Dam.

Engineering Assessment Scope:
• Mechanical Systems
- Spillway Gates
- Stop Logs Slots and Rails
- HVAC
- Bubbler Systems
- Piping and Drainage
- Cranes
• Civil Systems
- Concrete and Steel Assessment
- Stairwells
- Downstream Apron
- Superstructure
• Electrical Systems
- Lighting
- Electrical Systems and Load Study
- Fire Alarm
- Communications
- Generator

OPG has a contractual obligation under the Joint Works (JW) Agreement with NYPA to pay for 50% of this project. NYPA identified the need for this project based on condition of legacy systems and structures, and the need to extend design and operating life of Long Sault Dam.

The JW is an agreement between OPG and NYPA to share certain costs at certain facilities and its auxiliary structures such as the Long Sault and Iroquois Dam. One party is responsible to manage the joint works asset while both parties contribute equally to the costs associated with the asset. For this project, the project management and work execution will be performed by NYPA. OPG will pay 50% of the gross cost.

Key Risks:
1. (Cost) There is a risk of discovery issues that arise during engineering assessment and evaluation. This will increase detailed design and construction scope, and schedule. Mitigate: Cost and Schedule contingency added.
2. (Schedule) There is a risk that project execution schedule could be accelerated or deferred by NYPA. This project is executed and managed by NYPA. Accept: Schedule acceleration. Mitigate: Schedule deferral/delay by added contingency into the schedule. OPG has monthly project meetings with NYPA to review project progress and schedule and cost forecasts.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Development Phase BCS	Gate G1 Approval		2023-02-24

ONTARIO POWER GENERATION

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Business Case Summary

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Definition Phase BCS	Gate G2 Approval		2025-01-31
Execution Phase BCS	Gate G3 Approval		2027-01-31
Project Close Out (PCR)	Project Close Out Completed		2033-12-31

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86595 - SAU-LSD CAPITAL PROGRAM (JW)(NYPA)						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2023	2024	2025	2026	2027	2028	Future	Total	%
0 - Cost Management										0
1 - Project Management		300	200						500	13
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		2,402	1,420						3,822	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.50	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Vichetr Lim Program Coordinator / Advisor Programming	2023-02-14	Luigi Perra Section Mgr Projects Projects	2023-02-14

ONTARIO POWER GENERATION

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Business Case Summary

Project #	86792	**BCS Document Number**	P4-BCS-08707-1631626
Project Title	86792 - ALX G2 CAPITAL REFURB		
Facility	ALX - ALEXANDER	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Planning Phase - (Superseding)	**Target Project Completion Date**	2030-May-16
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $3,041K, including [redacted] of contingency for the project. This will bring the total released-to-date to $3,868K, including [redacted] of contingency.

Previous funding released from Project ALX84751 has been transferred to Project ALX86792, as per Change Control Form 11538. The Project ALX84751 scope included field pole and instrumentation. Project ALX84751 scope of work was transferred to Project ALX86792 to consolidate scope for efficiency.

This project shall complete the refurbishment of the generator, and the replacement of the turbine, governor and exciter systems.

The previous Planning Phase gate has been superseded due to the additional funding required to complete runner model testing.

The estimated total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This project release will involve the following definition phase activities:
- Development of Technical Specifications,
- Refine cost estimate,
- Development of Scope of Work,
- Development of Project Management Plan,
- Development of Contracting strategy,
- Completion of preliminary engineering including runner model test, and
- Prepare Definition phase gate package.

Investment Cash Flows

Project Number	86792 - ALX G2 CAPITAL REFURB					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	459	368							827
Currently Requested	0	2,571	470						3,041
Total released to date	459	2,939	470						3,868
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	3,868.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		

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

ONTARIO POWER GENERATION

Records File Information:
Retention Permanent

Business Case Summary

Recommended by: Direct Report of Line Approver : Sean Lacey Asset Manager NWO Production Support	Sean Lacey	2025-05-14
I concur with the business decision as documented in this BCS.		
Finance Approval : Katrina Alton Finance Controller	Katrina Alton	2025-05-14
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Laura Hurley Director Asset & Project Mgmt	Laura Hurley	2025-05-15

EXECUTIVE SUMMARY – Project Overview

Alexander Generating Station (GS) is a five-unit hydroelectric station located on the Nipigon River, approximately 17 kilometers north of Nipigon, Ontario. The station was placed in-service from 1930 to 1958, with unit #2 (G2) being placed into service in 1930. Alexander G2's last completed refurbishment was from 1992-1993 . The last refurbishment scope included: generator rewind, generator cables replaced, rotor field poles cleaned (corn-blasted). wicket gate sleeve replaced, bushings replaced, pin replaced, generator/turbine shaft coupling replaced, turbine bearing refurbished, runner cavitation repaired..

The G2 generator field poles have no historical evidence of ever being refurbished , and thus are considered to be original. Insulation resistant tests found that the insulation properties are degraded.

The G2 turbine is original to the station with the original runner being replaced in 1963. Inspections have shown that the runner, wicket gate, and embedded components showed signs of pitting, cavitation, degradation, evidence of weld repairs, and cracks on the cast iron stay ring. The turbine shaft is original and has a tapered connection interface that does not meet current design standards and would require modernization to connect to a new runner.

The G2 governor system is original to the station, however, the pressure subsystem was replaced in 1994. Testing confirmed that the governor system does not meet IESO requirements and has poor repeatability in meeting performance requirements required to connect the G2 to the grid. The current system is unable to meet future IESO market conditions and response requirements.

The G2 excitation systems were installed in 2005. However, the original equipment manufacturer (OEM) no longer supports the excitation system. Spare parts are unavailable for purchase.

Additionally, there is a potential opportunity to increase generation by approximately 1.8MW (13%) by replacing the current runner design.
It is expected that replacing the current runner design will increase generation by approximately 1.8MW"

The previous release funded the development of scope, detailed cost estimate, project execution schedule to replace the runner. However, a 2024 non-destructive examination revealed cracks in the cast iron stay ring, necessitating an expanded scope.

The current release captures the expanded scope and the project will address, in addition to the runners, the turbine, generator windings, governor system, and excitation system. The current release focuses on developing technical specifications, a project management plan, and completing preliminary engineering. A future Gate 2 release will fund detailed design and procurement, with a Gate 3 release funding construction and field execution.

The main risks and associated mitigating actions for this project include:
1. Contractor Engineering Design Duration for Turbine Replacement: This risk has a moderate probability and could lead to project delays. Mitigating actions include regular progress meetings, model testing, and scheduled design reviews.
2. Schedule Delay Due to Long-Lead Items: With a high probability, this risk could significantly impact the project timeline. Mitigation involves early identification and procurement of long-lead items and regular schedule reviews.
3. Installation of New Turbine Embedded Components: This risk carries a moderate probability and could affect the construction phase. Mitigating strategies include feasibility studies, execution procedure reviews, and weekly construction meetings.

Business Need

For Project Level A or B

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Business Case Summary

Refurbishment of the generator and replacement of the turbine aligns with OPG's strategic initiatives, and presents an opportunity to provide an annual aggregate energy gain (AAEF) between 2-4 GWh. This energy gain shall will be validated with a runner model test and on site performance testing. The turbine upgrade shall assist in meeting future energy demands. TTurbine components such as headcover, stay vanes, bottom ring and throat ring are made of cast iron. Given the challenges in repairing cast iron and the high discovery risk associated with the 90+ year-old components, replacement is advisable. Cast iron from this era has a greater risk of internal defects and varying microstructures, especially since the quality control and testing available during that time was less than in the present day.

Given the potential energy gains, current age, and condition of assets at G2, the preferred alternative is a comprehensive refurbishment of the G2 unit. This includes refurbishment of the field poles, replacing the turbine's runner, headcover, bearings, shaft, embedded components, and upgrading the governor and excitation systems. This approach aligns with OPG's strategic direction by ensuring the long-term sustainability and efficiency of its assets. Other alternatives, such as deferring the work, or addressing the items piecemeal were not viable as these options either didn't address the business need, were inefficient, or more costly.

Preferred Alternative:	Generator Refurbishment, Turbine Replacement	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is a complete the refurbishment of the generator, and replacement of the turbine.

The preferred alternative shall will address the business need of equipment reliability, mechanical asset protection, and safe means of completing future generator and turbine maintenance activities.

Based on the available service life and historical operating experience of the unit, the refurbishment of the generator and replacement of the turbine is the only viable option to sustain reliable operation for the future. Refurbishments are currently scheduled every 30 to 40 years, therefore, it is unlikely that the systems requiring refurbishment and replacement will establish continuous operation until the next refurbishment if not replaced immediately. Replacement of only particular components of the turbine increases the risk of reliability issues due to the increased complexity to complete installation and construction integration.

The generator refurbishment scope of work shall will include:
- Field pole refurbishment,
- Exciter replacement,
- Thrust bearing replacement, and
- Guide bearing refurbishment.

The complete turbine replacement scope of work shall will include:
- Turbine shaft,
- Headcover,
- Turbine bearing,
- Stay ring,
- Bottom ring,
- Servomotors, and
- Governor controls and hydraulic power unit.

The preferred alternative has several advantages including:
- Modern equipment design with expected increased reliability and new design life;
- Reduced risk of in-service failure resulting in forced outage and lost power generation;
- Reduced risk of non-compliance with IESO market rules for governor and exciter; and
- Anticipated increase in runner power output and efficiency.

Deliverables:

Previous Release: N/A

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR1	Gate G1 Approval		2025-04-30
LLT	Long Lead Time Material Identified		2026-02-15
TES	Technical Specifications Complete	Includes all engineering technical specifications	2026-03-14
GR2	Gate G2 Approval		2026-04-14
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
LDC	Labour Determination Completed		2026-09-13
PES	Preliminary Design Complete		2026-09-13
ECP	Detailed Design Complete		2027-03-13
RFP	Request for Proposals		2027-03-31
PMP	Project Management Plan		2027-06-13
SOW	Scope of Work Document Complete		2027-06-13
GR3	Gate G3 Approval		2027-07-01
EPC	Award Contracts / PO Issued	Construction Contracts	2027-07-15
SOI	Start of Installation		2027-09-13
SOO	Start of Outage		2027-09-13
UAT	UAT - User Acceptance Testing		2027-11-30
FOI	Finish of Installation		2029-01-31
CMF	Commissioning Finished		2029-03-16
FOO	End of Outage		2029-03-16
AFS	Available for Service and/or Ready For Service Completed		2029-03-31
ROE	Report of Equipment in Service		2029-05-16
PCO	Project Close Out Completed		2030-05-16

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

The No Project alternative has the following advantages:
- Avoiding refurbishment means no immediate investment in new equipment or upgrades, preserving capital for other uses.
- Continuing operations without interruption avoids the downtime associated with refurbishment activities.
- Resources such as personnel and equipment remain available for other projects or operational needs.

The No Project alternative is not a feasible option as without refurbishment, the following disadvantages may occur:
- The unit is not likely to operate at the optimal efficiency, resulting in reduced generation,
- Older equipment may not meet current and future energy market requirements, potentially leading to compliance issues,
- Continuing to operate an unmaintained and inefficient unit can lead to increased operational costs, potentially making it economically unviable in the long run, and
- Continuous risk of exciter failing resulting in extended outage due to limited support from OEM and inability to procure spare components.

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Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Delaying the generator refurbishment and replacement of the turbine has the following advantages:
- Delaying the project may free up financial resources in the short term, allowing the organization to allocate funds to other more urgent needs or priorities.

Delaying the generator refurbishment and turbine replacement is not the preferred option, as delaying the project may result in:
- Costs for materials and labor increase due to inflation, potentially making the project more expensive in the future,
- The risk of equipment failure increases with age, potentially leading to unplanned outages and costly emergency repairs,
- Delaying may result in the expiration of necessary permits or approvals, requiring reapplication,
- Postponing refurbishment may hinder progress toward OPG meeting its future energy commitments, and
- Increase in risk of exciter failing and establishing extended outage due to limited support from OEM and inability to procure spare components.

Alternative 4:	For Project Level A, B

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Procurement - Materials	Turbine Major Components Procurement Delays	Mitigate 72391 - Long Lead Material Engineering Resources and Procurement Schedule 11/1/2025	Medium
Project Management	IESO Outage Approval	Accept 72393 - Review outage schedule in ITOA on quarterly basis with Operations to review IESO approval status, review schedule on quarterly basis to ensure outage length is acceptable for execution duration 7/10/2025	Medium

Additional Risk Analysis	For Project Level A or B
Montecarlo contingency modelling shall be completed prior to G3 full release.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)			
Is PIR Required?	Yes	**PIR Completion Date**	2031-05-16

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86792 - ALX G2 CAPITAL REFURB						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management	8	10	6						24	1
1 - Project Management	246	110	35						391	10
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	459	2,939	470						3,868	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	4.00	Interest Rate (going-forward)	4.04

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Justin Bujold Project Leader Western Overhauls Project Management	2025-05-02	Darryl Flank Section Manager Western Overhauls	2025-04-22

ONTARIO POWER GENERATION

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Business Case Summary

Project #	86793	**BCS Document Number**	P4-BCS-08707-1237493
Project Title	86793 - G3 RUNNER REPLACEMENT		
Facility	ALX - ALEXANDER	**Investment Classification**	Sustaining
Project Level (Scalability)	D	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2029-Oct-20
Estimate Class (Current Request)	Class 5	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $150k, including [redacted] of contingency for the ALX86793 - G3 Runner Replacement project.

The total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This project release will involve the following planning activities:
- Refinement of Scope development;
- Detailed cost estimate;
- Project execution schedule; and,
- Development of execution BCS to implement project plan.

Investment Cash Flows

Project Number	86793 - G3 RUNNER REPLACEMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	50	100						150
Total released to date	0	50	100						150
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	150.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Laura Hurley Asset Manager NWO Production Support	Laura Hurley	2023-06-12
I concur with the business decision as documented in this BCS.		
Finance Approval : John Sim Finance Controller	John Sim	2023-06-13
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : **OAR Element : 1.1** **Brian Dietrich** **Director Asset & Project Mgmt**	Brian Dietrich	2023-06-13

EXECUTIVE SUMMARY – Project Overview

In 2015, a study was completed by an OEM titled “Alexander Falls G1 G2 and G3 Hydro Generator Uprate Study” (Ref #: HCP-ETR-201501) to determine if the Alexander Falls generators #1, #2, and #3 can operate at the “overload” rating of 17.25MW safety. The findings confirmed that there are no mechanical/structural obstacles to operating at 17.25MW. A more recent HUUE analysis was performed and a conceptual estimate of the achievable generator output due to a runner upgrade is 15MW at normal station gross head of 17.8m. This represents a 1.8MW (13.6%) increase over the current runner design. Under maximum head conditions and high river flows this runner upgrade concept could produce up to 17.25MW, which matches the generator rating of the OEM study. The energy gain expectations in a one unit, two unit and three unit runner upgrade scenario are as follows:

- One unit upgrade = 9.0 GWh
- Two unit upgrade = 16.8 GWh
- Three unit upgrade = 22.4 GWh

Given the potential energy gains and the current age and condition of the runner, it is recommended to replace the existing runner. The 2021 Alexander Generating Station Plant Condition Assessment (PCA) recommended the G3 Runner replacement be executed at the same time as the G3 overhaul.

This BCS will fund planning activities, including scope, cost, and schedule.

Gating Strategy: The gate strategy is to proceed from Gate 1 to Gate 2 due to the lead time required for the procurement of the runner.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR1	Gate G1 Approval	ALX86793 - G3 Runner Replacement	2024-03-13
SOW	Scope of Work Document Complete	ALX86793 - G3 Runner Replacement	2025-01-05
LLT	Long Lead Time Material Identified	ALX86793 - G3 Runner Replacement	2025-01-05

Business Case Summary

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR2	Gate G2 Approval	ALX86793 - G3 Runner Replacement:	2025-04-23
LDC	Labour Determination Completed	ALX86793 - G3 Runner Replacement	2025-05-14
TES	Technical Specifications Complete	ALX86793 - G3 Runner Replacement	2025-08-13
EPC	Award Contracts / PO Issued	ALX86793 - G3 Runner Replacement Runner Design	2025-09-10
EPC	Award Contracts / PO Issued	ALX86793 - G3 Runner Replacement Runner Purchase	2025-09-17
GR3	Gate G3 Approval	ALX86793 - G3 Runner Replacement	2026-03-18
SOI	Start of Construction	ALX86793 - G3 Runner Replacement	2027-02-03
SOO	Start of Outage	ALX86793 - G3 Runner Replacement	2028-01-12
FOO	End of Outage	ALX86793 - G3 Runner Replacement	2028-12-06
FOI	Finish of Installation	ALX86793 - G3 Runner Replacement	2028-12-13
AFS	Available for Service and/or Ready For Service Completed	ALX86793 - G3 Runner Replacement	2028-12-20
PCO	Project Close Out Completed	ALX86793 - G3 Runner Replacement	2029-10-20

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	2030-10-20
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86793 - G3 RUNNER REPLACEMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		20	12						32	21
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		50	100						150	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	4.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jason Bailey Program Coordinator / Advisor Programming	2023-05-29	Brian Mason Section Mgr Projects Northwest Project Managem	2023-02-23

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Business Case Summary

Project #	86859, 86860	**BCS Document Number**	FP2-BCS-08707-1387802
Project Title	86859 - MAN G3 OM&A REFURB 86860 - MAN G3 CAPITAL REFURB		
Facility	MAN - MANITOU FALLS	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	62030 - OM&A - PROJECT 17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Planning Phase - (Full)	**Target Project Completion Date**	2029-Feb-28
Estimate Class (Current Request)	Class 5	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $1,404 K, including [redacted] of contingency.

The total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This project will replace Unit 3's generator stator and address loosening of the rotor rim's fit during a unit refurbishment. The project will either refurbish or replace the turbine, as well as assess power and efficiency increases through modern runner designs and water passage modifications.

This release is to:
-Develop the scope of work
-Refine the cost estimate
-Initiate preliminary engineering and design
-Develop technical specifications
-Prepare definition phase gate package

Investment Cash Flows

Project Number	86859 - MAN G3 OM&A REFURB					**FAC**	62030 - OM&A - PROJECT		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	56	169						225
Total released to date	0	56	169						225
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Project Number	86860 - MAN G3 CAPITAL REFURB	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

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Business Case Summary

$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total
Previous releases									
Currently Requested		210	969						1,179
Total released to date		210	969						1,179
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs									

Total OAR Approval	1,404.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Laura Hurley Director Asset & Project Mgmt NWO Production Support	Laura Hurley	2024-11-29
I concur with the business decision as documented in this BCS.		
Finance Approval : Melissa Hannon Director Controllership	Melissa Hannon	2024-12-03
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.2 Brian Dietrich VP Regional Operations	Brian Dietrich	2024-12-03

EXECUTIVE SUMMARY – Project Overview

ONTARIO POWER GENERATION

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Business Case Summary

Manitou Falls Generating Station comprises five units and is situated on the English River, 32 kilometers southwest of Ear Falls, Ontario. The facility has been operational since 1958. The generators are original Canadian General Electric machines.
During a G3 maintenance outage in 2021, the generator was discovered to have an eccentric rotor, stator split collapsing and core damage.

A temporary repair solution was implemented to restore the unit to operation and not extend a forced outage. This solution managed the risk of further stator collapse at the split locations. A complete replacement of the stator component and rotor reshrink is necessary to ensure reliable long-term operation and mitigate the risk of failure. OPG Engineering recommends that this work be done during the next planned unit refurbishment.

The current release will develop the scope of work, refine the cost estimate, initiate preliminary engineering and design, develop technical specifications, and prepare the definition gate package for the preferred alternative. The release will also assess potential power and efficiency increases through modern runner design and water passage modifications. Either a turbine refurbishment or replacement will occur during the outage. This will be assessed in this release as well.

Future releases will fund the detailed design, procurement of long lead materials, construction, and commissioning.

This work will be carried out under two project numbers: Project 86859 for OM&A portion Project 86860 and for the capital portion.

The project aligns with OPG's net-zero commitments and supports electrification efforts.

The key projects risk are managing schedule of extended lead time components, and availability of resources, both internally and externally, to complete the approved scope of work. To mitigate extended lead times, long lead parts will be identified during this phases so that adequate schedule contingency can be incorporated into the project schedule. Regular progress meeting would be held with the supply vendors to ensure that progress is maintained and critical timelines are met. To mitigate the risk of resources constraints the projects will engage the Programmatic Vendor Partner to secure specialized technical resources. Internally a resource plan will be developed to ensure hours are input into work group forecasts.

Preferred Alternative:	Stator Replacement, Hydraulic Assessment & Turbine Refurbishment/Replacement	For Project Level A, B or C

Description of Preferred Alternative

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Business Case Summary

The preferred alternative is the major G3 generator stator component replacement with a rotor rim reshrink, refurbishment and replacement of turbine components, and updates to machine monitoring to the latest engineering standards. This alternative is the most effective way to address the business need of re-establishing the G3 unit generator to a reliable operational status, mitigating the risk of in-service failure, and restoring the machine to acceptable tolerances for long-term operation.
The generator condition is poor based on engineering field assessment. The turbine has various systems that are in poor to fair status that are due to be addressed on a refurbishment outage.

During the initiation phase the range of alternatives considered for the G3 Unit were:
1. Completion of rotor reshrink only.
2. Do nothing and accept risk of current condition.

However, the preferred alternative is the best way to address the business need because it provides a comprehensive solution that addresses the root causes of the generator's current condition, reducing the risk of in-service failure and ensuring long-term reliability.

This development phase release will further the preferred alternative by:
• Refining the scope of work, cost estimate, and project schedule
• Initiating preliminary engineering and design activities
• Developing technical specifications and preparing the definition gate package

The preferred alternative has several advantages, including:
• Re-establishing the G3 unit generator to a reliable operational status
• Mitigating the risk of in-service failure
• Restoring the machine to acceptable tolerances for long-term operation
• Potential for improved efficiency and performance gains through hydraulic assessment and water passage improvements.
However, the alternative also has some potential drawbacks, including:
• Higher upfront cost compared to alternatives that do not meet business needs
• Potential delays in project completion due to lead times for component procurement

The project will be executed through a phased approach, with each phase building on the previous one. The basis for cost and schedule contingencies will be further developed during the development and definition phase.

The preferred alternative is subject to the following constraints and obligations:
• The project must be completed within the approved budget and schedule
• The project must meet all relevant regulatory requirements and standards
• The project must minimize disruptions to operations and ensure safe working conditions

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR1	Gate G1 Approval	Gate Package Approved	2024-11-28
DES	Preliminary Design Complete	Hydraulic Assessment Complete of Water Passage	2025-08-21
TES	Technical Specifications Complete	Long Lead Material Technical Specifications	2025-09-25
LLT	Long Lead Time Material Identified	Materials Greater Than 12 Months Leadtime Identified	2025-10-16
PMP	Project Management Plan	Project Management Plan Approved	2025-10-30

ONTARIO POWER GENERATION

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Business Case Summary

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR2	Gate G2 Approval	G2 Definition Release Approval by Governing Body	2025-12-12
SOW	Scope of Work Document Complete	SOW Approved by Stakeholders	2026-01-29
LDC	Labour Determination Completed	Labour Assignment Completed by Steering Committee	2026-02-26
ECP	Detailed Design Complete	Long Lead Material Detail Design Complete	2026-04-23
GR3	Gate G3 Approval	G3 Execution Release Approval by Governing Body	2026-05-21
SOO	Start of Outage	Unit Outage Breaker Open	2026-08-03
FOO	End of Outage	Unit Outage Breaker Closed	2028-02-04
AFS	Available for Service and/or Ready For Service Completed	Unit Available and Turnover Accepted by Operations	2028-02-29
ROE	Report of Equipment in Service	REIS Routed and Approved	2028-05-03
PCO	Project Close Out Completed	PCR Completed	2029-02-28

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Resources	Insufficient Technical Resources to Advance Project	Mitigate Issue contract to OEM supporting Manitou Falls under the Overhaul Programmatic Approach to secure specialized engineering resources. 12/12/2024	Medium
Procurement - Materials	Long Lead Generator and Turbine Components Delays	Mitigate 68297 - Identify lead time of major components with schedules through early contractor engagement on scope development through the Vendor Programmatic Approach. 68355 - Hold Regular Progress Meeting with Long Lead Supply Vendors 8/20/2025	Medium

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

ONTARIO POWER GENERATION

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Business Case Summary

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86859 - MAN G3 OM&A REFURB						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		9	22						31	14
2 - Inspection										0
3 - Engineering		[redacted]								
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		56	169						225	100
Removal Costs (incl. above)										0

Project Number	86860 - MAN G3 CAPITAL REFURB						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		48	97						145	12
2 - Inspection										0
3 - Engineering		[redacted]								
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

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Interest		[redacted]									
Other											
Total		210	969							1,179	100
Removal Costs (incl. above)											0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**3.50**	**Interest Rate (going-forward)**	**4.80**

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Jordan Hansen Project Leader Western Overhauls Project Management	2024-11-19	Laura Hurley Director Asset & Project Mgmt Western Region Production Support	2024-09-23

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Business Case Summary

Project #	86937, 86945	**BCS Document Number**	NA9-BCS-08707-1360812
Project Title	86937 - SAU - G16 CAPITAL REFURBISHMENT 86945 - SAU - G16 OVERHAUL		
Facility	SAU - RH SAUNDERS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES 62030 - OM&A - PROJECT
Release: Gate and Project Phase	G2 - Definition - (Full)	**Target Project Completion Date**	2028-Jul-28
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 4

Recommendation

We recommend a bundled execution release of $11,165k, including [redacted] of contingency. This will bring the total release to-date to $11,165k, including [redacted] of contingency. This is the first bundled release of these two projects. Project specific releases include:

SAU86937 (Capital): $10,038k, including [redacted] of contingency
SAU86945 (Non-Standard): $1,127k, including [redacted] of contingency

The bundled estimated project cost range is $35M-$45M.

These two projects are for the refurbishment/overhaul of Generator Unit 16 at R.H. Saunders Generating Station. This release will fund the definition scope of work to restore integrity, reliability, and long-term viability of this generator for the next 25 years.

The scope of this release includes the following:

- The long lead equipment supply. The long lead equipment supplied include fabrication, testing and delivery of the new discharge ring, pivot ring and servo motors supplied by the OEM and various auxiliary system control panels and other miscellaneous long lead equipment/materials.
- Drawings development.
- Site preparation work.

It should be noted that the refurbishment/overhaul of G16 was originally started under different projects (SAU86587 & SAU86593). However, due to a recent forced outage at Saunders Unit G12, the decision was made to shift the priority from G16 to G12, as G16 is still in operation. Both units are Westinghouse units, and refurbishment/overhaul scope is similar, therefore the planning and design work that has been performed for G16 applies to G12. As a result of this priority change, the bundled projects of SAU86587 & SAU86593 are approved to become the G12 Refurbishment / G12 Overhaul projects. No changes to budget and schedule are expected and all work that was planned for G16 under previous projects, will now occur on G12.

Investment Cash Flows

Project Number	86937 - SAU - G16 CAPITAL REFURBISHMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	27	2,940	7,071					10,038
Total released to date	0	27	2,940	7,071					10,038
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Project Number	86945 - SAU - G16 OVERHAUL	**FAC**	62030 - OM&A - PROJECT

ONTARIO POWER GENERATION

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Business Case Summary

$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total
Previous releases									
Currently Requested			372	755					1,127
Total released to date			372	755					1,127
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs									

Total OAR Approval	11,165.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Amanda Griener Director Asset & Project Mgmt Production Support	Amanda Griener	2024-10-27
I concur with the business decision as documented in this BCS.		
Finance Approval : Melissa Hannon Director Controllership	Melissa Hannon	2024-11-29
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Bruce Robertson VP Regional Operations	Bruce Robertson	2024-11-29

EXECUTIVE SUMMARY – Project Overview

ONTARIO POWER GENERATION

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Business Case Summary

R.H. Saunders Generating Station (GS) is a “Flagship” asset in OPG’s fleet of hydroelectric stations, providing 1000MW of emissions free energy to Ontario. The objective of this project is to restore the integrity, long-term reliability and ensure the continued availability of the sixteen generating units at R.H. Saunders GS. The most recent mechanical and electrical overhauls of the turbine and generators (all 16) were completed during the 1990s and early 2000s. Components included in the last overhaul project are nearing end of life and require refurbishment or replacement in order to meet the project objectives of:
• Restore integrity, long-term reliability and ensure the continued availability of the generating units at RH Saunders GS
• Address deteriorating condition of the components (discussed in detail below)
• Re-establish rotor-stator air gap and runner-discharge ring clearances
• Reduce risk of thrust bearing failures

The R.H. Saunders GS refurbishments/overhauls have been organized as unitized projects. Each generating unit will have a capital and non-standard release with individual project numbers. The non-standard overhaul G16 (SAU86945) project scope includes significant cleaning and repair of generator and turbine components. The capital refurbishment G16 (SAU86937) project scope will include system upgrades and new installations.

This definition release will fund development and procurement work for the overhaul of Unit 16 including design development, equipment supply, and site preparation activities. Scope for the supply of long lead equipment includes fabrication, testing and delivery of new discharge ring, pivot ring, servo motors and various auxiliary system control panels.

Risk:-

- Saunders G.S operates 16 generating units. 8 units are General Electric, and 8 units are Westinghouse. Overhaul Program has an ongoing risk of other unit(s) going into forced outage particularly for the Westinghouse units, which may necessitate re-visiting overall program strategy and overhaul priority.

Business Need

For Project Level A or B

A hydro-electric generating unit requires a major electrical and mechanical overhaul approximately every 25 years. The most recent mechanical and electrical overhauls of the G16 turbine and generator were completed during the 1990s and early 2000s. The turbine and generator components have experienced unique operational issues and structure damage for many years, such as reduced generating unit clearances, discharge ring deformation, concrete structure cracking, relative movement of structural members, and powerhouse water leakage. These issues are either caused or have been exacerbated by Alkali-Aggregate Reaction (AAR), which is a chemical reaction that induces concrete growth. Impact of AAR is being addressed by other investments outside of this project.

A Pre-Overhaul Condition Assessment was finalized in 2016, which examined major water-to-wire electrical, mechanical and civil equipment and structures to provide a basis for this project scope. From the technical condition assessment, the following major work was recommended on all units at R.H. Saunders GS:

• Turbine – major overhaul, new servomotors, replace discharge ring,
• Turbine Regulation – repair and rehabilitate Woodward Cabinet Actuators,
• Generator – major mechanical/electrical overhaul, re-wedge stator and re-shrink rotor as required, rehab field poles and field circuit components, replace CTs, replace neutral grounding system, replace surface air coolers, cooling system upgrades,
• Electrical Auxiliaries – replace, refurbish, upgrade systems as required including the online monitoring system,
• Scrollcase and Draft Tube – grouting and sealing,
• Turbine - new upgraded runner.

New runners are being procured under a separate Capital project, SAU83104 and will be installed concurrently with this project in the refurbishment outage.

Preferred Alternative:

For Project Level A, B or C

Description of Preferred Alternative

Business Case Summary

It is recommended to proceed with the mechanical and electrical refurbishments/overhauls at R.H. Saunders GS. Executing the overhauls will address deteriorating component condition and restore reliability to end of life components and systems and meet the stated project objectives.

The full definition phase (Gate 2) scope of work includes:

- Procurement of long lead time equipment for G16
- G16 specific design details
- OPG Project Management & Engineering activities

The future full execution phase (G3) scope of work includes:

Components and activities funded under the non-standard SAU86945 SOW:
- Unit disassembly
- Scroll case refurbishment
- Turbine embedded component maintenance
- Turbine non-embedded and non-rotating component refurbishment

Components and activities funded under the capital SAU86937 SOW:
- Replace thrust bearing with new polytetrafluoroethylene (PTFE) bearing
- Install new discharge ring
- Re-insulate/refurbish field poles
- Generator & bearing cooling system replacements
- Install stator push-pull system
- Install new main shaft seal
- Installation of new runners
- Servomotor replacement
- Install new neutral grounding resistor cabinet and instrumentation and control cabinets
- Install new mounting and diagnostic (M&D) center online monitoring system
- Unit reassembly and commissioning
- Governo component maintenance including Permanent Magnet Generator (PMG)
- Generator mechanical and electrical component refurbishment

The scope of work was split and, assigned per the CPAA to both PWU and BTU. The project estimates are based on this labor assignment.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 2 BCS Approval	Gate G2 Approval		2024-11-29
Notice to Proceed Original Equipment Manufacturer Contractor	Award Contracts / PO Issued		2025-02-28
Gate 3 BCS Approval	Gate G3 Approval		2025-12-12
G16 Design Complete	Detailed Design Complete		2026-03-27
Pivot Ring Delivery to Canada	LLM_Materials Delivered		2026-04-24
Discharge Ring Delivery to Canada	LLM_Materials Delivered		2026-04-24

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Notice to Proceed General Contractor	Award Contracts / PO Issued		2026-02-02
Start of Outage (SOO)	Start of Outage		2026-06-02
Start of Construction/Disassembly	Construction Start		2026-07-07
Reassembly Finish (FOI)	Finish of Installation		2027-10-01
Start of Commissioning	Commissioning Start		2027-11-01
Commissioning Finished	Commissioning Finished		2028-01-28
Available for Service (AFS)	Available for Service and/or Ready For Service Completed		2028-02-08
Project Complete	Project Close Out Completed		2028-07-28

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Executing the Base Case option (i.e. no project) will not ensure the reliable, safe operation of R.H. Saunders sixteen generating units, including G16. The generator and turbine components are reaching the end of their service life as the last overhaul was completed in the 1990s and 2000s. It is not recommended to exceed component design life as forced outages will likely result. Recent major forced outages have been experienced at R.H. Saunders, including a generator bearing wipe in 2019 which resulted in a seven-month forced outage. As a flagship asset, R.H. Saunders provides 1000MW of emissions free energy for Ontario Continued forced outages will jeopardize the generating station's ability to contribute clean, reliable energy to the market. Forced outages will also result in increased maintenance costs as components begin to fail and require replacement.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

This alternative would delay the execution of the overhauls by 3 years. As highlighted in Alternative 2 above, the generator and turbine components are nearing the end of their service life and require replacement as recommended in the Pre-Overhaul Condition Assessment. In order to maximize the benefits of the Saunders overhauls, the Pre-Overhaul Condition Assessment recommended completing slot cutting to relieve internal stresses caused by AAR. This recommendation was accepted and executed through a project SAU83086 from 2017-2019. Delaying the start of the overhauls would diminish the added benefits the concrete slot cutting will provide to the Saunders overhauls. As well, the risk of forced outages increases with the delay.

Alternative 4:	For Project Level A, B

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Procurement - Materials	Material Procurement Delays	Mitigate 64187 - Prepare an updated list for potential long lead time items using G9/G12 experience & actively procure in advance 1/2/2026	Medium
Technical	Unit Forced Outage	Accept	Medium
Project Management	G12 Schedule Delays	Mitigate 68488 - Include float in the G16 schedule to accommodate any unforeseen delay resulting from G12 schedule delay. 68489 - Include contingency in the estimate to cover any potential storage fee for material/components 9/27/2024	Medium

Business Case Summary

Additional Risk Analysis	For Project Level A or B
Risks are registered in the online risk tool ePRM. An EMV was performed resulting in a recommended cost contingency of [redacted]	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects.

Qualitative Factors — For Project Level A or B

Execution of the preferred alternative will result in the following qualitative benefits:
- Restore integrity, long-term reliability and ensure the continued availability of the generating units at RH Saunders GS for another 25 years,
- Re-establish rotor-stator air gap and runner-discharge ring clearances,
- Reduce risk of thrust bearing failures,
- Implement component and system design improvements to improve health and safety and operational performance.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2029-07-28

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
TBD	TBD	TBD	TBD	TBD

Definitions and Acronyms	
OEM	Original Equipment Manufacturers
NTP	Notice to Proceed
GS	Generating Station
EMV	Expected Monetary Value
PWU	Power Workers' Union
SOW	Scope of Work
PMG	Permanent Magnet Generator
AAR	Alkali-aggregate Reaction
GC	General Contractor
PCR	Project Close-out Report
NCR	Non Conformance Report
BTU	Building Trades Union
CPAA	Chestnut Park Accord Addendum

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	86937 - SAU - G16 CAPITAL REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		22	512	333					867	9
2 - Inspection										0
3 - Engineering	[redacted]									
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest		5	203	139					347	3
Other										0
Total		27	2,940	7,071					10,038	100
Removal Costs (incl. above)										0

Project Number	86945 - SAU - G16 OVERHAUL						FAC	62030 - OM&A - PROJECT		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management										0
2 - Inspection										0
3 - Engineering										0
4 - Procurement	[redacted]									
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										

Business Case Summary

Interest										0
Other										0
Total			372	755					1,127	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	**2.50**	**Interest Rate (going-forward)**	**4.00**

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		**Reviewed and Endorsed by (Execution Authority)**	
Zain Chaudhry Senior Project Leader Madawaska Project Management 1	2024-10-08	Amanda Griener Director Asset & Project Mgmt Production Support	2024-10-08

ONTARIO POWER GENERATION

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Business Case Summary

Project #	87142	**BCS Document Number**	NA9-BCS-08707-1087666
Project Title	87142 - SAU-LSD ALCOA EARTHEN DAM JW NYPA CPTL		
Facility	SAU - RH SAUNDERS	**Investment Classification**	
Project Level (Scalability)	D	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - (Full)	**Target Project Completion Date**	2027-Dec-31
Estimate Class (Current Request)	Class 4	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $2,208k (net), including [redacted] of contingency.

The estimated total project cost range is between $30M and $50M.

This is a NYPA managed project under the OPG/NYPA Joints Works Agreement, which requires OPG to contribute 50% of the total project cost. CAD to USD exchange rate of January 2023 was used in the estimate.

This release is to complete the following G3 Execution Phase work:
• NYPA Project Management and Oversight,
• NYPA Engineering and Detailed Design, and Engineering Oversight for identified and recommended remediation of the Alcoa Powerhouse,
• NYPA and NYPA Contracted External Vendor for Materials and Construction costs for the remediation of Alcoa Powerhouse.
• NYPA Project Closeout.
• OPG Prepare Project Closeout Report (PCR)

Investment Cash Flows

Project Number	87142 - SAU-LSD ALCOA EARTHEN DAM JW NYPA CPTL					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	492	1,716						2,208
Total released to date	0	492	1,716						2,208
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	2,208.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Scott Gagnon Director Asset & Project Mgmt Production Support	Scott Gagnon APPROVED IN EBX	2023-02-23
I concur with the business decision as documented in this BCS.		

Business Case Summary

Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	APPROVED IN EBX	2023-02-26
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.			
Line Approval per OAR : OAR Element : 1.1 Shaun Hinds Director Plant Operations.	Shaun Hinds	APPROVED IN EBX	2023-03-01

EXECUTIVE SUMMARY – Project Overview

The New York Power Authority (NYPA) owns and maintains the Alcoa Powerhouse. The Powerhouse was completed in 1902 and it was decommissioned with the construction of the St. Lawrence Franklin D. Roosevelt Power Project and Saunders GS. The mechanical and electrical systems of the Alcoa Powerhouse were removed in 1958. The Alcoa powerhouse remains and functions as a water-retaining structure for the Massena Power Canal. The Massena Power Canal starts at the Massena Intake on the St. Lawrence River and ends at the Alcoa Powerhouse. The Powerhouse separates the Massena Power Canal from the Grasse River. The structure is part of the water control assets for the ST. Lawrence Power Project and is subject to the OPG/NYPA Joint Works agreement.

The Alcoa Powerhouse has not been operational since1958, and the structure is over 100 years old. Its advanced age and deterioration present a hazard to site inspection and maintenance activities. During project planning (i.e. Definition) phase, an evaluation of the entire structure was performed on the safety, stability and long term maintainability of the Alcoa Powerhouse, which resulted in identification of recommended cost-effective remediation. The remediation addresses the risks associated with public safety, asset protection, and environmental/ public relations issues.

This project is planned/managed/executed by NYPA under an OPG/NYPA Joint Works Agreement. OPG has a contractual obligation under the Joint Works (JW) Agreement with NYPA to pay for 50% of this project. Definition Phase work was done under Projects SAU82338 / SAUN0130.

Key Risks:
1. (Cost) There is some risk around fluctuating exchange rate as NYPA will be invoicing OPG in USD. Recent cost estimates provided by NYPA in USD have been converted to CDN funds using a rate of 1.40 (USD to CDN). Contingency has also been added.
2. (Schedule) There is a risk that project definition (i.e. Detailed Design) schedule could be accelerated or deferred by NYPA. This project is executed and managed by NYPA. Accept: Schedule acceleration. Mitigate: Schedule deferral/delay by added contingency into the schedule. OPG has monthly project meetings with NYPA to review project progress and schedule and cost forecasts.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Development Phase BCS (NSTD SAU82338)	Gate G1 Approval		2019-10-27

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Definition Phase BCS (CAP SAU87142)	Gate G2 Approval		2023-02-24

Future Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Execution Phase BCS	Gate G3 Approval		2023-11-30
Project Close Out (PCR)	Project Close Out Completed		2027-12-31

Business Case Summary

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87142 - SAU-LSD ALCOA EARTHEN DAM JW NYPA CPTL						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**	**%**
0 - Cost Management										0
1 - Project Management		126	295						421	19
2 - Inspection										0
3 - Engineering		[redacted]								
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		492	1,716						2,208	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.50	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
87142	2024-12-15	Partial In-Service		
87142	2025-12-15	Partial In-Service		
87142	2026-12-15	Partial In-Service		
87142	2027-12-15	Partial In-Service		
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Donald Ferko Program Coordinator / Advisor Programming	2023-02-14	Luigi Perra Section Mgr Projects Projects	2023-02-14

Business Case Summary

ONTARIO POWER GENERATION

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Business Case Summary

Project #	87197	**BCS Document Number**	08152-BCS-28100-0001
Project Title	87197 - TIMMINS BUILDING EXPANSION		
Facility	TIM - TIMMINS	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17662 - CAPITAL - SERVICES BLDGS & FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2029-Jun-29
Estimate Class (Current Request)	Class 4	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $2,572K, including [redacted] of contingency.

The estimated total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This Full Development release will fund external engineering services, including space analysis, conceptual design with geotechnical investigations, and surveys of the building, property, and infrastructure. It will also cover layout options and alternative analysis.

Additionally, this release will finance the purchase of office furniture, materials, and labor needed to modify and increase capacity within the existing office space as an interim measure to ensure sufficient workspaces are available until the building expansion is completed. The furniture installed as part of the interim space measure will be utilized as part of the final deliverable for this project.

Investment Cash Flows

Project Number	87197 - TIMMINS BUILDING EXPANSION					**FAC**	17662 - CAPITAL - SERVICES BLDGS & FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	1,015	1,557						2,572
Total released to date	0	1,015	1,557						2,572
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	2,572.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Brad Bacvar Director Asset & Project Mgmt Production Support Manager	Brad Bacvar	2024-09-16
I concur with the business decision as documented in this BCS.		
Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	2024-09-17

ONTARIO POWER GENERATION

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Jamey Deforge Director Plant Operations.	Jamey Deforge	2024-09-20

EXECUTIVE SUMMARY – Project Overview

The Timmins Service Centre is a 16,254 sq.ft. facility which includes spaces for office staff, Timmins production, and the Northeast Control Centre (NECC). The existing capacity of these spaces can accommodate approximately 100 work stations. Additionally, there is a large storage yard on the property for production operations with cold storage buildings and open areas.

The Timmins Service Centre is currently operating at full capacity with over 100 employees. There is no available space to accommodate additional staff, and the facility lacks sufficient meeting rooms and hoteling stations for visitors. With the relocation of NECC from Schumacher to the Timmins office in 2015-16, the building's capacity had been further constrained to support administrative staff. To address this constraint, three office trailers had been added to the facility with 20 workstations, however they are also at full capacity. With the expansion of our project portfolio in addition to the previously outlined information, there is a growing need for additional personnel to support various departments, including Projects, Supply Chain, Programming, Finance, Engineering, NECC, and drafting. Without this project, we will need to either bring in additional trailers or relocate some groups to another facility in the Timmins area.

Some alternatives have been reviewed at a high level to address this issue, inclusive but not limited to; relocation of staff to a different location, building a new building on property, and expansion to the existing facility. Through review of these alternatives, it was deemed that completing a building expansion to the existing facility would be the most suitable option to satisfy the business need.

The renovations associated with this work would be designed to accommodate 170 work stations and would include all applicable support areas (washrooms, huddle rooms, meeting rooms, etc.) to accommodate those staff in accordance with the corporate real-estate workplace transformation playbook. The building expansion would be approximately 12,000 sq.ft. and would include the removal of the 3 existing trailers. Due to the age of the infrastructure of the existing building, as part of the renovations the existing building, upgrades to the windows and doors, heating and cooling systems, electrical distribution equipment and mechanical equipment will occur.

Business Need

For Project Level A or B

The Timmins Service Centre is currently operating at full capacity with over 100 employees. There is no available space to accommodate additional staff, and the facility lacks sufficient meeting rooms and hoteling stations for visitors. There is a growing need for additional personnel to support various departments, including Projects, Supply Chain, Programming, Finance, Engineering, NECC, and drafting. Without this project, we will need to either bring in additional trailers or relocate some groups to another facility in the Timmins area.

Preferred Alternative:	Proceed with project as outlined in this BCS	For Project Level A, B or C

Description of Preferred Alternative

Some alternatives have been reviewed at a high level to address this issue, inclusive but not limited to; relocation of staff to a different location, building a new building on property, and expansion to the existing facility. In order to ensure that the preferred alternative is a suitable direction for the project, a more detailed review of these and other available options / alternatives will be completed as part of this stage of the project and will be highlighted in the definition BCS. With this being said, a review of these high level alternatives appears to indicate that completing a building expansion to the existing facility and to renovate the existing facility would be the most suitable option to satisfy the business need. The building expansion would be approximately 12,000 sq.ft., would be designed to accommodate 170 work stations, would include all applicable support areas, and would include the removal of the 3 existing trailers. Due to the age of the infrastructure of the existing building, as part of the renovations the existing building, upgrades to the windows and doors, heating and cooling systems, electrical distribution equipment and mechanical equipment will occur.

Deliverables:

Previous Release: N/A

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Full Development BCS	Gate G1 Approval		2024-09-20
Office furniture supplier selected, and material ordered for interim solution.	Procurement Contracts Awarded/PO Issued		2024-10-11
Request for External Engineering Services and conduct Indigenous Services review.	Request for Proposals		2024-10-18
Scope of work document for Engineering / Architect Completed	Scope of Work Document Complete		2024-11-01
Interim furniture upgrades in existing office area.	Start of Installation		2024-11-04
PMP Completed	Project Management Plan		2024-12-13
External Engineer selected and PO issued.	Award Contracts / PO Issued		2024-12-20
Interim upgrades completed to a portion of the existing office area.	Finish of Installation		2025-01-30
Studies and Surveys complete	Engineering Studies Complete		2025-10-30
G2 - Full Definition BCS Approval	Gate G2 Approval		2025-11-28
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
	Labour Determination Completed		2026-02-06
Construction Tech Spec Complete	Technical Specifications Complete		2026-08-28
Construction SOW Complete	Scope of Work Document Complete		2026-08-28
Engineering Completed	Detailed Design Complete		2026-08-28
RFP for Construction Contractor	Request for Proposals		2026-10-02
Full Execution BCS	Gate G3 Approval		2027-03-12
PO Issued for Construction Contractor	Award Contracts / PO Issued		2027-04-09
Start of Installation/Contruction	Start of Installation		2027-06-01
Finish of Installation/Contruction	Finish of Installation		2028-12-01
REIS	Available for Service and/or Ready For Service Completed		2028-12-08
PCR	Project Close Out Completed		2029-06-29
PIR	Post Implementation Review		2029-11-23

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
This alternative is not suitable as the existing building is at / over capacity with anticipated additional staffing increase to approximately 170 people occurring in the future.		
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
This alternative is not suitable as the existing building is at / over capacity with anticipated additional staffing increase to approximately 170 people occurring in the future.		

Business Case Summary

Alternative 4:	**N/A**	For Project Level A, B
Alternatives will be presented at the Definition phase.		

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
N/A			

Additional Risk Analysis	For Project Level A or B
Risks will be presented at the Definition phase.	

Financial Evaluation				For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing	
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					
Analysis of financial evaluation will be presented at the Definition phase.					

Qualitative Factors	For Project Level A or B
Qualitative factors will be presented at the Definition phase.	

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	Yes		**PIR Completion Date**	2030-06-29
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87197 - TIMMINS BUILDING EXPANSION						FAC	17662 - CAPITAL - SERVICES BLDGS & FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		207	316						523	20
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		1,015	1,557						2,572	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Dylan Mcleod Project Leader PM Group 1	2024-09-10	Tom Gauthier Senior Manager Projects Project Management - Balance of Projects	2024-09-10

ONTARIO POWER GENERATION

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Business Case Summary

Project #	87217	**BCS Document Number**	P27-BCS-08707-1248628
Project Title	87217 - AGU DAM REHAB - HAYS LAKE MAIN DAM		
Facility	AGU - AGUASABON	**Investment Classification**	Sustaining
Project Level (Scalability)	C	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Planning Phase - (Full)	**Target Project Completion Date**	2029-Feb-14
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $792k, including [redacted] of contingency to begin development activities for the Aguasabon Generating Station (GS) Dam Rehabilitation for the Hayes Lake Main Dam.

This project release will involve the following planning activities:
- Refinement of Scope development;
- Detailed cost estimate;
- Project execution schedule; and,
- Development of execution BCS to implement project plan.

The total project cost is to be determined upon Gate 3 approval to proceed to the Execution Phase.

Investment Cash Flows

Project Number	87217 - AGU DAM REHAB - HAYS LAKE MAIN DAM					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	54	693	45					792
Total released to date	0	54	693	45					792
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	792.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Laura Hurley Asset Manager NWO Production Support	Laura Hurley	2023-08-14
I concur with the business decision as documented in this BCS.		
Finance Approval : John Sim Finance Controller	John Sim	2023-08-14

ONTARIO POWER GENERATION

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Brian Dietrich** **Director Asset & Project Mgmt**	Brian Dietrich	2023-08-14

EXECUTIVE SUMMARY – Project Overview

There have been several recent assessments on the condition of Hayes Lake Dam including; a Plant Condition Assessment (PCA) in 2020, Dam Safety General Inspection (DSGI) in 2020, and a Detailed Inspection and Condition Assessment of Hays Lake Dam provided by an external consultant in 2022.

In 2020, a Plant Condition Assessment (see report P27-REP-01557-0001) was completed where the condition of Hays Lake Dam examined. At the time of inspection several handrail anchorages were found to be loose and the face/surface of the deck exhibited localized concrete deterioration. As such, the recommendations at that time were to conduct concrete deck repairs and handrail repairs at the left and right gravity section in combination with overall dam deck and handrail repairs within 7-10 years.

The latest DSGI recommended that concrete repairs are required in the next couple of years as the concrete condition was significantly worse than the previous year. Resultantly, it was recommended to conduct a more detailed assessment including underwater inspection using divers, inspection of other areas of the dam with the help of rope access crews, and concrete core sampling to determine the scope of required remedial works.

In 2022, OPG contracted an external consultant to perform a detailed inspection and condition assessment of Hayes Lake Dam (see report P27-REP-26100-0997904). The condition of the Hays Lake Dam was found to vary from unacceptable to good across the various structures. Most of the bulkhead sections were in fair to good condition, with some poor areas mostly due to active leakage through the dam concrete body. The sluiceway condition varied from unacceptable to fair, likely caused by alkali-aggregate reaction (AAR) concrete expansion within the main dam body pushing into the end sluiceway piers. For a more detailed description of deficiencies found please see the above report.

The Gate Strategy for this project is G1 to G3 as no long lead delivery material has been identified at this time.

Preferred Alternative:	Rehabilitation of Concrete and Handrail Integrity	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is the rehabilitation of concrete including the integrity of handrail anchors. This project will reduce the risk of the Hayes Lake Dam failing and the threat to the safety and reliability of hydro operations in the area. In addition, this project will strengthen the existing dam, extend its life and minimize the likelihood of the dam needing to be fully replaced.

RGPM's 2023 Business Plan identified the safety of our people and the reliability of our facilities as priorities for 2023 and beyond. Addressing these concerns directly aligns with RG?operating priorities and generates?an opportunity to create a safer work environment, enhance public safety, and maximize long term cost savings.

The negative aspect of this project is the cost associated with the concrete rehabilitation.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR1	Gate G1 Approval		2023-06-21
SOW	Scope of Work Document Complete		2025-06-18
TES	Technical Specifications Complete		2026-08-19
LDC	Labour Determination Completed		2026-10-21

Business Case Summary

Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
GR3	Gate G3 Approval		2027-01-20
EPC	Award Contracts / PO Issued		2027-03-17
SOI	Start of Installation		2027-05-19
AFS	Available for Service and/or Ready For Service Completed		2028-09-20
PCO	Project Close Out Completed		2029-02-14

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Project Management	Scope increase due to discovery work during execution.	Accept	Medium

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	No		**PIR Completion Date**	2029-02-14
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87217 - AGU DAM REHAB - HAYS LAKE MAIN DAM						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2023	2024	2025	2026	2027	2028	Future	Total	%
0 - Cost Management										0
1 - Project Management		15	8	17					40	5
2 - Inspection										0
3 - Engineering		[redacted]								
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		54	693	45					792	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	4.00	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jason Bailey Program Coordinator / Advisor Programming	2023-07-24	Brian Mason Senior Manager Projects Northwest Project Managem	2023-07-14

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Business Case Summary

Project #	87329	**BCS Document Number**	81167-BCS-87300-0001
Project Title	87329 - DYMOND MACHINE SHOP EXPANSION		
Facility	DYM - DYMOND	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17662 - CAPITAL - SERVICES BLDGS & FACILITIES
Release: Gate and Project Phase	G1 - Planning Phase - b (Superseding)	**Target Project Completion Date**	2028-Jun-09
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a Gate 1 superseding release of $1,417K, including [redacted] of contingency. This will bring the total released-to-date to $1,976K.

The estimated total project cost range is to be determined in the Gate 2 package prior to the Definition Phase approval.

This release is to complete the remaining Planning/Development phase activities, including preliminary design of the lathe and boring mill equipment, additional engineering studies & environmental compliance approval (ECA) work, and the completion of the technical specifications for the design-build request for proposals (RFP).

Investment Cash Flows

Project Number	87329 - DYMOND MACHINE SHOP EXPANSION	**FAC**	17662 - CAPITAL - SERVICES BLDGS & FACILITIES

$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	377	182							559
Currently Requested	0	1,417							1,417
Total released to date	377	1,599							1,976
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	1,976.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Brad Bacvar Director Asset & Project Mgmt Production Support Manager	Brad Bacvar	2025-04-15
I concur with the business decision as documented in this BCS.		
Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	2025-04-15
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : **OAR Element : 1.1** **Jamey Deforge** **Director Plant Operations**	Jamey Deforge	2025-04-17

EXECUTIVE SUMMARY – Project Overview

Ontario Power Generation (OPG) is undertaking the Dymond Machine Shop Expansion project to add capacity to meet the demand increase created by the 20-year Renewable Generation (RG) unit overhaul/refurbishment program.

The Dymond Machine Shop is located in Temiskaming Shores, Ontario. This OPG owned machine shop provides machining and welding/fabrication services for all of RG. The largest portion of their work is refurbishment and fabrication of turbine and generator parts for the overhaul of hydro units across the province. Currently, the existing large, 1992 Broadbent lathe, used extensively for unit overhauls/refurbishments can no longer meet required machining tolerances having reached end-of-life, and the existing boring mill is not large enough to accommodate the headcovers or bottom rings from larger vertical units in the province. This project is expected to prepare the Dymond Machine Shop for the OPG 20-year unit overhaul/refurbishment program, by adding a new larger and more advanced boring mill that will allow it to machine larger headcovers and bottom/curb rings, and replacing the end-of-life lathe with a new 3 bed way CNC (computer numerical control) lathe used to machine most wicket gates and turbine/generator shafts.

The preferred alternative for the Dymond Machine Shop Expansion project is to design, construct, and commission a new shop expansion to house the new machines. This will entail the construction of a new 1,846 square meter (19,870 square feet) shop building with a 60-tonne overhead crane, a new 272 square meter (2,927 square feet) utility/office building, and the relocation and segregation of the welding/fabrication shop section to create the required laydown space, and to protect machine centers from contaminants. The new shop expansion is expected to be in service by Q4 2027.

The original Gate 1 release has achieved the following deliverables: contracting the owner's engineer, 100% conceptual design and report, technical specifications and competitive bid process for the selection of the new lathe and boring mill. This requested Gate 1 superseding release will fund the remaining Planning/Development phase activities, including the preliminary design of the lathe and boring mill equipment, additional engineering studies & environmental compliance approval (ECA) work, and the development and release of the technical specifications to Design-Build vendors.

Business Need

For Project Level A or B

With OPG's hydroelectric overhaul/refurbishment program underway, RG machining demands will increase by 50% over the next 20 years. To align with this business strategy, the Northeast Operations group (NEO) is looking to expand the Dymond Machine Shop and double the capacity of the machines most used for unit overhauls/refurbishments.

The existing 1992 Broadbent lathe can no longer meet required machining tolerances having reached end-of-life and must be replaced. A replacement CNC lathe will double the throughput for this machine mainly used for wicket gates and turbine/generator shafts. The existing boring mill is not large enough to accommodate the headcovers or bottom rings from larger vertical units in the province. Adding a new larger boring mill would allow the shop to take all these components from across RG and machine them internally providing OPG with better cost control, schedule flexibility, quality assurance, and protection from increasingly volatile and aggressive market pricing for external machining services. To do so an expansion of the shop is required to provide additional space for the equipment and to create the necessary laydown space.

Unit overhauls/refurbishments currently planned to be completed by the Dymond Machine Shop following the expansion project include:
- Abitibi Canyon GS Units 1, 3, 4, and 5
- Manitou Falls GS Unit 2
- Alexander GS Unit 3
- Chenaux GS Unit 2
- Otto Holden GS Unit 4
- And others

Preferred Alternative:	New Large Mill, New Lathe in a Shop Expansion	For Project Level A, B or C

Description of Preferred Alternative

ONTARIO POWER GENERATION

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Business Case Summary

The preferred alternative involves preparing OPG's Dymond Machine Shop for the 20+ year unit overhaul/refurbishment program by making it capable of machining all major components of a unit overhaul and removing reliance on original equipment manufacturers (OEMs). This will be accomplished by installing a new large boring mill and replacing the existing lathe with a new 3 bed way lathe. Both pieces of equipment will need pile foundations and for that reason will be located in a shop expansion as this is not possible inside the existing shop. This alternative will add a 232ft long by 80ft wide (width of existing shop) addition to house the new mill and lathe and build a segregated fabrication and welding shop, making the existing fabrication and welding shop the new laydown area. This option also includes a 60-tonne crane in the expansion building to handle larger parts accepted by the new boring mill. Adding a large boring mill will allow OPG to machine all headcovers and bottom/curb rings in RG except for RH Saunders G.S.

It's expected that improvements in CNC lathe and boring mill technology and automation would improve efficiencies by a factor of 4x when compared to the manual machines that OPG currently operates. Additional benefits in terms of safety and reliability are also anticipated.

Advantages:
• Minimal construction impact to the existing Dymond Machine Shop operations
• Capacity is increased for the boring mill
• Throughput is increased for the CNC boring mill & lathe
• Provides additional laydown areas addressing health and safety concern with congestion
• Segregates the fabrication and welding shop area from the machining equipment, protecting our assets and improving safety
• Supports the RG unit overhaul/refurbishment program

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Complete RFP for Owner's Engineer	Request for Proposals	Complete bidding and selection of Owner's Engineer	2024-01-19
Technical Specifications Completed for Lathe and Boring Mill	LLM_Technical Specifications Completed	Complete bidding and selection for Lathe and Boring Mill	2024-01-30
Issue PO for Owner's Engineer	Award Contracts / PO Issued	Complete 100% conceptual design	2024-04-05

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate G1B Approval	Gate G1 Approval		2025-04-25
Technical Specifications Complete for D-B Contractor	Technical Specifications Completed for EPC or Non LLM Contracts	Complete bidding and selection for D-B Contractor	2025-07-25
Preparation of Gate 2 documents, cost estimates, risk register, and updated project schedule	Gate G2 Approval	Complete detailed engineering	2025-10-31

Future Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Issue PO to DB Contractor for Design	Design Contract Awarded/PO Issued		2025-11-28
Issue PO for Long Lead Equipment	LLM_Contract Awarded PO Issued		2025-12-12
Full Execution BSC Approval	Gate G3 Approval		2026-09-18
Issue PO to DB Contractor for Procurement & Construction	Award Contracts / PO Issued for EPC or Non LLM Contracts		2026-10-16
Start of Construction	Start of Construction		2026-11-02
Finish of Installation	Finish of Installation		2027-11-19
Available for Service	Available for Service and/or Ready For Service Completed		2027-12-10

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

The base case involves the status quo. Continue to use the same lathe.

Advantages:
• No capital cost incurred
• No outage time required

Disadvantages:
• Does not meet the requirements of the Purchased Services Agreement (PSA) with the Power Workers Union (PWU)
• Does not address worn-out lathe and accuracy issues
• Will no longer be able to machine wicket gates and shafts in the near future
• Does not address the health and safety concerns of congestion in the shop
• Does not address the need to segregate the machine shop from the fabrication/welding shop

This base case alternative has no project/execution cost or schedule implications. It carries an unacceptable level of risk as it does not address the poor asset condition. Failure to address the asset condition will result in inaccurate machining with difficulty meeting customer's required tolerances and inability to properly machine wicket gates and turbine/generator shafts. This option does not address the lack of a laydown area in the shop for parts that come in for overhauls from across the province, nor does it address debris, particulate, and dust from the fabrication/weld shop contaminating the electronics of the newer CNC machining equipment.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 involves removing the lathe from the shop and sending it out for refurbishment then re-installing it.
The cost of this option is about 50% of the cost of a new lathe and it will result in 10-16 months downtime for the lathe while it is out for refurbishment.

Advantages:
• Lower cost
• Keep the same foundation
• Maintains existing capacity

Disadvantages:
• Risk of cost and schedule overrun as scope is not 100% defined until the lathe is offsite and disassembled
• Long lathe downtime with unit overhauls/refurbishments scheduled for RH Saunders and Otto Holden in the near future
• Still an old lathe that is not computer controlled with soft slideways
• No increase in productivity
• Does not address the health and safety concerns of congestion in the shop
• Does not segregate the machine shop from the weld shop

This option has an in-direct cost that other options do not have. In the 10-16 months the lathe would be out of service, the shop would typically refurbish 3 units so this would be 3 sets of wicket gates, 3 turbine shafts, and 3 generator shafts on the lathe. When these items are sent out for refurbishment to an external shop, one set of refurbished wicket gates costs OPG approximately $300k, one refurbished turbine shaft is approximately $350k, and one refurbished generator shaft is approximately $150k. The total cost for the duration of the lathe outage would be approximately $2,400k.

This alternative meets the short-term business needs by extending the life expectancy of the lathe but it has the following drawbacks: i) does not modernize the lathe, ii) does not address the wear issues with the non-hardened bed slideways, iii) has a high risk of scope creep since the details of the refurbishment can't be defined until the lathe is disassembled, iv) does not address the lack of laydown area, v) does not segregate the machining shop from the fabrication/weld shop, and vi) will cost OPG roughly $2,400K in external machining while the lathe is out of service.

Alternative 4:	**Expansion and Lathe Only**	For Project Level A, B

Alternative 4 involves replacing the existing lathe with a new 3 bed way lathe and a new foundation that will be in a shop expansion. Piles would likely have to be driven at the location of the new foundation as was the case for the existing foundation. The existing lathe would be left as is for a back-up lathe. Add a 100ft long by 80ft wide (width of existing shop) addition to house the new lathe and build a segregated fabrication and welding shop, making the existing fabrication/weld shop the new laydown area.

The 3 bed way lathe is beneficial because the carriage can travel past the steady rest and tailstock, avoiding removal and second set-up associated with a 2 bed way lathe that adds days to the process. This will cut the shop's refurbishment costs on turbine shafts, generator shafts, actuator shafts, and wicket gates. It will also minimize the hazards associated with hoisting large pieces and employees having to dismantle these heavy parts on the machine in awkward places.

Advantages:
• No downtime
• Minimal construction impact to the existing Dymond Machine Shop operations
• Existing capacity is maintained
• Update to CNC lathe that will increase throughput
• 3 bed way lathe – double the productivity of the existing lathe
• Provides additional laydown areas addressing health and safety concern with congestion
• Segregates the fabrication and welding shop area from the machining equipment, protecting our assets and improving safety
• Supports the RG unit overhaul/refurbishment program

Disadvantages:
• High Capital cost

This alternative meets all business needs by replacing the worn asset with a modern more efficient machine that will increase throughput. It also improves the shop workflow by adding a laydown area and separating the machining shop from the fabrication/weld shop and protecting the sensitive electronics of the new CNC machining equipment. The alternative does so by adding an extension to the building. It also supports the 20-year unit overhaul/refurbishment program and RG machining demands that will increase by 50%.

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Licensing & Regulatory	Environmental Compliance Approval (ECA) Required to Begin Construction may be delayed	Mitigate 72122 - Early fieldwork and engagement with ministries 72123 - EA provider [redacted] to prepare and submit ECA submission for approval 10/31/2025	Low
Technical	Potential Insufficient Interior Building Space or Height for New Machining Equipment	Mitigate 72164 - Complete Preliminary Design for The Vertical Boring Mill and Lathe LLE 10/31/2025	Low

Additional Risk Analysis	For Project Level A or B
N/A for gate 1 will be provided for gate 2	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					

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Business Case Summary

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)				
Is PIR Required?	Yes		**PIR Completion Date**	2029-06-09
PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate										
Project Number	87329 - DYMOND MACHINE SHOP EXPANSION						**FAC**	17662 - CAPITAL - SERVICES BLDGS & FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**	**%**
0 - Cost Management										0
1 - Project Management	315	182							497	25
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	377	1,599							1,976	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes			
Escalation Rate	**2.50**	**Interest Rate (going-forward)**	**3.95**

Appendix A3: Summary of Estimate - In-Service Estimates				
$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Jean-Francois Blain Project Leader PM Group 1	2025-04-09	Tom Gauthier Senior Manager Projects Project Management - Balance of Projects	2025-03-24

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Business Case Summary

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Business Case Summary

Project #	87356	**BCS Document Number**	NF28-BCS-08707.021-0086
Project Title	87356 - BK2 G17 G18 REFURBISHMENT		
Facility	BK2 - SIR ADAM BECK 2	**Investment Classification**	Sustaining
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2029-Dec-08
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend the release of $38,306K including [redacted] of contingency for the Gate 1 Development Phase of this project.

The estimated total project cost range will be determined upon Gate 2 approval to proceed to Definition Phase in Q4 of 2025.

This project will refurbish the SAB2 G17 and G18 units to ensure their reliable operation for the next 25-30 years. The Development phase (Gate 1) release will fund the requirement gathering and scope definition, finalizing OPG engineering specifications, initiating the engineering phase for Protection and Control (P&C), issuing PO for the 3 Main Output Transformers (MOT), issuing worksheet to the OEM for long lead procurement and planning/estimation for the Gate 2 Definition phase.

Investment Cash Flows

Project Number	87356 - BK2 G17 G18 REFURBISHMENT	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	5,755	13,943	15,829	2,779				38,306
Total released to date	0	5,755	13,943	15,829	2,779				38,306
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	38,306.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicole Fabbro VP Regional Operations VP Niagara Operations	Nicole Fabbro	2025-05-21
I concur with the business decision as documented in this BCS.		
Finance Approval : Maha Tam VP Ops & Projects Controllership	Maha Tam	2025-05-22
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		

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Business Case Summary

Line Approval per OAR : OAR Element : 1.2 Nicholas Pender SVP Renewable Generation& Energy Markets	Nicholas Pender	2025-05-22

EXECUTIVE SUMMARY – Project Overview

The Sir Adam Beck 2 (SAB2) hydroelectric power station, consisting of 16 units, has been operational since the 1950s. As a "flagship" asset in OPG's fleet, it has the capacity to provide Ontario with a maximum continuous rating of 1,499 MW of emissions-free energy. The objective of this G17 G18 Refurbishment project (87356), which consolidates three previous capital projects (BK2 G17 Overhaul Cap, BK2 G18 Overhaul Cap and BK Transformer T17), is to restore integrity, ensure long-term reliability, and maintain the continued availability of the second pair of units, G17 and G18, and its associated MOT T17 as part of the SAB2 Refurbishment Program. Given the complexity of the refurbishment and the fact that SAB2 is a high-capacity factor station with several shared systems, joint unit outages must be scheduled concurrently to optimize the execution timelines.

The G17 and G18 turbines and generators were last refurbished in 1996. G17 is scheduled to be the first unit to be refurbished in Q2 of 2028, followed by G18 in Q3 of 2028, creating a gap of 32 years between refurbishments. Major hydroelectric unit refurbishments are typically required every 25 to 30 years to maintain reliability. Recent condition assessments have confirmed that unit reliability is decreasing due to normal wear and aging and there is a lack of available spare parts as the OEM no longer makes or supports the existing parts; this has led to prolonged outages required for repairs. The sequence of refurbishments for the SAB2 units is based on a Decision Analysis (DA) with input from Production, Engineering, Operations, and Project Representatives; this order may be adjusted as required based on the condition of each unit and any forced outages.

This project aligns with the Energy Ministry announcement on April 15, 2024, supporting OPG's refurbishment of Niagara Hydro Stations in collaboration with GE Vernova, stating that the "program would secure up to 1,700 megawatts (MW) of clean electricity, equivalent to powering 1.7 million homes, helping to meet increasing demand from electrification and fueling the province's growth." It also supports the Provincial Government's "Powering Ontario's Growth Plan", released on July 10, 2024, in response to public consultation on the Independent Electricity System Operator's Pathway to Decarbonization, which aims to achieve a net-zero economy by 2050. It also supports OPG's Climate Change Plan, which commits to refurbishing hydroelectric units across the fleet.

OPG plans to work with a selected OEM through the RG Programmatic Collaborative Agreement, employing a Design Build Contracting Strategy and a Target Price structure to provide engineering, procurement, and construction services for the project.

This Development Phase (Gate 1) release will be used to define the project scope, determine cost for the Definition Phase (Gate 2), issue PO for the MOTs, begin engineering for the P&C scope, finalize the OPG engineering specifications and issue PO for the OEM's long lead equipment.

The Definition Phase (Gate 2) is scheduled to begin in Q4 of 2025, which will include detailed engineering, procurement and any site inspections. This phase will also be used to plan and estimate for the Execution Phase (Gate 3) and Closeout Phase (Gate 4). The Execution Phase (Gate 3) is scheduled to begin in Q2 of 2027 and will include procurement, construction, commissioning and closeout.

The key risks identified during the Development Phase of this project include:
- Limitation of manufacturing capacity in the energy industry. The growing demand for electricity generation equipment is limiting manufacturing availability with OEMs and subcontractors. Delayed procurement can potentially lead to longer lead times, higher costs, and project delays. This risk is being avoided by pulling long item procurement earlier than originally planned.
- OEM Capacity and Capability Issues. This risk will be mitigated by supporting the OEM with OPG experienced vendors and contractors, to address project complexity and any other issues.
- Internal resource constraint. There may be a resource constraint due to simultaneous refurbishment projects at SAB2. This risk will be monitored closely and mitigated by hiring additional external staff if internal resources are not available.

Business Need

For Project Level A or B

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Business Case Summary

The business objective is to ensure the reliable and safe operation of the SAB2 hydroelectric generation of G17 and G18 units for the next 25-30 years. These units were last refurbished in 1996. Engineering assessments have indicated a decline in unit reliability due to normal wear and aging equipment. Currently these units are facing reliability issues due to on-going challenges and the availability of obsolete spare parts. This has resulted in extended unit outages for repairs. Therefore, adhering to the scheduled refurbishment is crucial to achieving the project's objectives.

This project will achieve business needs in the following ways:

1) Minimize the risk of forced outages due to unexpected equipment failure and replacement of obsolete parts.
2) Eliminate known safety hazards identified by plant staff.
3) Ensure reliable and safe operation for the next 25-30 years.
4) Increase the capacity and improve runner efficiency, with an approximate gain of 1.5 MW per unit.
5) Upgraded equipment will meet current regulatory requirements.

Given that it has already been 29 years since the last refurbishment, if the current situation persists, unit reliability is expected to decline because maintenance will be reactive, rather than proactive. This will likely lead to longer outages and a reduction in the amount of electricity capable of being generated for the grid.

Preferred Alternative:	Refurbishment and upgrade to a higher capacity	For Project Level A, B or C

Description of Preferred Alternative

In January 2024, OPG executed a strategic 15-year Programmatic Collaboration Agreement with the OEM to provide engineering, procurement, and construction (EPC) services utilizing the Target Pricing contract for the SAB Refurbishment Program. Under this agreement, G17 and G18 will be the second pair of units to be refurbished for SAB2.

The preferred alternative consists of refurbishing units and replacing the components where economical or required by the IESO regulation. Implementation of this alternative would involve the following scope:

1) Refurbish and replace turbine and auxiliaries.
2) Refurbish and replace generator and auxiliaries.
3) Replace governor system.
4) Refurbish and replace electrical common balance of plant.
5) Refurbish and replace the mechanical balance of plant.
6) Replace P&C.
7) Refurbish civil works.
8) Refurbish hydro mechanical headworks and headgate intake.
9) Replace Main Output Transformers

The preferred alternative will provide the following benefits:

1) Minimize the risk of forced outages due to unexpected equipment failure.
2) Reduce the frequency and intensity of maintenance caused by vibrations in the core.
3) Eliminate known safety hazards identified by plant staff.
4) Ensure reliable and safe operation for an estimated 25-30 years.
5) Increase capacity and runner efficiency.
6) Upgrade equipment to meet current regulatory requirements.

The disadvantages of this method are:

1) Warranty by OEM provided on replaced components only.
2) Reliability of G17 and G18 units is uncertain until the next scheduled outage starting April 2028 and July 2028, respectively.

Deliverables:

Previous Release: N/A

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
BCS for Gate 1 Approved	Gate G1 Approval		2025-05-12
PO Issued for 3 MOTs	Award Contracts / PO Issued		2025-06-12
Worksheet Issued to OEM for Gate 1	Award Contracts / PO Issued		2025-06-12
PO Issued for P&C Engineering	Award Contracts / PO Issued		2025-08-29
Gate 2 BCS Approval	Gate G2 Approval		2025-12-18
Gate 3 BCS Approval	Gate G3 Approval		2027-03-15
G17 - Start of Outage	Start of Outage		2028-04-08
G18 - Start of Outage	Start of Outage		2028-07-09
G17 - Finish of Outage	End of Outage		2029-09-08
G17 In Service	Available for Service and/or Ready For Service Completed		2029-09-08
G18 - Finish of Outage	End of Outage		2029-12-08
G18 In Service	Available for Service and/or Ready For Service Completed		2030-01-31
Project Closeout	Project Close Out Completed		2030-12-09
Post Implementation Review	Post Implementation Review		2030-12-09
Future Release: N/A			

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2 is not a valid option since the G20 G19 refurbishment project has already begun, and the G17 and G18 units are the next pair scheduled for the 15-year SAB2 refurbishment program. The decision analysis (DA) conducted in 2020 by OPG recommended the G17 and G18 units to be the second pair to be refurbished in SAB2. This alternative is not recommended since it does not address the business need for reliable operation of each unit for the next 25-30 years. This approach does not include major proactive maintenance, such as refurbishments or upgrades. Instead, any repairs would be performed reactively, which could lead to a further decline in unit reliability. Consequently, the reactive maintenance costs would increase resulting in revenue losses due to unplanned outages.

Advantages:

1) No up-front project costs.

Disadvantages:

1) Maintenance costs would increase each year as the unit condition continues to degrade.
2) Reduced probability of reliable operation of these units for the next 25-30 years. The forced outages are expected to increase.
3) The availability of existing spare parts is expected to decrease over time due to obsolescence.
4) The G20 and G19 units will have different components compared to all other SAB2 units.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 is not recommended since G17 is already experiencing repetitive failures and is due for a major overhaul. The last time G17 and G18 were overhauled was 29 years ago. By the time of the planned outage of G17 in April 2028, more time would have passed than the industry standard of refurbishing units every 25 to 30 years to maintain reliability. Delaying this project any further can lead to more forced unit outages, compromising reliability and potentially causing significant asset damage in the long term. In addition, there are other existing MOTs at SAB2 that now have an increased probability of failure in the coming years. Choosing this alternative may delay the scheduled refurbishment of these other units, further increasing the probability of forced outages.

Alternative 4:	**Full Unit Replacement**	For Project Level A, B

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Business Case Summary

This alternative involves the complete replacement of G17 and G18 units. Alternative 4 is not recommended due to its significantly higher costs compared to the preferred alternative. In addition, this option would require the entire SAB2 refurbishment program to be delayed by at least 1 year which increases the risk of reduced reliability due to extended operation of existing units.

Advantages:
1) Meets the business needs of reliable unit operation for 25-30 years.
2) Forced outages of the units will be reduced.
3) Lower production loss due to a shorter outage window.

Disadvantages:
1) Significantly higher project costs with no existing data to support added benefits over the preferred alternative.
2) A longer period would be required for design, manufacturing, model testing, and installation.
3) Previous experience has shown that new components don't necessarily last as long as existing components

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Technical	OEM Capacity and Capability Issues	Mitigate 71802 - OEM to provide a resource loaded CPM schedule to determine the required resources based on estimated man hours. 10/31/2025	Medium
Resources	Internal resource constraint	Mitigate 71803 - Project Leader to provide accurate resource plans, identify any forecasted gaps and communicate with relevant stakeholders before each gate/phase of the project. 3/31/2027	Medium
Integration	Integration of other pre-overhaul supporting projects	Mitigate 71807 - Coordinate and collaborate with the maintenance team to avoid unnecessary conflicts, interference, unavailability of space and resource constraints. 4/7/2028	Medium
Commercial (Contract/Legal)	One OEM for all 16 units (Program Risk)	Mitigate 71809 - Closely monitor and collaborate with the selected OEM to mitigate any potential risks. The OPG and OEM team are to work as "One Team", working in the same office space allowing open, frequent and transparent communication. 10/10/2025	Medium
Procurement - Materials	Supply chain and manufacturing capacity.	Avoid 72087 - Start procurement process of long lead equipment earlier than originally planned. 10/31/2025	Low
Procurement - Materials	Material Quality Risk	Mitigate 72582 - Work with the OEM to review and closely monitor their QA/QC process. Owner's engineering QA/QC representative to perform regular inspections at manufacturing facility 10/14/2026	Medium

Additional Risk Analysis — For Project Level A or B

Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards. Execution Phase risks will be identified in the risk assessment workshops during the Definition Phase.

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Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial analysis is not required for Sustaining Projects.

Qualitative Factors — For Project Level A or B

Qualitative factors provided by the Preferred Alternative are listed below:

1) Ensure OPG continues to provide a reliable renewable source of energy while reducing the environmental impact of meeting Ontario's electricity demand.
2) Provide unrestricted operation such as removing limitations on Automatic Generation Control.
3) Address identified safety hazards by implementing enhancements like ergonomic improvements to generator excitation and enhanced grounding.
4) Decrease the frequency and intensity of maintenance requirements.
5) Drive project excellence by leveraging the insights gained from the refurbishment of the G20 and G19 units to enhance the performance of the remaining SAB2 unit refurbishment projects.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2030-12-09

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

Definitions and Acronyms	
P&C	Protection and Control
SAB	Sir Adam Beck
DA	Decision Analysis
OEM	Original Equipment Manufacturers
PWU	Power Workers' Union
MV	Medium Voltage
QA	Quality Assurance
QC	Quality Control
RM	Revenue Metering
RFP	Request for Proposal

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87356 - BK2 G17 G18 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management										0
1 - Project Management		1,075	149						1,224	3
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		5,755	13,943	15,829	2,779				38,306	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.80	Interest Rate (going-forward)	4.70

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Syed Salman Ali Burney Project Leader SAB2 Refurbishment Program	2025-05-13	Kevin Kaczmarczyk Project Director Refurbishment Programs	2025-05-14

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Business Case Summary

Project #	87357	**BCS Document Number**	NF28-BCS-08707.021-0088
Project Title	87357 - BK2 G14 G13 REFURBISHMENT		
Facility	BK2 - SIR ADAM BECK 2	**Investment Classification**	Sustaining
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2031-May-08
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $39,143K including [redacted] of contingency for the Gate 1 Development Phase of this project.

The estimated total project cost range will be determined upon Gate 2 approval to proceed to Definition Phase in Q3 of 2027.

This project will refurbish the SAB2 G14 and G13 units to ensure their reliable operation for an estimated 25-30 years. The Development phase (Gate 1) release will fund the requirement gathering and scope definition, finalizing OPG engineering specifications, initiating the engineering phase for Protection and Control (P&C), issuing PO for the 3 Main Output Transformers (MOT), issuing worksheet to the OEM for long lead procurement and planning/estimation for the Gate 2 Definition phase.

Investment Cash Flows

Project Number	87357 - BK2 G14 G13 REFURBISHMENT	**FAC**	17553 - CAPITAL - GENERATING FACILITIES

$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	4,057	14,180	17,322	3,584				39,143
Total released to date	0	4,057	14,180	17,322	3,584				39,143
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	39,143.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicholas Pender SVP Renewable Generation& Energy Markets SVP RG & PM	Nicholas Pender	2025-05-22
I concur with the business decision as documented in this BCS.		
Finance Approval : Alec Cheng SVP Chief Controller & Acctng Offcr	Alec Cheng	2025-05-23

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.2** **Shelley Babin** **Chief Operations Officer**	Shelley Babin	2025-05-26

EXECUTIVE SUMMARY – Project Overview

The Sir Adam Beck 2 (SAB2) hydroelectric power station, consisting of 16 units, has been operational since the 1950s. As a "flagship" asset in OPG's fleet, it has the capacity to provide Ontario with a maximum continuous rating of 1,499 MW of emissions-free energy. The objective of this G14 G13 Refurbishment project (87357), is to restore integrity, ensure long-term reliability, and maintain the continued availability of the third pair of units, G14 and G13, and its associated MOT T13 as part of the SAB2 Refurbishment Program. Given the complexity of the refurbishment and the fact that SAB2 is a high-capacity factor station with several shared systems, joint unit outages must be scheduled concurrently to optimize the execution timelines.

The G14 and G13 turbines and generators were last refurbished in 2004. G14 is scheduled to be the first unit to be refurbished in Q3 of 2029, followed by G13 in Q4 of 2029, creating a gap of 25 years between refurbishments. Major hydroelectric unit refurbishments are typically required every 25 to 30 years to maintain reliability. Recent condition assessments have confirmed that unit reliability is decreasing due to normal wear and aging and there is a lack of available spare parts as the OEM no longer makes or supports the existing parts; this has led to prolonged outages required for repairs. The sequence of refurbishments for the SAB2 units is based on a Decision Analysis (DA) with input from Production, Engineering, Operations, and Project Representatives; this order may be adjusted as required based on the condition of each unit and any forced outages.

This project aligns with the Energy Ministry announcement on April 15, 2024, supporting OPG's refurbishment of Niagara Hydro Stations in collaboration with GE Vernova, stating that the "program would secure up to 1,700 megawatts (MW) of clean electricity, equivalent to powering 1.7 million homes, helping to meet increasing demand from electrification and fueling the province's growth." It also supports the Provincial Government's "Powering Ontario's Growth Plan", released on July 10, 2024, in response to public consultation on the Independent Electricity System Operator's Pathway to Decarbonization, which aims to achieve a net-zero economy by 2050. It also supports OPG's Climate Change Plan, which commits to refurbishing hydroelectric units across the fleet.

OPG plans to work with a selected OEM through the RG Programmatic Collaborative Agreement, employing a Design Build Contracting Strategy and Target Pricing structure to provide engineering, procurement, and construction services for the project.

This Development Phase (Gate 1) release will be used to define the project scope, determine cost for the Definition Phase (Gate 2), issue PO for the MOTs, begin engineering for the P&C scope, finalize the OPG engineering specifications and issue PO for the OEM's long lead equipment.

The Definition Phase (Gate 2) is scheduled to begin in Q2 of 2027, which will include detailed engineering, procurement and any site inspections. This phase will also be used to plan and estimate for the Execution Phase (Gate 3) and Closeout Phase (Gate 4). The Execution Phase (Gate 3) is scheduled to begin in Q1 of 2029 and will include procurement, construction, commissioning and close out.

The key risks during the Development Phase of this project include:
- Limitation of manufacturing capacity in the energy industry. The growing demand for electricity generation equipment is limiting manufacturing availability with OEMs and subcontractors. Delayed procurement can potentially lead to longer lead times, higher costs, and project delays. This risk is being avoided by pulling long item procurement earlier than originally planned.
- OEM Capacity and Capability Issues. This risk will be mitigated by supporting the OEM with OPG experienced vendors and contractors, to address project complexity and any other issues.
- Internal resource constraint. There may be a resource constraint due to simultaneous refurbishment projects at SAB2. This risk will be monitored closely and mitigated by hiring additional external staff if internal resources are not available

Business Need

For Project Level A or B

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Business Case Summary

The business objective is to ensure the reliable and safe operation of the SAB2 hydroelectric generation of G14 and G13 units for the next 25-30 years. These units were last refurbished in 2004. Currently, the units are facing reliability issues, for example, stator core winding and pilot excitor issues have been identified in G14. In addition, there is also a lack of readily available spare parts due to OEM no longer manufacturing or supporting the existing parts. Therefore, adhering to the scheduled refurbishment is crucial to achieving the project's objectives.

This project will achieve business needs in the following ways:

1) Minimize the risk of forced outages due to unexpected equipment failure and replacement of obsolete parts.
2) Eliminate known safety hazards identified by plant staff.
3) Ensure reliable and safe operation for the next 25-30 years.
4) Increase the capacity and improve runner efficiency, with an approximate gain of 1.5 MW per unit.
5) Upgraded equipment will meet current regulatory requirements.

Given that it has already been 21 years since the last refurbishment, if the current situation persists, unit reliability is expected to decline because maintenance will be reactive, rather than proactive. This will likely lead to longer outages and a reduction in the amount of electricity capable of being generated for the grid.

Preferred Alternative:	Refurbishment and upgrade to a higher capacity	For Project Level A, B or C

Description of Preferred Alternative

In January 2024, OPG executed a strategic 15-year Programmatic Collaboration Agreement with the OEM to provide engineering, procurement, and construction (EPC) services utilizing the Target Pricing contract for the SAB Refurbishment Program. Under this agreement, G14 and G13 will be the third pair of units to be refurbished for SAB2.

The preferred alternative consists of refurbishing units and replacing components where economical or required by regulation. Implementation of this alternative would involve the following scope:

1) Refurbish and replace turbine and auxiliaries.
2) Refurbish and replace generator and auxiliaries.
3) Replace governor system.
4) Refurbish and replace electrical common balance of plant.
5) Refurbish and replace the mechanical balance of plant.
6) Replace P&C.
7) Refurbish civil works.
8) Refurbish hydro mechanical headworks and headgate intake.
9) Replace Main Output Transformer

The preferred alternative will provide the following benefits:

1) Minimize the risk of forced outages due to unexpected equipment failure.
2) Reduce the frequency and intensity of maintenance caused by vibrations in the core.
3) Eliminate known safety hazards identified by plant staff.
4) Ensure reliable and safe operation for an estimated 25-30 years.
5) Increase capacity and runner efficiency.
6) Upgrade equipment to meet current regulatory requirements.

The disadvantages of this method are:
1) Warranty by OEM provided on replaced components only.
2) Reliability of G14 and G13 units is uncertain until the next scheduled outage starting September 2029 and December 2029, respectively.

Deliverables:

Previous Release: N/A

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
BCS for Gate 01 Approved	Gate G1 Approval		2025-05-12
PO Issued for MOTs	Procurement Contracts Awarded/PO Issued		2025-06-30
OEM's Ph. 1 Worksheet Approved	Procurement Contracts Awarded/PO Issued		2025-06-30
PO Issued for P&C Engineering	Procurement Contracts Awarded/PO Issued		2026-07-06
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
BCS for Gate 2 Approved	Gate G2 Approval		2027-04-05
BCS for Gate 3 Approved	Gate G3 Approval		2029-02-05
G14 Start of Outage	Start of Outage		2029-09-08
G13 Start of Outage	Start of Outage		2029-12-08
G14 Finish of Outage	End of Outage		2031-02-08
G13 Finish of Outage	End of Outage		2031-05-08
G14/G13 Available for Service	Available for Service and/or Ready For Service Completed		2031-05-08
Project Close Out	Project Close Out Completed		2032-05-10
Post Implementation Review	Post Implementation Review		2032-05-10

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

This alternative is not recommended since it does not address the business need for reliable operation of each unit for the next 25-30 years. This approach does not include major proactive maintenance, such as refurbishments or upgrades. Instead, any repairs would be performed reactively, which could lead to a further decline in unit reliability. Consequently, the reactive maintenance costs would increase resulting in revenue losses due to unplanned outages.

Advantages:

1) No up-front project costs.

Disadvantages:

1) Maintenance costs would increase each year as the unit condition continues to degrade.
2) Reduced probability of reliable operation of these units for the next 25-30 years. The forced outages are expected to increase.
3) The availability of existing spare parts is expected to decrease over time due to obsolescence.
4) Some SAB2 units will have different turbine and generator components compared to the rest of SAB2 units.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 is not recommended since G14 is already experiencing performance issues and is due for major refurbishment. The last time G14 and G13 were refurbished was 21 years ago. By the time of the planned outage of G14 in September 2029, more time would have passed than the industry standard of refurbishing units every 25 to 30 years to maintain reliability. Delaying this project any further can lead to more forced unit outages, compromising reliability and potentially causing significant asset damage in the long term. In addition, there are other existing MOTs at SAB2 that now have an increased probability of failure in the coming years. Choosing this alternative may delay the scheduled refurbishment of these other units, further increasing the probability of forced outages.

Alternative 4:	**Full Unit Replacement**	For Project Level A, B

This alternative involves the complete replacement of G14 and G13 units. Alternative 4 is not recommended due to its significantly higher costs compared to the preferred alternative. In addition, this option would require the SAB2 refurbishment program to be delayed by at least 1 year which increases the risk of reduced reliability due to extended operation of existing units.

Advantages:
1) Meets the business needs of reliable unit operation for 25-30 years.
2) Forced outages of the units will be reduced.
3) Lower production loss due to a shorter outage window.

Disadvantages:
1) Significantly higher project costs with no existing data to support added benefits over the preferred alternative
2) A longer period would be required for design, manufacturing, model testing, and installation.
3) Previous experience has shown that new components don't necessarily last as long as existing components

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Resources	Internal Resource Constraint	Mitigate 72442 - Project Leaders to provide accurate resource plans, identify any forecasted gaps and communicate with relevant stakeholders before each gate/phase of the project. 4/24/2028	Medium
Commercial (Contract/Legal)	One OEM for all 16 units	Mitigate 72444 - Closely monitor and collaborate with the selected OEM to mitigate any potential risks. The OPG and OEM team are to work as "One Team", working in the same office space allowing open, frequent and transparent communication.	Medium
Technical	OEM Capacity and Capability Issues	Mitigate 72441 - OEM to provide a resource loaded CPM schedule to determine the required resources based on estimated man hours.	Medium
Project Management	Integration of other pre-overhaul supporting projects	Mitigate 72445 - Coordinate and collaborate with the maintenance team to avoid unnecessary conflicts, interference, unavailability of space and resource constraints.	Medium
Procurement - Materials	Supply chain and manufacturing capacity	Avoid 72440 - Earlier procurement of long lead equipment than originally planned. 4/12/2027	Low
Procurement - Materials	Material Quality Risk	Mitigate 72583 -Work with the OEM to review and monitor their QA/QC process. Owner's QA/QC representative to maintain presence at manufacturing facility to perform regular inspections. 10/14/2026	Medium

Additional Risk Analysis — For Project Level A or B

Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards. Execution Phase risks will be identified in the risk assessment workshops during the Definition Phase.

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Business Case Summary

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial analysis is not required for Sustaining Projects.

Qualitative Factors — For Project Level A or B

Qualitative factors provided by the Preferred Alternative are listed below:

1) Ensure OPG continues to provide a reliable renewable source of energy while reducing the environmental impact of meeting Ontario's electricity demand.
2) Provide unrestricted operation such as removing limitations on Automatic Generation Control.
3) Address identified safety hazards by implementing enhancements like ergonomic improvements to generator excitation and enhanced grounding.
4) Decrease the frequency and intensity of maintenance requirements.
5) Drive project excellence by leveraging the insights gained from the refurbishment of the G20 and G19 units to enhance the performance of the remaining SAB2 unit refurbishment projects.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2032-05-10

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
Will be determined with G3 BCS.	To Be Developed.	To Be Developed.	To Be Developed.	To Be Developed.

Definitions and Acronyms	
SAB	Sir Adam Beck
P&C	Protection and Control
OEM	Original Equipment Manufacturers
PWU	Power Workers' Union
MV	Medium Voltage
MOT	Main Output Transformer
QA	Quality Assurance
QC	Quality Control
DA	Decision Analysis

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87357 - BK2 G14 G13 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management										0
1 - Project Management		298	1,306	126					1,730	4
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		4,057	14,180	17,322	3,584				39,143	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.90	Interest Rate (going-forward)	4.72

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Syed Salman Ali Burney Project Leader SAB2 Refurbishment Program	2025-05-14	Kevin Kaczmarczyk Project Director Refurbishment Programs	2025-05-16

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Business Case Summary

Project #	87362	**BCS Document Number**	NF28-BCS-08707.021-0084
Project Title	87362 - BK2 230KV CONDUCTOR REPLACEMENTS		
Facility	BK2 - SIR ADAM BECK 2	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2037-Dec-15
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend a release of $200K, including [redacted] of contingency.

The estimated total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This project is to replace the 230kV high voltage (HV) line insulators and conductors and any structural members missing or requiring replacement on the high voltage towers for the circuits connecting transformers T11, T13, T17, T19, T21, T23 and T25.

This Development Phase release will fund Project Management and Engineering planning, Functional Specification documentation creation, and RFP processing for a Construction Engineering, Procurement and Construction (EPC) contract.

Investment Cash Flows

Project Number	87362 - BK2 230KV CONDUCTOR REPLACEMENTS					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0		200						200
Total released to date	0		200						200
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	200.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Kent Keeler Director Asset & Project Mgmt Production Support Manager	Kent Keeler	2025-03-24
I concur with the business decision as documented in this BCS.		
Finance Approval : Katrina Alton Finance Controller	Katrina Alton	2025-03-24

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I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Eric Jury** **Director Plant Operations**	Eric Jury	2025-03-25

EXECUTIVE SUMMARY – Project Overview

Sir Adam Beck 2 Generating Station (SAB2) is a hydroelectric power station in operation since the 1950s, consisting of 16 generating units with 8 main output transformers. The transformers are connected to Hydro One's 230 kV transmission system via 8 circuits. An assessment was completed in 2019 of the system and the report indicated that all transmission shield wires are in poor condition, requiring tower structural elements as well as all insulator hardware and polymeric type insulators to be replaced.

Given that all components are recommended to be replaced along with splice connections onto the conductor, and given the conductors are 60+ years old, the preferred alternative is to replace conductors, insulators, the overhead shield wires, and necessary support elements for the remaining seven (7) circuits starting in 2026. The circuit connecting the T15 was replaced as part of project BK284989 in 2023. The lessons learned are being applied to the planning for this project.

This Development Phase (Gate 1) release will be used for OPG engineering, supply chain and project management support to go out for RFP.

Future releases will include Definition Phase (Gate 2) for detailed engineering, and Execution Phase (Gate 3) for procurement, installation, commissioning and project close out.

The main risks to the project are as follows:
• Design and safe constructability of the scaffolding and platforms required up the escarpment. Scaffolding is required to access the towers and bridges to replace the equipment.
• Working from heights must be carefully planned and executed and limits of approach must be closely monitored.
• Coordination with the MOT replacement commissioning requires resource availability to return to site to address any tie-in deficiencies
• Weather condition constraints in the spring and fall could impact project schedule.

Business Need

For Project Level A or B

This project is needed to ensure the continued reliability and safety of the high voltage transmission lines. The 230 kV towers have several deficient members, with all the tower insulators and conductors requiring replacement for the remaining seven (7) circuits with work starting in 2026 and completing construction by 2036. The project will take advantage of the SAB2 refurbishment program schedule, during which the conductors will start to reach or exceed the known lifespan of 75 years emphasizing the need to address the replacement of equipment.

Preferred Alternative:	Replace conductors and insulators for all the lines	For Project Level A, B or C

Description of Preferred Alternative

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Business Case Summary

The preferred alternative is the replacement of all conductors and insulators, including cable replacement from the Main Output Transformer (MOT) back to the Hydro One switch yard for all the lines. The alternative addresses required equipment replacement and leverages the existing planned SAB2 refurbishment outages. The strategy is to purchase equipment for one conductor route installation at a time, as well as purchase one complete spare set of equipment prior to the first conductor/insulator replacement. This strategy reduces storage requirements and spreads the procurement costs over a ten-year period while having critical spare equipment on hand to mitigate the risk of a failure event occurring on another transmission line prior to the scheduled replacement.

Advantages:
• Leverage existing planned outages to execute work.
• Final design with the entire Bill of Materials (BOM) established.
• Material risk is mitigated in case of emergent work by having a full spare set.
• Commence non-outage work on as many towers as possible.
• Reduces risk of failure to only work which requires an outage to complete.
• Reasonable expenditure and inventory on hand.

Disadvantages:
• Slow reduction in risk to critical infrastructure.
• Large components of infrastructure still in critical condition for 2+ years.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 1 approval and BCS signed by OAR	Gate G1 Approval	GR1	2025-04-07
Functional Specification Completed	Technical Specifications Completed for EPC or Non LLM Contracts	TES	2025-04-17
Request for Proposals (EPC) Issued	Request for Proposals for EPC or Non LLM Contracts	RFP	2025-05-28
Gate 2 approval and BCS signed by OAR	Gate G2 Approval	GR2	2025-11-28

Future Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Contract Awarded and PO Issued	Award Contracts / PO Issued for EPC or Non LLM Contracts	RPC	2025-12-12
Detailed Engineering Designs 80% Completed	Detailed Design Complete	EPC	2026-03-30
Gate 3 approval and BCS signed by OAR	Gate G3 Approval	GR3	2026-06-26
Long Lead Time, Parts & Material Ordered For T19 + Spare	Long Lead Time Material Identified	LLT	2026-07-31
Start of Installation T19	Start of Installation	SOI	2027-04-11
Finish of Installation T19 / Commissioning Finished T19	Finish of Installation	FOI	2027-05-28
Available for Service PEIS T19	Available for Service and/or Ready For Service Completed	AFS	2027-07-30
Long Lead Time, Parts & Material Ordered For T17	Long Lead Time Material Identified	LLT	2027-09-03
Start of Installation T17	Start of Installation	SOI	2028-09-24
Finish of Installation T17 / Commissioning Finished T17	Finish of Installation	FOI	2028-11-10

Available for Service PEIS T17	Available for Service and/or Ready For Service Completed	AFS	2028-12-29
Long Lead Time, Parts & Material Ordered For T13	Long Lead Time Material Identified	LLT	2030-03-02
Start of Installation T13	Start of Installation	SOI	2030-03-24
Finish of Installation T13 / Commissioning Finished T13	Finish of Installation	FOI	2030-05-10
Available for Service PEIS T13	Available for Service and/or Ready For Service Completed	AFS	2030-06-14
Long Lead Time, Parts & Material Ordered For T25 & T11	Long Lead Time Material Identified	LLT	2031-09-05
Start of Installation T25	Start of Installation	SOI	2032-09-05
Finish of Installation T25 / Commissioning Finished T25	Finish of Installation	FOI	2032-10-29
Available for Service PEIS T25	Available for Service and/or Ready For Service Completed	AFS	2032-11-26
Start of Installation T11	Start of Installation	SOI	2033-04-10
Finish of Installation T11 / Commissioning Finished T11	Finish of Installation	FOI	2033-05-31
Available for Service PEIS T11	Available for Service and/or Ready For Service Completed	AFS	2033-06-30
Long Lead Time, Parts & Material Ordered For T23	Long Lead Time Material Identified	LLT	2034-04-03
Start of Installation T23	Start of Installation	SOI	2035-04-08
Finish of Installation T23 / Commissioning Finished T23	Finish of Installation	FOI	2035-05-31
Available for Service PEIS T23	Available for Service and/or Ready For Service Completed	AFS	2035-06-29
Start of Installation T21	Start of Installation	SOI	2036-09-07
Finish of Installation T21 / Commissioning Finished T21	Finish of Installation	FOI	2036-11-14
Available for Service PEIS T21	Available for Service and/or Ready For Service Completed	AFS	2036-12-15
Closeout Completed; PCR Issued	Project Close Out Completed	PCO	2037-12-15

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Not recommended. The base case involves maintaining the status quo and continue to use the existing 230 kV insulators and associated hardware as is with the current maintenance strategy.

Advantages:
• The main advantage is that there will be no investment required in the short term.

Disadvantages:
• Possible failure of insulators and/or associated hardware could result in a significant loss of production.
• Elevated risk of public life safety due to possibility of failure of insulators and/or associated hardware (e.g., energized conductor will be within reach of public on a road level along the Niagara Parkway).

The base case is not recommended as it does not meet the business need. This option carries an unacceptable level of risk due to public safety and lost production due to failed insulators / downed conductors.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Not recommended. Delaying the work involves keeping the status quo until replacements can be completed at a future date. Historically, failure of the equipment typically forces the outage of two generators at a time until repairs/replacements can be made.

Advantage:
• Deferring large expenditure.

Disadvantages:
• Additional outages may be required to support the work.
• Conductors are approaching the age of 60+ during this project execution phase and will exceed 75 years of age, with failure potentially resulting in forced outages.
• Some of the parts have long lead times increasing the risk of long unplanned outages.

This alternative is impractical as an operational strategy as it could result in unscheduled forced outages for maintenance, repairs and may disrupt the SAB2 refurbishment program and supply chain.

Alternative 4:	**Replace all insulators only for all lines**	For Project Level A, B

Not recommended. Replacement of the polymeric insulators and not the conductors, is not an acceptable alternative, The conductor scope replacement is needed due to the age limitation of 75 years. Replacement of all the insulators and cable replacement from the MOT back to the Hydro One switch yard is required for all the lines.

Advantages:
• Reduces the upfront equipment costs by not including Conductor procurement and replacement.

Disadvantages:
• Conductors are approaching the age of 60+ during this project execution phase and will exceed 75 years of age, with failure potentially resulting in forced outages.
• Additional outages may be required to complete remaining work.

This alternative is impractical as an operational strategy as it would result in unscheduled forced outages for maintenance, repairs and may disrupt the SAB2 refurbishment program and supply chain.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Health and Safety	Poor weather conditions during the outage scheduled.	Mitigate 69859 - Poor weather conditions during the outage scheduled. Float to be added for each of the scheduled installations to allow for work stoppage due to high wind condition or thunderstorms. 12/31/2027	Low
Technical	Added Discovery Work	Mitigate 69861 - Added Discovery Work Manage the work within the schedule. 12/31/2025	Low
Commercial (Contract/Legal)	Insufficient installation time provided	Mitigate 69864 - Insufficient installation time provided. Coordinate additional time as required with the refurbishment program. 12/31/2026	Low
Integration	Limited Access to the Niagara Parkway	Mitigate 69863 - Timely communication with the Niagara Parks Commission being informative and transparent. 12/31/2027	Low

Additional Risk Analysis — For Project Level A or B

Business Case Summary

Additional risks will continue to be reviewed throughout the project lifecycle and align with the Project Excellence standards. Prior to the next gate review a Monte Carlo Simulation is required. SPOC has been assigned and preparations will start in March 2025 to complete.

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

A financial evaluation is not required for Sustaining projects.

Qualitative Factors — For Project Level A or B

Execution of the preferred alternative will result in:
• restoring the integrity and long-term reliability of the conductors, insulators, transmission lines, and tower structures.
• alignment with more stringent transmission line loading criteria that considers more adverse weather events.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	No	**PIR Completion Date**	
Justification	On completion of the testing and commissioning, the shield wire connection to the transformer will be tested and confirmed operating as expected.		

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87362 - BK2 230KV CONDUCTOR REPLACEMENTS						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management			80						80	40
2 - Inspection										0
3 - Engineering	[redacted]									
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest			1						1	1
Other										0
Total			200						200	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate		Interest Rate (going-forward)	4.75

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Michele Sokol Project Leader Pre-Refurb	2025-03-21	Kent Keeler Director Asset & Project Mgmt Niagara Production Support	2025-02-21

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Appendix C: Financial Evaluation Assumptions	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing
Key assumptions used in the financial model of the project are:	
A financial evaluation is not required for Sustaining projects.	

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Business Case Summary

Project #	87575	**BCS Document Number**	NA9-BCS-08707-1366109
Project Title	87575 - SAU-LSD DOWNSTREAM CONCRETE JW NYPA		
Facility	SAU - RH SAUNDERS	**Investment Classification**	Sustaining
Project Level (Scalability)	X	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G1 - Development Phase - (Full)	**Target Project Completion Date**	2038-Dec-31
Estimate Class (Current Request)	Class 4	**Estimate Class (Overall Project)**	Class 5

Recommendation

We recommend the release of $3,611k, including [redacted] of contingency.

The estimated total project cost range is to be determined upon Gate 2 approval to proceed to the Definition Phase.

This release will fund the following scope of work:
• Develop the preferred alternative for working over and near water; safety measures that need to be implemented during execution of the repair/refurbishment work to Long Sault Dam downstream spillway concrete structure,
• Detailed design and implementation of the preferred alternative for working over and near water,
• Intrusive onsite inspections of LSD downstream spillway concrete structure,
• Finalizing of the detailed design for the repair/refurbishment work to Long Sault Dam downstream spillway concrete structure.

This funding is under the NYPA-OPG Joint Works (JW) Agreement. The Canadian dollar cost in this BCS represents OPG's 50% share, which OPG is obligated to pay under the agreement. For this project, the project management and work execution are being performed by NYPA. Therefore, there is no project scalability in this case considering this is an administrative project. Furthermore, the project status and planning phase activities outlined under this current release are based on feedback from the New York Power Authority (NYPA).

Investment Cash Flows

Project Number	87575 - SAU-LSD DOWNSTREAM CONCRETE JW NYPA					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	2,017	600	80	80	834			3,611
Total released to date	0	2,017	600	80	80	834			3,611
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	3,611.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Amanda Griener Director Asset & Project Mgmt Production Support	Amanda Griener	2024-05-27

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Business Case Summary

I concur with the business decision as documented in this BCS.		
Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	2024-05-29
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Scott Gagnon Director Plant Operations.	Scott Gagnon	2024-06-11

EXECUTIVE SUMMARY – Project Overview

The New York Power Authority (NYPA) has a control dam called Long Sault Dam (LSD), also referred to as the spillway, which is in Massena, New York.

This project is to perform the engineering and subsequent refurbishment repairs of the Long Sault Dam downstream spillway surface. This will extend the useful life of the structure. The concrete structure of the LSD downstream spillway is over 50 years old and has begun to deteriorate at the vertical and horizontal construction joints throughout the 30 spillway gate bays. There is significant deterioration occurring at the tailrace water elevation, where areas of exposed rebar are beginning to show. This project will replace the deteriorated concrete with new concrete that will extend the life of the asset.

NYPA plans to perform the work to repair and refurbish the LSD downstream spillway concrete structure during spilling conditions. As such there are additional safety measures that will need to be undertaken to comply with OSHA requirement 1926.106 “Working Over or Near Water”. To comply with requirements, NYPA will investigate viability and cost of a few alternatives/options prior to start of execution of the repair/refurbishment work.

Under this release, NYPA will investigate the options for working over and near water. The preferred alternative will be selected along with the associated engineering and detailed design work and onsite implementation. This will also allow for intrusive onsite inspections to confirm extent of scope and support finalizing and completing the detail design for the repair/refurbishment of the LSD downstream spillway concrete structure.

One of the options/alternatives that NYPA will investigate is the purchase of a skiff (a shallow, flat-bottomed open boat, approx. $20k), and implement a cofferdam system. The cofferdam installation is required to get the skiff into the water during spilling events and allow for a safe location below the work area in the event of an incident. When multiple gates are open, as would be the case during spilling conditions, due to turbulence there is no way to introduce a skiff into the water without the cofferdam or provide a safe water location for workers. With continual spilling events, the cofferdam would need to be engineered so that each half of the dam, in conjunction with sequencing gates for spilling, would allow down-stream and/or up-stream dam activities to be performed.

Another alternative NYPA will investigate is dewatering/reductions of flow options for both the upstream and downstream sides of the dam.

OPG has a contractual obligation under the Joint Works (JW) Agreement with NYPA to pay for 50% of this project. These assets provide long-term benefits to both NYPA and OPG. The JW is an agreement between OPG and NYPA to share certain costs at certain facilities and its auxiliary structures such as the Long Sault Dam and Iroquois Dam. One party is responsible for managing the joint works asset while both parties contribute equally to the costs associated with the asset. For this project, the project management and work execution will be performed by NYPA. OPG will pay 50% of the gross cost. The description of the planned work under the current release and for future releases are based on feedback from the New York Power Authority.

Key Risks:
1. (Schedule) There is a risk that the project execution schedule could be accelerated or deferred by NYPA. This project is executed and managed by NYPA, with little/no OPG control. Accept: Schedule acceleration. Mitigate: Schedule deferral/delay mitigated by added contingency into the schedule.
2. (Cost) There is a risk that costs may vary from the released funding, due to exchange rate fluctuations, or scope creep which is inherent in concrete repair work. Mitigate: A cost contingency of [redacted] has been included in the release value. An exchange rate of 1.3 has been used to estimate the Canadian dollar value.

Business Need

For Project Level A or B

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Business Case Summary

Preferred Alternative:	For Project Level A, B or C
Description of Preferred Alternative	

Deliverables:
Previous Release: N/A
Current Release: N/A
Future Release: N/A

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing
Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing
Alternative 4:		For Project Level A, B

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
N/A			

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)			
Is PIR Required?	No	**PIR Completion Date**	2039-12-31
Justification			

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87575 - SAU-LSD DOWNSTREAM CONCRETE JW NYPA						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		228	98	13	13	136			488	14
2 - Inspection										0
3 - Engineering	[redacted]									
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest		81	24	3	3	34			145	4
Other										0
Total		2,017	600	80	80	834			3,611	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.50	Interest Rate (going-forward)	400.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Vichetr Lim Planning Officer Upper Ottawa Production	2024-05-22	Luigi Perra Senior Manager Projects Madawaska Projects	2024-05-22

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Business Case Summary

Project #	87768	**BCS Document Number**	NF28-BCS-08707.021-0082
Project Title	87768 - BK2 G20 G19 REFURBISHMENT		
Facility	BK2 - SIR ADAM BECK 2	**Investment Classification**	Sustaining
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - b (Full)	**Target Project Completion Date**	2029-Jul-30
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 4

Recommendation

We recommend a release of $187,307K, including [redacted] of contingency.

This will bring the total released-to-date to $221,079K, including [redacted] of contingency.

The estimated total project cost, including CAP and OM&A, is in the range of $300M to $350M.

The OM&A and removal costs are not known at this time but anticipated to be approximately 5% of project construction expenses. These costs will be accounted for under project BK284293 during the Execution Phase at Gate 3.

This project is to refurbish Sir Adam Beck 2 (SAB2) G20 and G19 Units in order to ensure their reliable operation for an estimated 25-30 years. This Definition Phase release will provide funding for the OEM's target price, covering project management, detailed engineering design of the turbine, generator, governor, electrical balance of plant, mechanical balance of plant, civil works, headworks, scale model testing, auxiliary systems, and procurement. Procurement efforts will focus on securing key vendors and contracts, long-lead materials, tooling, and equipment to meet critical path milestones and support the construction schedule.

Investment Cash Flows

Project Number	87768 - BK2 G20 G19 REFURBISHMENT					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	4,891	12,522	10,822	4,734	803				33,772
Currently Requested	0		49,911	70,758	46,716	19,922			187,307
Total released to date	4,891	12,522	60,733	75,492	47,519	19,922			221,079
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	221,079.0

Approvals	**Signatures**	**Date**
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Nicolle Butcher Chief Operations Officer Chief Operations Officer	Nicolle Butcher	2024-12-03
I concur with the business decision as documented in this BCS.		

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Business Case Summary

Finance Approval : **Aida Cipolla** **CFO & Corporate Services Officer**	Aida Cipolla	2024-12-09
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : **OAR Element : 1.1** **Ken Hartwick** **President & Chief Executive Officer**	Ken Hartwick	2024-12-10

EXECUTIVE SUMMARY – Project Overview

Business Case Summary

The Sir Adam Beck 2 (SAB2) hydroelectric power station, consisting of 16 units, has been operational since the 1950s. As a "flagship" asset in OPG's fleet, it has the capacity to provide Ontario with a maximum continuous rating of 1,499 MW of emissions-free energy. The overall SAB2 refurbishment program aims to restore the integrity, ensure long-term reliability, and maintain the continued availability of the SAB2 units. Project BK287768, which consolidates five projects (G20 CAP/OM&A, G19 CAP/OM&A, and Upgraded Main Output Transformers (MOT) T19), will execute the refurbishment of the first pair of units, G19 and G20, and its associated MOT T19. Given the complexity of the refurbishment and the fact that SAB2 is a high-capacity factor station with several shared systems, joint unit outages must be scheduled concurrently to optimize the execution timelines.

The G20 and G19 turbines and generators were last refurbished in 1999 and 2000, respectively. G20, the first unit scheduled for refurbishment, will begin in Q4 2026, followed by G19, the second unit, in Q1 2027, creating a 27-year gap between refurbishments. Major hydroelectric unit refurbishments are typically required every 25 to 30 years to maintain reliability. Recent condition assessments have confirmed that unit reliability is decreasing due to normal wear and aging and there is a lack of readily available spare parts as the OEM no longer makes or supports the existing parts; this has led to prolonged outages required for repairs. The sequence of refurbishments for the SAB2 units is based on a Decision Analysis (DA) with input from Production, Engineering, Operations, and Project Representatives; this order may be adjusted as required based on the condition of each unit and any forced outages.

This project aligns with Energy Minister Todd Smith's announcement on April 15, 2024, supporting OPG's refurbishment of Niagara Hydro Stations in collaboration with GE Vernova, stating that the "program would secure up to 1,700 megawatts (MW) of clean electricity, equivalent to powering 1.7 million homes, helping to meet increasing demand from electrification and fueling the province's growth." It also supports the Provincial Government's "Powering Ontario's Growth Plan", released on July 10, 2024, in response to public consultation on the Independent Electricity System Operator's Pathway to Decarbonization, which aims to achieve a net-zero economy by 2050. It also supports OPG's Climate Change Plan, which commits to refurbishing hydroelectric units across the fleet.

OPG plans to work with a selected OEM through the RG Programmatic Collaborative Agreement, employing a Design Build Contracting Strategy and Target Pricing structure to provide engineering, procurement, and construction services for the project.

Prior to the consolidation of the five predecessor projects into this project, BK287768 G20 G19 Refurbishment, the previously approved scope was mostly for Development Phase (Gate 1) activities. This included developing a detailed project scope, completing engineering specifications, conducting site inspections, determining the contracting/procurement strategy, and selecting a contractor for turbine associated work. These activities have been completed, except for the turbine contractor selection. Since units G19 and G20 are the first to be refurbished, the upfront costs to complete the selection of suppliers and contractors required for the entire SAB2 refurbishment program are included in the G19 and G20 project cost and will not be incurred for the subsequent units. This scope includes selecting a contractor for the large OEM for the design, supply, and installation of the generator, turbine, and headgate; selecting contractors for quality assurance and control (QA/QC), engineering, and project support; and issuing a PO for protection and control (P&C) design & supply. These activities are expected to be completed in Q4 2024.

A Definition Phase (Gate 2) release was approved in August 2024, spanning from Q3 2024 to Q1 2025, to finalize the initial design and develop the detailed design. This phase includes reviewing actions following the conceptual design reviews, creating preliminary designs of major components, and preparing calculation reports, including Finite Element Analytical (FEA) calculations. Additionally, the funding covers costs for pass-through expenses, project management, project engineering, runner model testing, supply chain management, legal services, and procurement of long lead materials, and related project activities for the detailed mechanical design of the new runner and progressing through 30% and 60% design stages for various turbine and generator components along with their associated systems. These activities are underway.

According to the original Definition Phase plan, the project was intending to proceed directly to an Execution Phase (Gate 3) funding release for all remaining aspects of the project. However, in order to minimize the risks and uncertainties in the construction estimate, the remaining project will be executed in two phases: Gate 2B and Gate 3. This Definition Phase (Gate 2B) release will address critical path design and supply activities, including procurement, completion of the design work, and enabling the project to secure fixed-price contracts from the contractors for the construction and installation phase, which includes down payments to key contractors.

The future Execution Phase (Gate 3) funding release, anticipated in Q4 2025, will encompass the full execution costs for the construction phase, including commissioning and project closeout, while adhering to the provisions of the CPAA Labour Agreement. A fully integrated, resource-loaded schedule will be developed to ensure effective coordination and resource allocation throughout the outage period.

The key risks for this project are schedule delays and the complexity of the refurbishment. These include potential engineering delays caused by the availability of engineering design drawings and calculations which could require additional condition assessments, which in turn could delay engineering activities and the procurement of long-lead materials, impacting the equipment delivery timelines and critical path milestones. Further, there is a risk of delays due to the system integration complexity of the major equipment, including protection and control systems, main output transformers, excitation systems, governor systems, and related equipment. These issues could delay the interconnection assessments with Hydro One and Independent Electricity System Operator (IESO) and negatively impact the in-service date. To mitigate these potential risks, the OEM will provide a resource-loaded critical path milestone schedule, outlining the required resources based on estimated hours. Additionally, the roles and responsibilities for both the OEM and OPG personnel will be clearly defined to ensure transparency and accountability. This will support the development of a detailed strategy, tools, platform, and other pre-outage activities essential to the project's success.

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Business Case Summary

Business Need	For Project Level A or B

The business objective is to ensure the reliable and safe operation of the G20 and G19 units for an estimated 25-30 years. These units were last refurbished in 1999 and 2000, respectively. Engineering assessments have indicated a decline in unit reliability due to normal wear and aging equipment. Currently, these units are facing reliability issues due to on-going challenges and the availability of obsolete spare parts. This has resulted in extended unit outages for repairs. Therefore, adhering to the scheduled refurbishment is crucial to achieving the project's objectives.

This project will achieve the business need in the following ways:

1) Minimize the risk of forced outages due to unexpected equipment failure and replacement of obsolete parts.
2) Eliminate known safety hazards identified by plant staff.
3) Ensure reliable and safe operation for the next 25-30 years.
4) Increase the capacity and improve runner efficiency, with an estimated gain of 1.5 MW per unit.
5) Upgrade equipment to meet current regulatory requirements.

Given that it has already been 27 years since the last refurbishment, if the current situation persists, unit reliability is expected to decline because maintenance will be reactive, rather than proactive. This will likely lead to longer outages and a reduction in the amount of electricity capable of being generated for the grid.

Preferred Alternative:	Refurbishment and upgrade to a higher capacity	For Project Level A, B or C

Description of Preferred Alternative

In January 2024, OPG executed a strategic 15-year Programmatic Collaboration Agreement with the OEM to secure engineering, procurement, and construction (EPC) services utilizing the Target Pricing Structure for the SAB Refurbishment Program. Under this agreement, G20 and G19 will be the first pair of units to be refurbished for SAB2.

The preferred alternative consists of refurbishing units and replacing components where economical or required by regulation. Spares will be purchased prior to the refurbishment to reduce outage time, be used for future maintenance, or be used throughout the refurbishment program. Implementation of this alternative would involve the following scope:

1) Refurbish and replace turbine and auxiliaries.
2) Refurbish and replace generator and auxiliaries.
3) Replace governor system.
4) Refurbish and replace electrical common balance of plant.
5) Refurbish and replace mechanical balance of plant.
6) Replace protection and & control.
7) Refurbish civil works.
8) Refurbish hydro mechanical headworks and headgate intake.

The preferred alternative will provide the following benefits:

1) Minimize the risk of forced outages due to unexpected equipment failure.
2) Reduce the frequency and intensity of maintenance caused by vibrations in the core.
3) Eliminate known safety hazards identified by plant staff.
4) Ensure reliable and safe operation for an estimated 25-30 years.
5) Increase capacity and runner efficiency.
6) Upgrade equipment to meet current regulatory requirements.

The disadvantages with this method are:

1) Warranty has an upset limit of 2.4% of the Contract Price.
2) The project involves more replacement work than refurbishment, primarily due to the decision analysis and key critical path activities, which is negatively affecting the overall project cost.
3) The project scope is extensive, requiring a significant amount of qualified resources and hours, which are not available at this time.

Deliverables:

Previous Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
BCS for Gate 1A Approved	Gate G1 Approval		2019-10-31
Labour Determination	Labour Determination Completed		2020-02-25
Scope of Work Document	Scope of Work Document Complete		2021-06-30
Gate 2 Approval	Gate G2 Approval		2024-08-07
OEM Ph. 2 Worksheet Ext.	Contracts Awarded		2024-08-16
P&C Fac (Sub-Ph 1B)- Long Lead Procurement	Procurement Contracts Awarded/PO Issued		2024-08-30
Concept Design By OEM Specified In Worksheet Ext.	Conceptual Design Complete		2025-04-01
P&C Detailed Engineering	Detailed Design Complete		2025-10-24
Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
BCS for Gate 2B Approved	Gate G2B Approval		2024-11-15
OEM for gate 2B Worksheet Approved	Award Contracts / PO Issued		2024-12-16
P&C Sub-Ph 1C Approved	Award Contracts / PO Issued		2026-07-08
OEM Detailed Engineering Complete	Detailed Design Complete		2026-10-20
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 3 Approval	Gate G3 Approval		2025-11-17
G20 Start of Installation	Start of Installation		2026-10-08
G20 Start of Outage (SOO)	Start of Outage		2026-10-08
G19 Start of Installation	Start of Installation		2027-01-08
G19 Start of Outage (SOO)	Start of Outage		2027-01-08
G20 Finish of Installation	Finish of Installation		2028-01-19
G20 Available For In-Service	Available for Service and/or Ready For Service Completed		2028-04-10
G19 Finish of Installation	Finish of Installation		2028-04-10
G20 End Of Outage (EOO)	End of Outage		2028-04-10
G20 Report of Equipment	Report of Equipment in Service		2028-05-08
G19 Available For Service	Available for Service and/or Ready For Service Completed		2028-07-10
G19 End Of Outage (EOO)	End of Outage		2028-07-10
G19 Report of Equipment	Report of Equipment in Service		2028-07-31
Project Close-Out	Project Close Out Completed		2028-10-16
Post Implementation Review	Post Implementation Review		2029-07-30

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Alternative 2 is not recommended because it does not address the business need for reliable operation for the next 25-30 years. This approach would mean that no major proactive maintenance would be undertaken. Instead, repairs would be performed reactively, which would likely lead to a decline in unit reliability. Consequently, reactive maintenance costs are expected to rise, along with potential loss of generation.

Advantages:

1) No up-front project costs.

Disadvantages:

1) Maintenance costs are expected to increase each year as the unit condition continues to degrade.
2) Reliable operation for 25-30 years is not expected. Forced outages are expected to increase.
3) Spare parts availability is expected to decrease over time due to obsolescence.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Alternative 3 is not recommended because G20 is already experiencing repetitive failures and is due for a major refurbishment. Delaying the project will lead to more forced unit outages, further compromising reliability and potentially causing significant asset damage in the long term.

Alternative 4:	**Full Unit Replacement**	For Project Level A, B

Alternative 4 is not recommended due to its significantly higher costs compared to the preferred alternative. It involves the complete replacement of units G20 and G19.

Advantages:

1) Meets the business needs of reliable unit operation for 25-30 years.
2) Unit forced outages will be reduced.
3) Lower production loss due to shorter outage window.

Disadvantages:

1) Significantly higher project costs.
2) A longer period is required for design, manufacturing, model testing, and installation.

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Resources	Internal resource constraint	Mitigate 52859 - OPG will hire additional external staff if internal resources are not available (PWU) 10/8/2026	Medium
Technical	System integration complexity	Mitigate 57042 - Project team will collaborate and adopt One Team approach by working together in shared office environment to enhance communication and transparency, ensure the project is executed safely, on time and within budget 12/31/2026	Medium
Licensing & Regulatory	Hydro One coordination for Transfer trip signal cable replacement	Mitigate 57087 - Engage Hydro One early; Identify a tech SPOC from both Hydro One & OPG for effective technical coordination; Develop an alternative plan if Hydro One is not willing to upgrade. 12/31/2024	Medium
Technical	Technical complexity and large amount of work by OEM	Mitigate 57899 - Supporting OEM with OPG experienced vendors and contractors, to address project complexity 12/31/2024	Medium
Integration	Insufficient Drawings for CWC Rotor Components including Rim, Spider, and Poles.	Mitigate 66667 - Perform Condition Assessments 12/20/2024	Medium

Additional Risk Analysis	For Project Level A or B
Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards. Execution Phase risks will be identified in the risk assessment workshops during the Definition Phase.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					
A financial analysis is not required for Sustaining Projects.					

Qualitative Factors	For Project Level A or B

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Business Case Summary

Qualitative factors provided by the Preferred Alternative are listed below:

1) Ensure OPG continues to provide a reliable renewable source of energy while reducing the environmental impact of meeting Ontario's electricity demand.
2) Provide unrestricted operation such as removing limitations on Automatic Generation Control.
3) Address identified safety hazards by implementing enhancements like ergonomic improvements to generator excitation and enhanced grounding.
4) Decrease the frequency and intensity of maintenance requirements.
5) Drive project excellence by leveraging the insights gained from the first refurbishment of G20 unit to enhance the performance of the remaining SAB2 units.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2030-07-30

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Will be determined with Gate 3 BCS.	To be developed.	To be developed.	To be developed.	To be developed.

Definitions and Acronyms	
SAB	Sir Adam Beck
P&C	Protection and Control
OEM	Original Equipment Manufacturers
PWU	Power Workers' Union
MV	Medium Voltage
MOT	Main Output Transformer
QA	Quality Assurance
QC	Quality Control
DA	Decision Analysis

ONTARIO POWER GENERATION

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	87768 - BK2 G20 G19 REFURBISHMENT						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management	21	882	10,317	13,678	13,678	8,924			47,500	21
1 - Project Management	2,402	2,976	4,836	5,069	4,909	2,864			23,056	10
2 - Inspection		321				100			421	0
3 - Engineering	[redacted]									
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	4,891	12,522	60,733	75,492	47,519	19,922			221,079	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	3.50	Interest Rate (going-forward)	4.43

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
87768	2025-09-30	The in-service estimate will be determined with Gate 3 BCS.		
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Duc Hoang Senior Project Leader SAB2 Refurbishment Program	2024-11-19	Nicolle Butcher President & Chief Executive Officer President	2024-11-28

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Business Case Summary

Appendix C: Financial Evaluation Assumptions	For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing
Key assumptions used in the financial model of the project are:	
Cost estimates come from OEM, Key Vendors Input, and OPG Estimates. The interest rates used in the calculation are based on the following inputs: 2025: 3.95%, 2026: 4.25%, and 4.75% from 2027 to 2031. The escalation rates used in the calculation are based on the BP assumptions.	

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Business Case Summary

Project #	89252	**BCS Document Number**	NF20-BCS-62900-1477911
Project Title	89252 - SAB1 CANAL ISOLATION PREPAREDNESS PHASE1		
Facility	BK1 - SIR ADAM BECK 1	**Investment Classification**	Sustaining
Project Level (Scalability)	A	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - (Full)	**Target Project Completion Date**	2029-Dec-31
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 4

Recommendation

We recommend release of $6,007K, including [redacted] of contingency. Previously, $5,288K had been transferred from Project 82771 to this project. This will bring the total released for this project to date to $11,295K, including [redacted] of contingency.

The estimated total project cost range is between $45M and $65M.

This project is the first of three projects for the Sir Adam Beck No.1 (SAB1) canal rehabilitation program. This SAB1 Canal Isolation Preparedness Phase 1 (CIP1) project includes the rehabilitation of the SAB1 closure structure, provision of 16 sectional service gates for the closure structure, and support for progressing the overall approach to rehabilitating the SAB1 canal.

This Definition Phase (Gate 2) release will fund engineering for the closure structure, contractor selection and project management related activities.

Work was started under Project 82771 which funded condition assessments, and various project management activities, including the development of an initial plan and technical specification prior to the project's deferral in 2020. The project was restarted in June 2024, and spending from June 2024 to date, along with the costs associated with the closure structure work completed prior to project deferral under the previously released funding for Project 82771 will now be included in this SAB1 CIP1 project. Project 82771 will be closed following BCS approval for this project and funding transfer from Project 82771.

Investment Cash Flows

Project Number	89252 - SAB1 CANAL ISOLATION PREPAREDNESS PHASE1					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	2,808	691	1,789						5,288
Currently Requested	0	2,135	2,797	1,075					6,007
Total released to date	2,808	2,826	4,586	1,075					11,295
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	11,295.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		

Business Case Summary

Recommended by: Direct Report of Line Approver : Eric Jury Director Plant Operations Operations Manager	Eric Jury	2025-07-09
I concur with the business decision as documented in this BCS.		
Finance Approval : Derek Kindlon Director Controllership	Derek Kindlon	2025-07-11
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Nicole Fabbro VP Regional Operations	Nicole Fabbro	2025-07-11

EXECUTIVE SUMMARY – Project Overview

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Business Case Summary

The SAB1 canal was constructed between 1917 and 1921 and has not undergone significant rehabilitation since 1965. Condition assessments have indicated a reduced flow rate and noticeable deterioration. In addition, the Ministry of Transportation (MTO) has a Hwy 420 culvert repair that may require canal dewatering / isolation.

The SAB1 canal program is expected to:
- Restore the structural integrity of the SAB1 canal and associated infrastructure to ensure safe and reliable operation for an expected 50 years.
- Reclaim degraded flow capacity and limit future degradation of flow capacity to reduce operational losses.
- Provide an isolation solution to support the potential MTO Hwy 420 culvert repair.
- Gain SAB1 canal maintenance flexibility that reduces stakeholder dependencies.

The overall program involves three projects:
Project 1 (#89252): Canal Isolation Preparedness Phase 1 (SAB1 CIP1) - Closure Structure
Project 2 (#89253): Canal Isolation Preparedness Phase 2 (SAB1 CIP2) - Montrose Gate
Project 3 (#89254): SAB1 Canal Rehabilitation Project (SAB1 CRP) - Canal Rehabilitation

Significant portions of work to be done as part of the rehabilitation will require canal outages/dewatering. SAB1 CIP1 work will not require canal dewatering. The SAB1 CIP2 project, in conjunction with SAB1 CIP1, is required to dewater all or part of the canal, to complete the rehabilitation.

The canal rehabilitation project began under Project 82771, which funded condition assessments and various project management activities, including the development of an initial overall cost estimate and technical specification. The project was deferred in 2020 following a risk analysis that confirmed that the canal conditions could sustain this delay. As per the plan upon project deferral, a team was reassembled to explore restarting the project in 2024. Work completed since June 2024 has been completed using unspent funding under Project 82771, which will now be included with this SAB1 CIP1 project.

This Definition Phase (Gate 2) release will include:
- Program and project management level efforts.
- SAB1 CIP1 - 100% design of the Closure Structure
- SAB1 CIP1 - Value Engineering
- SAB1 CIP1 - Civil Work Contractor Selection

The Execution Phase (Gate 3) release will include:
SAB1 CIP1 - Closure Structure In-service

Key risk for the program includes:
1. MTO requires SAB1 canal outage/dewatering before the SAB CIP1 and SAB CIP2 projects are complete. The mitigating action is accomplished by carrying out this program, with the primary focus on canal isolation in the near term.

Key risks for the SAB1 CIP1 project include:
1. Permit delays related to Indigenous Engagement/Crown Duty to Consult.
2. Species at Risk may require a lengthy permitting window.
3. Archeological features identified in areas that require project disturbance.
4. Sectional gates may require long lead time.

An environmental strategy and permitting plan, as well as an Indigenous engagement plan have been developed to identify permits, commission studies to support permitting/archeological concerns and to guide engagement with Indigenous communities and environmental regulators to mitigate the risks identified above.

Business Need

For Project Level A or B

The Niagara Complex is made up of SAB1 GS, SAB2 GS and the Pump Generating Station (PGS). Water is conveyed by means of the SAB1 Canal, SAB2 Canal/Twin Tunnels and the Niagara Tunnel No. 3. This complex represents one of the highest installed capacity and annual output of OPG's hydroelectric fleet. The theoretical diversion capacities of this water conveyance system is 2,343 m3/s ("cms"), distributed as follows:
- SAB1 Canal, 617 cms, ~ 26% of the diversion flow
- SAB2 Twin Tunnels (Tunnel 1 and 2): 1,209 cms, ~52% of the diversion flow
- Niagara Tunnel (Tunnel 3): 517 cms, ~22% of the diversion flow

The SAB1 Canal was constructed between 1917 and 1921. The SAB1 Canal construction consisted of 6.8km improvements to the natural channel of the Welland River, and 13.7km of dry excavation. The dry excavation section consists of:
- 1.9km long earth cut section
- 0.75km long trapezoidal section
- 11.05km of rock cut rectangular sections.

There are two canal isolation structures, the Closure Structure located upstream and in close proximity to the SAB1 station, and the Montrose Gate located further upstream, ~9.5 km from the Closure Structure.

In 1981, major dredging of the SAB1 Canal was performed and restored the flow capacity by approximately 51 cms, from 560.7 cms pre-dredging to 611.6 cms post-dredging. Approximately 1,835 m3 of debris was removed. The continuing deterioration of the canal walls, localized collapsed areas, debris accumulation including trees falling into canal, and weed growth are the likely contributing factors resulting in reduced flows. Since the 1981 dredging, canal flow has reduced to about 583.6 cms (potential maximum loss of up to 0.5 TWh/year), calculated based on SAB1 and SAB2 operating at efficiency over the entire year.

In 1964/65, the rectangular and trapezoidal sections of the SAB1 Canal were deepened and widened to provide additional design flow capacity (from original 450 cms design flow capacity to the present 617 cms design flow capacity). Repairs were also performed to the concrete floors and walls of the SAB1 Canal and weathered rock surfaces above the concrete liner. Since the mid-1990s, several general inspections and condition assessments of the SAB1 Canal and other components of the SAB1 water conveyance system have been performed. The inspections/assessments reveal that some sections of the canal concrete and rock slopes at the waterline are significantly deteriorated. This deterioration likely also continues to cause accumulation of debris on the invert (floor) of the canal thus further hindering conveyance capacity.

The Closure Structure was built in 1964 for the purpose of dewatering the canal upstream to the Montrose Gate. This helped complete the canal rehabilitation work undertaken at the time. Stability assessments revealed that the Closure Structure meets stability criteria when assuming no sheet ice load applied to the structure; however various other issues and concerns were identified with the structure during the 2018 condition survey. The following items were recommended to be addressed in order to use the Closure Structure for future potential canal dewatering/lowering of water.
- Review options for anchoring the downstream sides of the concrete abutments to bedrock and the central pier.
- Clean debris from the stop log sill.
- Refurbish six of the existing stop logs that are salvageable and replace at least six of the deteriorated stop logs. Alternatively, procure 12 new logs to serve the Closure Structure or 16 new logs which could also be used at the SAB2 Twin Tunnels outlet (requires 6).
- Refurbish the stop log follower.

The Montrose Gate was built in 1921 and was last rehabilitated between 1995-1999. Due to current equipment conditions, the gate currently has an 8-foot head differential restriction while lifting and lowering the gate. A condition assessment conducted in 2017 identified a number of issues and high risks to be addressed (e.g., gates upon opening or closing, could become jammed or partially jammed).

The Ministry of Transportation (MTO) manages the Hwy 420 provincial infrastructure located in the Niagara region. Hwy 420 has a large overpass and associated culvert located over the SAB1 Canal that requires ongoing inspections and maintenance. MTO has previously notified OPG that they will require a lowered water level to complete culvert repairs. However, at this time the condition of the overpass culvert is being monitored by MTO, with a projected repair timeline to be determined.

The Welland River has been diverted into the SAB1 Canal since it was placed in-service in 1921. Any closure of the SAB1 Canal for maintenance or other reasons results in the Welland River reverting to its natural flow eastwards towards the Niagara River (this piece of river is commonly referred to as Chippawa Creek). Naturally present turbidity and silt in the Welland River causes a change to the chemistry of the existing raw water in Chippawa Creek, which consists mainly of Niagara River water, which is much less turbid. This change in water quality would likely negatively impact landowners/users of the Chippawa Creek. This includes the Niagara Region Water Treatment Plant, which has their water intake on Chippawa Creek. Changes to water chemistry could negatively impact the Region of Niagara's ability to provide clean drinking water to the entire City of Niagara Falls. Therefore, any SAB1 Canal closures and dewatering for maintenance or other reasons, would require the Region of Niagara to relocate their water intake. This effort requires a long lead time for their infrastructure changes. There is also another water intake (Niagara Parks Horticultural Garden/Whirlpool Golf Course) that would be impacted by canal dewatering and will need to be addressed.

In addition, since the construction of the SAB1 Canal, various external stakeholders have been provided access to discharge into the SAB1 Canal. This includes stormwater drains and sanitary sewage outlets. Any closure and dewatering of the SAB1 Canal for maintenance or other reasons means that these discharges would need to be addressed as part of the overall closure plan. This effort could require a long lead time for infrastructure changes and/or the development of accommodation measures by OPG in a dewatering plan.

The rehabilitated closure structure will support the future rehabilitation of the SAB1 canal, which is expected to mitigate the on-going degradation of flow to the Niagara Complex and support the isolation of the MTO's Hwy 420 culvert. Following rehabilitation, the closure structure will have an extended design life of an estimated 50 years and will serve as an effective isolation point for maintenance and operation purposes.

Preferred Alternative:	SAB1 Canal Program and SAB1 CIP1 Rehabilitation of the Closure Structure without Canal Dewatering	For Project Level A, B or C
Description of Preferred Alternative		

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Business Case Summary

The preferred alternative for SAB1 CIP1 is to rehabilitate the SAB1 closure structure without canal dewatering. Once completed, it will extend the design life of the closure structure for an estimated 50 years. It will also include provision of sixteen (16) sectional gates for the closure structure, that can also be utilized with the SAB2 tunnel outlets. It will also include studies to support selecting the preferred alternative for the SAB1 CIP2 project.

Pros:
- Supports addressing the MTO risk related to potential need for an outage to support Hwy 420 culvert repairs, by initiating the canal isolation projects that are required.
- Closure structure rehabilitation will provide long term structural integrity, is anticipated to require less maintenance and support future canal dewatering efforts.
- Initiation of engagement with external stakeholders and Indigenous communities on the overall program will allow time to address concerns expected when dewatering the canal (in support of SAB1 CIP2 and SAB1 CRP), for example, concerns expected around changes to water flow direction in the Chippawa Creek.

Cons: Capital expenditure required.

Deliverables:

Previous Release: N/A

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 3 Approval			2027-05-31

Future Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Available for Service - Closure Structure			2029-03-30
Project Complete			2029-09-28

Alternative 2: **Base Case - No Project** For Project Level A, B or Value-Enhancing

Not recommended. This alternative does not allow for proactive efforts required to ensure the ability to be able to isolate/dewater the canal in support of MTO Hwy 420 culvert repairs. It also does not address the need to restore the canal's structural integrity for safe and reliable operation for at least the next 50 years. It also will not assist in reclaiming degraded flow capacity and associated monetary value, limit future degradation or provide maintenance flexibility with reduced stakeholder dependencies.

Pros:
- No capital expenditures required.

Cons:
- Does not address the MTO risk related to potential need for a potential outage to support Hwy 420 culvert repairs.
- Does not address identified business needs.
- As the conveyance system continues to age, it will continuously deteriorate and due to current lack of maintenance flexibility, Operations will be unable to effectively (i.e. isolate/dewater) address these expected ongoing/additional maintenance requirements.
- Degraded flow capacity will remain and become more degraded, continuing to impact the generation production at the Sir Adam Beck generating stations.

Alternative 3: **Delay Work** For Project Level A, B or Value-Enhancing

Not recommended. This alternative to delay the program and associated projects, does not allow for timely, proactive efforts required to ensure the ability to be able to isolate/dewater the canal in support of MTO Hwy 420 culvert repairs. Also, the conveyance system structures will continue to deteriorate.

Pros:
- Delay expenditures.
- Will eventually meet the identified business needs.

Cons:
- Does not address the MTO risk related to potential need for an outage to support Hwy 420 culvert repairs in a timely manner.
- Costs are expected to continue to increase over time due to inflation and ongoing deteriorating conditions.
- Continued delay in reclaiming degraded flow capacity and the associated power generation.

Alternative 4:	**SAB1 Canal Program and SAB1 CIP1: Rehabilitation of the Closure Structure at same time as SAB1 CIP2**	For Project Level A, B

Not recommended. This alternative is to complete the closure structure work at the same time as SAB1 CIP2, once the Niagara Region Water Treatment Plant intake is relocated. This alternative does not allow for OPG to initiate timely, proactive efforts to address the canal degradation and also ensure the ability to be able to isolate/dewater the canal in support of potential MTO Hwy 420 culvert repairs. It also will limit time to engage with various stakeholders, and Indigenous communities supporting the future dewatering/isolation work under SAB1 CIP2 and SAB1 CRP.

Pros:
- Delay expenditures.
- Will eventually meet the identified business needs.

Cons:
- Does not address the MTO risk related to potential need for an outage to support Hwy 420 culvert repairs, by initiating the canal isolation projects as soon as possible.
- Costs are expected to continue to increase over time due to inflation and ongoing deteriorating conditions.
- Does not provide extended time to initiate and carry out environmental studies and stakeholder, regulatory and Indigenous engagement activities to support future canal isolation/dewatering.

Business Case Summary

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Stakeholder/Reputational	MTO may require Power Canal outage before Canal isolation is ready	Mitigate 71323 - Program set up to initiate work on isolation preparedness as soon as possible 71324 - Complete Project 1 Canal Isolation Preparedness (Closure Structure) 71325 - Complete Project 2 Montrose Gate/Other Canal Isolation 12/31/2031	Medium
Stakeholder/Reputational	Permit delays related to Indigenous Engagement/Crown Duty to Consult	Mitigate 73987 - Carry out Indigenous Engagement Plan activities and Env. Strategy recommendations. 1/31/2027	Medium
Environmental	Species at Risk may require lengthy permitting window	Mitigate 70462 - Assess potential to use Hydroelectric Exemption or Health and Safety exemption for potential SAR identified in the area of Project 1 (2 or 3). 69403 - Assess and complete species inventories to identify where permits are required - Related to Project 1 Closure Structure 6/15/2026	Medium
Technical	Archeological features identified in areas that require project disturbance	Mitigate 69404 - Conduct Archeological survey. 12/31/2025	Medium
Procurement - Materials	Project may trigger need for long lead items, e.g. closure structure logs/storage building	Mitigate 72496 - Team to confirm timelines and review and implement vendor strategies 9/30/2025	Medium

Additional Risk Analysis	For Project Level A or B
Definition phase risks were used in a Monte Carlo analysis to provide a quantitative risk assessment to support cost contingencies for this Phase.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					
Analysis of Financial Evaluation – Key Assumptions and Key Results:					
A financial evaluation is not required for a Sustaining projects.					

Qualitative Factors	For Project Level A or B

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Business Case Summary

The preferred alternative aligns with OPG's core business as follows:

Operational Excellence: Rehabilitation of the SAB1 water conveyance system will provide long term structural integrity and minimize future maintenance costs. It will also help continue to produce low-cost, clean hydroelectric power for Ontario by reclaiming degraded flow capacity and associated power generation.

Project Excellence: The SAB1 canal program and associated projects will undergo a rigorous environmental review and engagement exercises to address opportunities for environmental mitigations, where identified.

The strategic direction of OPG is to Electrify life in one Generation. The four associated Strategic Imperatives are further defined, and the preferred alternative aligns with them as follows:

People Powering the Future: The program will support economic development in local communities and also provides opportunities for Indigenous and ED&I businesses, in support of OPG's Reconciliation Action Plan and ED&I Strategy.

Value through Operational Innovation & Efficiency: The program will explore and identify any innovations and efficiencies through early value engineering to optimize design.

Putting Customers & Communities First: Maintaining the water conveyance isolation structures in good operating condition provides for the ability to provide for MTO Hwy repairs in a timely fashion. Program management protocols have been developed to support timely and effective engagement with local stakeholders, Indigenous communities and regulators to ensure program planning addresses concerns raised and meet all regulatory requirements.

Energy Industry leader: Degraded flow capacity of the current canal will be reclaimed. Investment in hydroelectric facilities such as the SAB1 water conveyance system demonstrates OPG's leadership and commitment to clean, renewable power and is in-line with OPG's Climate Change Plan.

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2030-12-31

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
To be developed as part of Gate 3				

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	89252 - SAB1 CANAL ISOLATION PREPAREDNESS PHASE1						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management		57	200	15					272	2
1 - Project Management	172	1,793	2,324	581					4,870	43
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	2,808	2,826	4,586	1,075					11,295	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.90	Interest Rate (going-forward)	4.50

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Melissa Hernandez-Chiang Senior Manager Projects SAB 1 Canal Program	2025-07-07	Lonny Tulk Project Director Strategic Projects	2025-07-07

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Business Case Summary

Project #	89354	**BCS Document Number**	NA6-BCS-08707-1384351
Project Title	89354 - OTO-REFURBISH STOP LOG SLUICE PIERS		
Facility	OTO - OTTO HOLDEN	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G2 - Definition - a (Partial)	**Target Project Completion Date**	2037-Apr-30
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 4

Recommendation

We recommend the release of $1,390k, including [redacted] of contingency. The estimated total project cost range is between $69M and $115M.
The project scope is to rehabilitate the upstream concrete pier nosings, stoplog gains and downstream pier surfaces in areas of deterioration to ensure continued structural integrity of the stoplog structure and supports and continued reliable operation at the Otto Holden Generating Station. The work under the project is extending the useful life of the existing asset beyond its original service life.

In the previous release of this work, a total of $720k was approved under non-standard project OTO82327. The current release is now requested under new capital project OTO89354.
This capital project replaces non-standard project OTO82327. During the planning phase for project OTO82327, it was determined that the scope was more extensive than preliminary assessments indicated. As such, project OTO82327 will be closed, and all 2024 expenditures journalled to this new capital project OTO89354.

This release will fund the following scope:
- OPG Project Management and Engineering Oversight,
- Detailed Engineering and preparation of a Construction Technical/Performance Specification (including permit applications),
- RFP Process to retain the construction contractor (for constructability review and official Quebec perimetry application),
- A Release Quality Estimate for Gate G2b (full) Phase Work,
- Preparation of the Gate G2b (full) BCS and Phase Gate Package

Investment Cash Flows

Project Number	89354 - OTO-REFURBISH STOP LOG SLUICE PIERS					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**Future**	**Total**
Previous releases	0								0
Currently Requested	0	748	642						1,390
Total released to date	0	748	642						1,390
Future required	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Total Project Cost	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ongoing Costs	0								0

Total OAR Approval	1,390.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		

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Business Case Summary

Recommended by: Direct Report of Line Approver : Amanda Griener Director Asset & Project Mgmt Production Support	Amanda Griener	2024-10-08
I concur with the business decision as documented in this BCS.		
Finance Approval : Martin Rupnik Finance Controller	Martin Rupnik	2024-10-09
I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Scott Gagnon Director Plant Operations	Scott Gagnon	2024-10-10

EXECUTIVE SUMMARY – Project Overview

Otto Holden GS is an eight-unit hydroelectric generating station with 6 sluice gates and 42 stop log sluiceways located on the Ottawa River, eight kilometers upstream of Mattawa, Ontario. The station was put in service in 1952.

The Station has been experiencing deteriorating concrete caused by long-term freeze thaw and Alkali Aggregate Reaction (AAR). Continued concrete deterioration could result in future challenges with removing/installing stoplogs and affect the structural integrity of the stoplog structure. Therefore, the following work is required:
- Condition Assessment and Recommendation Report for the Log Sluice Piers and East Powerhouse Wall
- Civil rehabilitation of the pier upstream noses,
- Civil rehabilitation of the pier faces downstream of the existing stoplog gains, and
- Civil rehabilitation of the pier downstream structure

Under the previous release, the following major project deliverables and scope have been completed:
- Inspection (including video) of the Sluiceway,
- Inspection (including video) of the East Powerhouse Wall, and
- Submission of the drawings for 30% design.

The work remaining from the previous release, which are in progress and will be funded under the new capital project OTO89354 release are:
- Completion of the Detailed Design (including permit applications), and
- Request for Proposal (RFP) for the construction contractor.

This release will fund the remaining planning phase work from the non-standard project OTO82327 currently in progress (which will be closed and replaced by this project), additional preliminary investigations not previously completed in the initiation phase (see details below), and to support the execution phase of the project. This includes the following scope:
- Drone visual survey and rope access inspection
- Additional concrete coring and laboratory testing

Further preliminary investigations are required for the following reasons:
- During the 30% design review, it was determined that additional investigation was required to validate the concrete condition for the rehabilitation. To better identify and quantify critical repairs at different locations on the downstream side of the piers, a drone visual survey and rope access inspection will need to be performed.
- Additional coring samples are required to provide the necessary information on the depth and extent of the distressed concrete, which is required to understand and determine the appropriate repair approach. To confirm scope, additional coring and laboratory testing downstream of the stoplog guides under the sluiceway deck and downstream sloped pier top surfaces are needed. These activities are expected to extend the project planning phase durations and will require additional resources.

Operating Experience (OPEX) and Lessons Learned from the Abitibi Canyon Tailrace Pier Remediation and the SAB2 Rock Cliff Concrete Rehab projects have been applied to this project and are reflected in the estimated contingency amounts.

This project will be executed using the Design-Bid-Build project delivery model. A G2b Definition release (full) shall follow upon completion of the current G2a - Definition work.

The next release (Gate G2b full - Definition BCS) includes the following scope:
- On-boarding of the construction contractor to perform a constructability and official perimetry review for submission with the Quebec Authorities. Considering the level of precision required to describe the technical aspects of the works to be carried out and the mitigation measures, the construction contractor must be involved in order to minimize the potential for rework and additional costs to the project.
- Submission of the Technical Specification and perimetry into the Quebec Portal for environmental approval, and
- Preparation of the Gate G3 full Execution Release.

Key risks include:
- External engineering requires more time to provide the design and required documentation (Risk Ranking: Medium; Response Type: Mitigate; Mitigating Strategy: Contingency included in the schedule to avoid delays in the execution timeline)
- Additional core samples may be required after the drone survey and rope access inspections are completed (Risk Ranking: Medium; Response Type: Mitigate; Mitigating Strategy: A petrographer will be present in the field during the entire coring process to determine the adequacy of the extracted cores and if additional coring is required. Contingency is included in the estimate to account for concrete unknowns.
- Hydro Quebec may ask for additional information to support their permit review and approvals (Risk Ranking: Medium; Response Type: Mitigate; Mitigating Strategy: Onboarding the Construction Contractor to do a constructability review and participate in the final Technical Specification/work sequencing to support the permit application process. 18-month approval timeline included in the schedule for review.

Business Need For Project Level A or B

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Business Case Summary

Otto Holden has 6 sluice gates and 42 stop log sluices. A deck replacement project was completed in 2006. The deck was replaced with precast slabs along with the concrete 1.8m below the stoplog sluice deck. Otto Holden has been known to have Alkali Aggregate Reaction (AAR), which causes upward and outward expansion of the powerhouse substructure concrete. The portion 1.8m below the stoplog sluice deck was not repaired and has severely deteriorated as a result of AAR and freeze-thaw cycling. Continued concrete deterioration could result in future challenges with removing/installing stoplogs and affect the structural integrity of the stoplog structure.

The business need is to maintain the ability to use the stop log sluice nose piers for mobile craning operations, reliable operations of stop log sluices and will be achieved by the rehabilitation of the upstream pier nosings, stoplog gains, downstream pier surfaces.

The following are impacts if we do not proceed with this project:
- Increased probability of complications during stop log operations (removals/installation) due to long term deterioration of concrete,
- Impact on safe mobile crane operations using the stop log sluice nose piers for outrigger support, and
- Increased cost of maintenance due to accelerated concrete deterioration.

Preferred Alternative:	Repair the Stop Log Sliceways	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is to restore the concrete to original state with additional protection of steel pier nosings. Executing the civil rehabilitation of the upstream pier noses, pier faces downstream of the existing stoplog gains and the pier downstream structure will restore the structural integrity of the stop log piers.

The condition of the stop log pier nosings will continue to deteriorate if the proposed solution is not executed. Further deterioration will eventually result in decreased loading capacity and unreliable operation of the stop logs. Failure to restore the structural integrity of the stop log piers could result in the inability to meet water flow control and dam safety requirements.

A Design-Bid-Build (DBB) project delivery strategy has been endorsed for the rehabilitation of the stop log sluices at Otto Holden GS.

This release includes engineering design services to perform inspections and prepare a condition assessment report on the current conditions and prepare IFC drawings/technical specifications (including permit applications). The additional investigations being conducted during this release (drone survey and additional coring/testing) will give the project the necessary information related to the concrete deteriorations/distresses to recommend the repair option for execution.

The next release (Gate G2b full Definition BCS) will fund the onboarding of the construction contractor to finalize the technical specification and official permit application to the Quebec Authorities.

The rehabilitation of the stop log sluice piers release strategy consists of the following gate releases and associated deliverables:
Gate G2b Definition BCS (full)
- Contract award of the construction contractor
- Finalization of the Technical Specification and Quebec perimetry
- Preparation of the Gate G3 - Execution BCS (full)

Gate G3 - Execution BCS (full)
- Civil rehabilitation of the pier upstream noses,
- Civil rehabilitation of the pier faces downstream of the existing stoplog gains, and
- Civil rehabilitation of the pier downstream structure.

Once the construction contractor is onboarded, the gate strategy will be confirmed based on field execution (i.e. partial execution gates).

Pros:
- Long term reliability
- Lower lifecycle costs
- Improved social license

Cons:
- Upfront expenditure

Deliverables:

Previous Release: N/A

Current Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Definition BCS (G2A)	Gate G2A Approval		2024-10-15
Submission of 100% Design Drawings	Detailed Design Complete		2025-04-15
Scope of Work Document Complete	Scope of Work Document Complete		2025-04-30
Request for Proposal - Construction Contract	Request for Proposals		2025-05-15
Gate G2B (full) Approval	Gate G2B Approval		2025-09-15
Future Release:			
Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Award Contract	Award Contracts / PO Issued		2025-11-30
Technical Specification Complete	Technical Specifications Complete		2026-04-15
Submit Permit Applications - Quebec Environmental Perimetry	Submittal Milestone		2026-05-15
Gate G3 (full) Approval	Gate G3 Approval		2027-11-30
Start of Installation	Start of Installation		2028-05-15
Finish of Installation	Finish of Installation		2036-09-30
Available for Service/REIS Completed	Available for Service and/or Ready For Service Completed		2036-09-30
Project Closure Report	Project Close Out Completed		2037-04-30

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

The base case involves the status quo. Higher probability of complications requiring the repair of stop log sluice gains and nose piers will increase over time. Major repairs due to accelerated deterioration to the log sluices is a long process that will require environmental permits (12 - 18 months) and can only be performed between June 16th - September 30th for in-water work. This alternative is not recommended.
Advantages:
- No immediate maintenance or repair costs to OPG

Disadvantages:
- Cost of repairs will be significant when performed on an as required basis compared to executing through a project
- Aesthetics of continued deterioration of stop log nose piers will decline public and employee perception of OPG
- Increased probability of complications during stop log operations (removals/installation)

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

Delaying the stop log sluice repairs will result in a similar outcome as Alternative 2. Higher probability of complications requiring the repair of stop log sluice gains and nose piers will increase over time. Major repairs due to accelerated deterioration to the log sluices is a long process that will require environmental permits (12 - 18 months) and can only be performed between June 16th - September 30th for in-water work. This alternative is not recommended.
Advantages:
- No immediate maintenance or repair costs to OPG

Disadvantages:
- Accelerated concrete deterioration will increase OM&A expenditure to execute at a later time
- Aesthetics of continued deterioration of stop log nose piers will decline public and employee perception of OPG
- Increased probability of complications during stop log operations (removals/installation

Alternative 4:		For Project Level A, B

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Business Case Summary

Key Risk Assessment			For Project Level A, B or C
Risk Class	**Description of Risk**	**Response Type / Actions / Final TCD**	**Residual Ranking**
Technical	Increased Costs due to Additional Scope or Discovery Work	Mitigate	Medium
Environmental	Environmental Permits Cause Schedule Delays	Mitigate	Medium
Technical	Results from Coring/Testing Program are Insufficient	Mitigate	Medium
Resources	Access for inspections are not readily available	Mitigate	Low

Additional Risk Analysis	For Project Level A or B
Additional risks will be assessed throughout the project life cycle to ensure alignment with Project Excellence Standards. Execution Phase risks will be identified in the risk assessment workshops during the Definition Phase.	

Financial Evaluation		For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing			
$K	**Alternative**	**Base Case (No Project)**	**Delay Work**	**Alternative 4**	**Alternative 5**
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Financial Evaluation not required for B Level Sustaining Projects without a feasible alternative.

Qualitative Factors	For Project Level A or B

Qualitative benefits provided by the Preferred Alternative are listed below:
- Restore integrity and long-term reliability of the stop log nose piers
- Experienced site project staff - Project Site Manager with concrete rehabilitation experience
- Environmental permit complexity likely to be higher if preferred alternative is not chosen

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2038-04-30

PIR KPI's	**Current Baseline**	**Target Result**	**How to Measure?**	**Who will measure?**
N/A				

Definitions and Acronyms	
AAR	Alkali-aggregate Reaction
MFFP	Ministère des Forêts, de la Faune et des Parcs

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	89354 - OTO-REFURBISH STOP LOG SLUICE PIERS						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2024	2025	2026	2027	2028	2029	Future	Total	%
0 - Cost Management										0
1 - Project Management		115	94						209	15
2 - Inspection										0
3 - Engineering	[redacted]									
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total		748	642						1,390	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	2.50	Interest Rate (going-forward)	4.00

Appendix A3: Summary of Estimate - In-Service Estimates

$K	Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.			
Project#	**Date**	**Description**	**Amount**	**%**
N/A				
		Total:		

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Melanie Bannon Project Leader Ottawa Project Management 2	2024-09-27	Amanda Griener Director Asset & Project Mgmt Production Support	2024-09-06

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Business Case Summary

Project #	89505	**BCS Document Number**	FA12-BCS-00120-1467792
Project Title	89505 - ABITIBI CANYON CONCRETE REHABILITATION ZONE 7		
Facility	CAN - ABITIBI CANYON	**Investment Classification**	Sustaining
Project Level (Scalability)	B	**Financial Classification**	17553 - CAPITAL - GENERATING FACILITIES
Release: Gate and Project Phase	G3 - Execution - (Full)	**Target Project Completion Date**	2026-Nov-30
Estimate Class (Current Request)	Class 3	**Estimate Class (Overall Project)**	Class 3

Recommendation

We recommend a release of $26.3 M, including [redacted] contingency. This will bring the total release-to-date and total project cost to $35.6 M, including [redacted] contingency.

The project is required to address existing safety concerns associated with falling concrete, and to extend the life of the concrete walls on the downstream face of the Abitibi Canyon Generating Station which are original to the initial commissioning of the station in 1933. This release is to carry out execution phase work, including construction, commissioning, and close-out.

This release will facilitate the completion of remaining concrete chipping and demolition, the injection of grout into leaks and cracks, the installation of dowels, and the re-pouring of the concrete surface.

Investment Cash Flows

Project Number	89505 - ABITIBI CANYON CONCRETE REHABILITATION ZONE 7					**FAC**	17553 - CAPITAL - GENERATING FACILITIES		
$K	**LT YE last year**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Future**	**Total**
Previous releases	7,482	1,816							9,298
Currently Requested	0	22,231	4,088						26,319
Total released to date	7,482	24,047	4,088						35,617
Future required	0								0
Total Project Cost	7,482	24,047	4,088						35,617
Ongoing Costs	0								0

Total OAR Approval	35,617.0

Approvals	Signatures	Date
The recommendation, including the identified ongoing costs, if any, represents the best option to meet the validated business need.		
Recommended by: Direct Report of Line Approver : Bruce Robertson VP Regional Operations VP Eastern Operations	Bruce Robertson	2025-04-25
I concur with the business decision as documented in this BCS.		
Finance Approval : Maha Tam VP Ops & Projects Controllership	Maha Tam	2025-04-25

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Business Case Summary

I confirm that this investment/project, including the identified ongoing costs, if any, will address the business need, is of sufficient priority to proceed, and provides value for money.		
Line Approval per OAR : OAR Element : 1.1 Nicholas Pender SVP Renewable Generation& Energy Markets	Nicholas Pender	2025-04-25

EXECUTIVE SUMMARY – Project Overview

Abitibi Canyon Generation Station (GS) is a key asset in Ontario Power Generation's (OPG) fleet of hydroelectric stations, providing 349 MW of emissions-free energy to the province. The station's concrete structures, originally commissioned in 1933, have deteriorated over time, with falling concrete becoming an increasing concern. Protective barriers have been installed in front of critical equipment and egress points to safeguard personnel from potential falling concrete. The structure undergoes annual inspections as part of the Engineering Risk Assessment Program (ERAP), which has classified the deteriorating concrete as a "very high risk".

The degradation, which includes surface scaling, spalling, cracking, staining, and delamination, has affected all exposed main gravity downstream faces, to a point where isolated repairs are no longer practical to maintain the long-term integrity of the structure. As a result, dislodged concrete debris poses risks to critical areas such as the canyon slopes, breaker deck, penstock roof, and the transformer/powerhouse roof. To mitigate these risks, OPG's risk treatment plan mandates quarterly inspections by Production Staff and annual inspections by Engineering Staff.

A recent engineering assessment has highlighted the urgent need for rehabilitation, particularly in Zone 7, where the rebar has been exposed. The current condition of this area can only be safely maintained for approximately one to two more years, before further deterioration is expected. Prioritizing the rehabilitation of Zone 7 will address the immediate risks associated with falling concrete, particularly in areas critical for staff access.

This project (COR89505) was initiated as a result of the as-found conditions discovered during execution of ABI87192: during the initial execution of ABI87912, chipping of the Zone 7 concrete identified that the condition of the concrete and subsurface conditions necessitated more extensive repairs. As a result of these as-found conditions, work in this zone was stopped to explore potential planning efficiencies in the remaining scope for Zone 7. The quoted contractor cost to complete Zone 7 under ABI87192 was approximately $17.1 million. By removing Zone 7 from the scope of ABI87192 and executing the remaining work under COR89505, OPG has realized a potential cost avoidance of $4.3 million, this is the result of a competitive RFP process for the completion of Zone 7. Further integration of value engineering strategies to optimize project costs may be considered during construction which include the use of a mobile batch plant—eliminating the need to transport concrete from Timmins, located 182 kilometers away, and usage of shotcrete.

Project risks for this release include:
Delays in Hydro One's Feeder Cable Replacement Project: Hydro One's Feeder Cable Replacement project is outside of the scope of this project, but may cause execution delays or be descoped due to competing priorities. To mitigate this risk, the project team has developed an alternate plan to complete the work above the cable. The unchipped area located beneath the cables may be transferred to COR89506 for execution as this area doesn't pose a significant risk as it is left unchipped.

Quality of concrete: The quality of concrete transported from Timmins to Abitibi Canyon may be compromised due to the 184 km travel distance (about 2 hours drive), potentially leading to rejected shipments and schedule delays. To mitigate this risk, additive will be added to the mix to account for the travel time and further review of a mobile batch plant will be considered during construction.

Crack Injection and Grouting Scope: The allocated budget for crack injection and grouting may not fully account for the potential extent of leakage within the dam. To address this concern, the project has secured volumetric unit pricing, allowing for payment based on actual usage rather than a blended average for installation. This approach aims to ensure financial transparency and accuracy in addressing the needs of the project.

Business Need

For Project Level A or B

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Business Case Summary

The business need for this project is to eliminate existing safety concerns associated with falling concrete, and to extend the life of the concrete on the downstream face of the Abitibi Canyon Generating Station which are original to the initial commissioning of the station in 1933.

Demolition activities in Zone 7 were initially undertaken under ABI87192 but were subsequently halted upon the discovery of extensive concrete deterioration. At that time, work was stopped to allow for a thorough assessment of the condition, identification of the most appropriate corrective measures, and incorporation of lessons learned.

Given the extent and severity of the degradation, the remaining scope of work was transferred to COR89505 to ensure effective remediation.

The need for this project is driven by the existing deterioration of the concrete. Independent of any prior activity, the condition of the concrete would have required remediation. While alternatives such as deferral were considered, they were ultimately deemed impractical due to the advanced stage of deterioration in Area 7 and the associated risks. Prolonged exposure of the concrete—beyond one to two years—would present significant operational and safety concerns.

Preferred Alternative:	Rehabilitate downstream face of the West Gravity Wall (Zone 7)	For Project Level A, B or C

Description of Preferred Alternative

The preferred alternative is to resurface the downstream face of the West Gravity Wall (Zone 7) to restore its structural integrity.

The scope of work will include:
- OPG Project Management, QA/QC, and Engineering Oversight
- Removal of deteriorated concrete and placement of new concrete along the West Gravity Wall (Zone 7)
- Installation of Guardrail along downstream side of roadway along Zone 7.
- Installation of canopy and emergency shelter.

Deliverables:

Previous Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 2 Approval	Gate G2 Approval		2024-12-20
Issuance of RFP for EPC Vendor	Request for Proposals for EPC or Non LLM Contracts		2025-02-04

Current Release:

Deliverable Type	*Milestones*	*Associated Milestones (if any):*	*Target Date*
Gate 3 Approval	Gate G3 Approval		2025-04-25
Zone 7 Concrete Available for Service	Available for Service and/or Ready For Service Completed		2026-04-30
Project Closure	Project Close Out Completed		2026-11-30

Future Release: N/A

Alternative 2:	**Base Case - No Project**	For Project Level A, B or Value-Enhancing

Based on an assessment by OPG Engineering, it was determined that the chipped concrete, which has exposed rebar, can remain exposed for a period of 12 to 24 months without significant further deterioration. If the Project would not go ahead, safe restoration efforts shall be investigated and undertaken accordingly.

This alternative is not recommended.

Alternative 3:	**Delay Work**	For Project Level A, B or Value-Enhancing

As outlined in Alternative 2 above, if the Project were delayed, safe restoration efforts shall be investigated and undertaken accordingly.

This alternative is not recommended.

Alternative 4:	**Rehabilitate entire downstream face of Abitibi Canyon**	For Project Level A, B

The rehabilitation of the entire downstream face of Abitibi Canyon is listed in the work program catalogue from 2030 - 2032. However, due to the need for significant planning to accurately scope and develop the major project, this timeline would extend beyond the allotted 12 to 24 months for leaving Zone 7 concrete exposed, as recommended by OPG Engineering.

Key Risk Assessment — For Project Level A, B or C

Risk Class	Description of Risk	Response Type / Actions / Final TCD	Residual Ranking
Stakeholder/Reputational	The local First Nations may oppose the project and/or the selected contractor.	Mitigate 71651 - Project has engaged with Local FN and Contractor has committed spend and hiring requirements for project. 2/28/2026	High
Project Management	Unexpected Scope Expansion in project	Mitigate 72000 - Unexpected Scope Expansion in Project - Ensure Stakeholder agreement of scope and work in progress 1/30/2026	Medium
Procurement - Materials	Delayed Power Cable Delivery - LLM	Mitigate 72102 - Escalated with HONI for action and project developed alternative plans if the schedule can not be achieved. 7/31/2025	Medium
Technical	Underestimation of Required Grouting Injection	Mitigate 72315 - Unit rates are within the contract to ensure project is paying appropriate amount and not blended average. 9/30/2025	Medium

Additional Risk Analysis — For Project Level A or B

An Execution Phase Risk Register has been developed and includes a quantitative risk assessment (i.e. Monte Carlo analysis). Cost contingencies were established based on the results of the Monte Carlo simulation with a 90% confidence level.

Financial Evaluation — For Project Level A, B (with multiple feasible alternatives) or Value-Enhancing

$K	Alternative	Base Case (No Project)	Delay Work	Alternative 4	Alternative 5
N/A					

Analysis of Financial Evaluation – Key Assumptions and Key Results:

Post Implementation Review (PIR) Plan (refer to OPG-GUID-00120-0007)

Is PIR Required?	Yes	**PIR Completion Date**	2027-05-31

ONTARIO POWER GENERATION

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Business Case Summary

PIR KPI's	Current Baseline	Target Result	How to Measure?	Who will measure?
Cost Performance	35.6M	35.6M	Actuals for project which are tracked in Ecosys	Project Controls
Schedule Adherence	In-service = April 30th, 2026	In-service = April 30th, 2026	Report of Equipment In-service Date	Project Controls

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Business Case Summary

APPENDICES

Appendix A1: Summary of Estimate

Project Number	89505 - ABITIBI CANYON CONCRETE REHABILITATION ZONE 7						FAC	17553 - CAPITAL - GENERATING FACILITIES		
$K	LT YE last year	2025	2026	2027	2028	2029	2030	Future	Total	%
0 - Cost Management		2,710	1,212						3,922	11
1 - Project Management	3	1,192	628						1,823	5
2 - Inspection	[redacted]									
3 - Engineering										
4 - Procurement										
5 - Construction										
6 - Commissioning										
Closeout										
Subtotal										
Outside WBS										
Contingency										
Subtotal w/ Contingency										
Interest										
Other										
Total	7,482	24,047	4,088						35,617	100
Removal Costs (incl. above)										0

Appendix A2: Summary of Estimate – Notes

Escalation Rate	0.00	Interest Rate (going-forward)	4.10

Appendix A3: Summary of Estimate - In-Service Estimates

$K — Only applicable to capital projects. In-Service amount shall include interest but exclude removal costs.

Project#	Date	Description	Amount	%
89505	2024-12-11	1M Area 7	1,433	5.0
89505	2026-04-30	Zone 7 Concrete & Misc. Metals	29,745	95.0
89505	2026-11-30	Project Closeout	100	1.0
		Total:	**31,278**	**100**

Prepared by		Reviewed and Endorsed by (Execution Authority)	
Zach Brandt Senior Manager Projects North East Projects	2025-04-24	Paul Burroughs VP Major Projects RG Major Projects	2025-04-25

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Business Case Summary

Numbers may not add due to rounding.

Table 1
Capital Project Listing - Regulated Hydroelectric and Hydro Common
Projects ≥ $30M Total Project Cost (Allocated)[1]

Line No.	Region	Facility	Project Name	Project Number	Category	CRVA Eligible[8]	Start Date	Final In-Service Date[4]	Total Project Cost[2] ($M)	1st Execution Business Case[3] ($M)	Total In-Service ($M)	In-Service LTD[5] ($M)	In-Service IR Term ($M)	In-Service 2025 ($M)	In-Service 2026 ($M)	In-Service 2027 ($M)	In-Service 2028 ($M)	In-Service 2029 ($M)	In-Service 2030 ($M)	In-Service 2031 ($M)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)
1	Eastern	Calabogie	Calabogie GS - Redevelopment	82089	Value Enhancing (Redevelopment)	Yes	Jan-17	Oct-23	167.2	136.5	165.6	165.7	0.0	(0.1)	0.0	0.0	0.0	0.0	0.0	0.0
2	Niagara	DeCew Falls 2	G2 Overhaul & Upgrade	80851	Sustaining (Refurbishment)	Yes	Feb-15	Jul-19	35.5	38.1	34.9	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Niagara	Sir Adam Beck 1	BK1 G1/G2 Replacement	84185	Value Enhancing (Expansion)	Yes	Feb-19	Oct-22	122.8	115.8	112.9	112.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Niagara	Sir Adam Beck 1	SAB1 Canal Isolation Preparedness Phase 1 (SAB1 CIP1)	89252	Sustaining (Canal Rehabilitation)	Yes*	Jul-25	Dec-29	65.0	n/a	65.0	0.0	65.0	0.0	0.0	0.0	0.0	65.0	0.0	0.0
5	Niagara	Sir Adam Beck Pump Generating	Sir Adam Beck Pump GS - Reservoir Refurbishment	80583	Sustaining	Yes	Sep-11	Apr-17	48.7	58.2	48.7	48.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Niagara	Sir Adam Beck 1	Sir Adam Beck I GS - G10 Major Overhaul & Upgrade	80649	Sustaining (Refurbishment)	Yes	Oct-13	Jun-17	30.8	27.0	30.2	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Western	Ranney Falls	Ranney Falls Expansion Project	80581	Value Enhancing (Expansion)	Yes	Sep-11	Jun-22	74.5	77.3	74.5	74.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Niagara	Sir Adam Beck 1	Sir Adam Beck 1 GS - Unit G5 Upgrade	82777	Sustaining (Refurbishment)	Yes	May-18	Sep-21	44.7	19.8	43.4	43.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	Eastern	Abitibi Canyon	Abitibi - G2 Capital Upgrades/HG	83155	Sustaining (Refurbishment)	Yes*	Feb-19	Mar-22	30.1	27.5	29.5	29.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
10	Eastern	Otter Rapids	Otter Project Camp	84907	Sustaining	No	Jun-20	Jul-24	39.5	39.5	39.0	38.6	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
11	Eastern	Frederick House[6]	Frederick House Lake Dam Upgrades	83194	Sustaining	Yes*	Oct-21	Dec-25	90.0	90.0	79.9	35.3	0.0	37.4	7.2	0.0	0.0	0.0	0.0	0.0
12	Eastern	R.H. Saunders	SAU - G9 Capital Refurbishment	83495	Sustaining (Refurbishment)	Yes*	Dec-20	Aug-25	42.7	17.2	38.4	0.0	0.0	37.0	1.4	0.0	0.0	0.0	0.0	0.0
13	Eastern	Chenaux	CHE - Limerick Isl. Spr Structure Sluice Gate Hoist	84494	Regulatory	Yes	May-19	Nov-23	32.7	32.7	28.8	28.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	Eastern	Otter Rapids	Otter G2 Capital Upgrade	82543	Sustaining (Refurbishment)	Yes*	Aug-20	Dec-25	78.1	43.1	70.1	7.8	0.0	61.9	0.4	0.0	0.0	0.0	0.0	0.0
15	Eastern	Coniston/Stinson	Coniston/Stinson GS Redevelopment	82087	Value Enhancing (Redevelopment)	Yes*	Mar-19	Apr-27	178.0	178.0	176.4	0.0	45.9	0.0	130.5	45.9	0.0	0.0	0.0	0.0
16	Western	Kakabeka Falls	Kakabeka Falls GS Redevelopment	86386	Value Enhancing (Redevelopment)	Yes*	Mar-21	May-28	519.0	519.0	511.0	0.0	487.1	12.7	11.2	300.6	171.9	14.6	0.0	0.0
17	Niagara	Sir Adam Beck 2	BK2 G20/G19 Refurbishment	87768	Sustaining (Refurbishment)	Yes*	Oct-19	Feb-29	377.5	n/a	353.0	0.0	353.0	0.0	0.0	0.0	176.5	176.5	0.0	0.0
18	Eastern	Matabitchuan	Matabitchuan GS Redevelopment	86387	Value Enhancing (Redevelopment)	Yes*	Nov-22	Aug-28	190.0	190.0	187.6	0.0	183.4	4.2	0.0	3.1	180.0	0.3	0.0	0.0
19	Eastern	R.H. Saunders	SAU - G12 Capital Refurbishment	86587	Sustaining (Refurbishment)	Yes*	Jun-22	Jun-26	30.4	30.4	26.9	0.0	0.0	0.0	26.9	0.0	0.0	0.0	0.0	0.0
20	Eastern	Otter Rapids	Otter G1 Capital Upgrade	82542	Sustaining (Refurbishment)	Yes*	Feb-19	Dec-26	40.7	40.7	35.8	0.0	1.8	0.0	34.0	1.8	0.0	0.0	0.0	0.0
21	Eastern	Abitibi Canyon	ABI - G1 Capital Upgrades	83148	Sustaining (Refurbishment)	Yes*	Mar-25	Jan-31	54.7	n/a	46.8	0.0	46.8	0.0	0.0	0.0	0.0	0.0	0.0	46.8
22	Eastern	R.H. Saunders	SAU - Long Sault Dam Capital Program (JW)(NYPA)	86595	Regulatory	No	Mar-23	Dec-33	88.0	n/a	74.8	0.0	45.3	0.0	0.0	0.0	0.0	25.0	9.0	11.3
23	Eastern	R.H. Saunders	SAU - Massena Canal Dam (JW)(NYPA)(CAP)	87142	Regulatory	No	May-15	Dec-29	47.3	n/a	39.1	0.0	39.1	0.0	0.0	0.0	0.0	39.1	0.0	0.0
24	Eastern	Abitibi Canyon	Abitibi Canyon Concrete Repair Zone 7	89505	Sustaining (Abitibi Concrete)	Yes*	Dec-24	Apr-26	35.6	35.6	26.4	1.4	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0
25	Eastern	Otto Holden	OTO - Refurbish Stop Log Sluice Piers	89354	Sustaining	No	Oct-24	Sep-36	108.0	n/a	91.8	0.0	51.3	0.0	0.0	0.0	9.4	13.8	14.0	14.1
26	Western	Alexander	G1 Capital Refurb	82391	Sustaining (Refurbishment)	Yes*	Apr-23	Sep-30	45.9	n/a	42.0	0.0	42.0	0.0	0.0	0.0	0.0	0.0	41.0	1.0
27	Western	Silver Falls	Surge Tank Replacement	83833	Sustaining	Yes*	Mar-21	Dec-28	40.7	n/a	38.8	0.0	38.8	0.0	0.0	0.0	38.8	0.0	0.0	0.0
28	Western	Northwest Operations[7]	NWO Work Centre Building	84901	Sustaining	No	Feb-20	Aug-27	44.4	n/a	39.9	0.0	39.9	0.0	0.0	39.9	0.0	0.0	0.0	0.0
29	Western	Alexander	G2 Capital Refurb	86792	Sustaining (Refurbishment)	Yes*	Apr-23	Aug-27	49.7	n/a	43.5	0.0	43.5	0.0	0.0	0.0	0.0	42.5	0.0	1.0
30	Western	Alexander	G3 Capital Refurb	86793	Sustaining (Refurbishment)	Yes*	Jun-23	Dec-31	43.6	n/a	41.5	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0
31	Western	Manitou Falls	MAN G3 Capital Refurb	86860	Sustaining (Refurbishment)	Yes*	Dec-24	May-29	53.2	n/a	48.0	0.0	48.0	0.0	0.0	0.0	0.0	47.0	0.0	1.0
32	Western	Aguasabon	Aguasabon Dam Rehab. Hayes Lake Main Dam	87217	Sustaining	Yes*	Aug-23	Dec-33	116.5	n/a	110.00	0.0	70.0	0.0	0.0	0.0	0.0	10.0	30.0	30.0
33	Niagara	Sir Adam Beck 1	SAB1 Station Service Upgrade	86364	Sustaining	No	Dec-20	Jan-30	33.4	n/a	31.8	0.0	31.8	0.0	0.0	0.0	0.0	15.9	15.9	0.0
34	Niagara	Sir Adam Beck 1	BK1 G6 G8 Refurbishment	86372	Sustaining (Refurbishment)	Yes*	May-24	Apr-30	232.3	n/a	226.2	0.0	226.2	0.0	0.0	0.0	113.1	0.0	113.1	0.0
35	Niagara	Sir Adam Beck 1	BK1 G4 Refurbishment	86570	Sustaining (Refurbishment)	Yes*	May-22	Jun-27	109.1	109.1	96.7	0.0	96.7	0.0	0.0	96.5	0.2	0.0	0.0	0.0
36	Niagara	Sir Adam Beck 2	BK2 G18 G17 Refurbishment	87356	Sustaining (Refurbishment)	Yes*	May-25	Nov-30	361.1	n/a	344.2	0.0	344.2	0.0	0.0	0.0	0.0	0.0	344.2	0.0
37	Niagara	Sir Adam Beck 2	BK2 G14 G13 Refurbishment	87357	Sustaining (Refurbishment)	Yes*	May-25	Jul-32	375.6	n/a	360.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	Eastern	R.H. Saunders	SAU - G16 Capital Refurbishment	86937	Sustaining (Refurbishment)	Yes*	Nov-24	Feb-28	49.3	n/a	38.7	0.0	38.7	0.0	0.0	0.0	38.6	0.1	0.0	0.0
39	Niagara	Sir Adam Beck 2	BK2 230kV Conductor Replacement	87362	Sustaining	No	Mar-25	Aug-39	35.9	n/a	29.8	0.0	9.6	0.0	0.0	3.2	0.0	3.2	0.0	3.2
40	Eastern	R.H. Saunders	SAU - Long Sault Dam Downstream Concrete (JW) (NYPA)	87575	Regulatory	No	Jun-24	Dec-38	38.4	n/a	32.6	0.0	20.2	0.0	0.0	0.0	0.0	9.6	4.9	5.7
			Total Regulated Hydroelectric						4,200.4				2,408.3	153.7	236.6	491.0	728.5	462.6	572.1	154.1
			Hydro Common																	
41	Common	Timmins Work Centre	Timmins Building Expansion	87197	Sustaining	No	Sep-24	Dec-28	35.1	n/a	30.9	0.0	30.9	0.0	0.0	0.0	0.0	30.9	0.0	0.0
42	Common	Dymond Machine Shop	Dymond Machine Shop Expansion	87329	Sustaining	No	Oct-23	Dec-27	44.3	n/a	40.4	0.0	40.4	0.0	0.0	0.0	40.4	0.0	0.0	0.0
			Total Hydro Common						79.4				71.2	0.0	0.0	0.0	40.4	30.9	0.0	0.0

Notes:
1 Projects with expenditures during forecast period OR In-Service Amounts in the historical, bridge, or forecast period AND Completed/Deferred Projects in the historical period (2016-2024) at the time of preparing the 2025-2031 Business Plan.
2 Total Project Cost reflects BCS amounts at the time of preparing the 2025-2031 Business Plan, with the exception of Completed/Deferred/Cancelled Projects (for which actual costs are shown). BCS amounts include minor removal costs and reflect point estimates or, if range estimate or no estimate is provided in lieu of a point estimate, the current estimate of total project cost.
3 The designation of "n/a" means the project has not advanced to a First Execution BCS.
4 Final In-Service Date means either the current forecast of the final date for in-service and close-out of project, or the historical final project in-service date (but not the final project close out date which may not have yet occurred).
5 Life Time to Date (LTD) means in service amounts as of Dec 31, 2024.
6 Frederick House Lake Dam supports Abitibi Canyon and Otter Rapids generating stations.
7 Supports regulated generating stations in Thunder Bay and Kenora (refer to Ex. A1-4-2, Att. 1).
8 Col.(f): "Yes" indicates identified CRVA-eligible projects with in-service amounts in the 2016-2024 period that do not also have in-service amounts in the 2025-2031 period, and therefore do not form part of the proposed 2027-2031 capital-related revenue requirement for the CRVA.
"Yes*" indicates identified CRVA-eligible projects with expected in-service amounts in the 2025-2031 period and forming part of the proposed 2027-2031 capital-related revenue requirement for the CRVA (Ex. H1-1-1, Att. 5). Additionally, this includes a preliminary assessment of CRVA eligibility, amongst unallocated projects, without expected in-service amounts in the 2025-2031 period.

Numbers may not add due to rounding.

Table 2a
Capital Project Listing - Regulated Hydroelectric and Hydro Common
Projects $10M - $30M Total Project Cost (Allocated)[1]

Line No.	Region	Facility	Project Name	Project Number	Category	Project Description	CRVA Eligible[4]	Start Date	Final In-Service Date[3]	Total Project Cost[2] ($M)	In-Service IR Term ($M)	In-Service 2025 ($M)	In-Service 2026 ($M)	In-Service 2027 ($M)	In-Service 2028 ($M)	In-Service 2029 ($M)	In-Service 2030 ($M)	In-Service 2031 ($M)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
1	Eastern	Matabitchuan	Replace Penstocks & Saddles	80703	Sustaining	Design and installation of new steel penstock and associated foundation saddles in place of 2 existing steel riveted penstocks.	No	Dec-09	Jan-13	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Eastern	Otto Holden	Otto Holden GS - Replace Sluicegates & Rehabilitate Sluicegates System	80717	Sustaining	Replacement of 6 sluicegates and rehabilitation of sluicegate system to comply with dam safety requirements and address operational and reliability needs.	Yes	May-06	Nov-15	22.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Niagara	Sir Adam Beck 2	Sir Adam Beck II GS - Station Service Upgrades	80666	Sustaining	Purchase and installation of 2 new 600V switchgear lineups and 10 new 600V motor control centres. Includes removal of old equipment and cabling.	No	Mar-11	Apr-19	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Eastern	R.H. Saunders	R.H. Saunders GS - Replace Station Service Breakers	80637	Sustaining	Station Service replacement of main, tie and feeder breakers. 600V lockable visi-break distribution panels to replace existing.	No	Feb-12	Dec-18	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	Eastern	R.H. Saunders	R.H Saunders GS - Replace Powerhouse Crane	80635	Sustaining	Replace original 300 ton station gantry crane, at end of life.	No	Aug-08	Jun-15	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	Eastern	Lower Notch	Lower Notch GS - Unit G2 Capital Upgrades	80694	Sustaining (Refurbishment)	Major unit refurbishment of all mechanical and electrical components, excluding replacement of the stator core.	No	Sep-12	Jun-18	15.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	Eastern	Lower Notch	Lower Notch GS - G1 Capital Upgrade	80692	Sustaining (Refurbishment)	Major unit refurbishment of all mechanical and electrical components, excluding replacement of the stator core.	No	Nov-11	Sep-16	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	Eastern	Des Joachims	Des Joachims GS - Rewind Generators G1, G3, G5	80604	Sustaining (Refurbishment)	Stator rewind of G1, G3 and G5 units along with runner upgrade. Stator windings nearing 40 years old and risk of failure is increasing.	No	Sep-10	May-15	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	Eastern	Chenaux	Chenaux GS - Replace Protections and Controls	80596	Sustaining	Replacement of DC distribution equipment including switchgear, distribution panels, battery chargers, batteries and inverters. Existing equipment is at end of life.	No	Aug-08	Nov-19	14.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Western	Caribou Falls	Caribou Block Dam #2 Rehab	83029	Regulatory	Repair and remediate the slumped Caribou Block Dam #2 by constructing a new wall downstream of existing dam and stabilizing the existing dam structure.	No	Mar-16	Oct-19	24.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Western	Manitou Falls	Sluicegate Replacement	82940	Sustaining	Replacement of existing sluicegate system as it is no longer suitable for current operational requirements. Conversion of adjacent log sluice to an auto sluice.	Yes*	Apr-18	Sep-21	25.4	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
12	Western	Silver Falls	SLV G1 Rewind and New Core	82385	Sustaining (Refurbishment)	Replace various G1 components including generator stator winding, rotor/field winding and stator core.	Yes	Jan-18	Dec-22	21.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Western	Aguasabon	Surge Tank Replacement	83610	Sustaining	Replacement of surge tank, which is in poor condition with moderate loss of wall thickness due to corrosion.	Yes	Jan-18	Aug-23	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	Western	Whitedog Falls	WHD Sluicegate Replacement	83031	Sustaining	Replacement of existing auto sluice gates #8 and #9, which are at end of life. Conversion of pinned gate #7 to an auto sluice gate.	Yes	Feb-17	Dec-21	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	Eastern	Des Joachims	DEJ - Controls - Repl. Generator Controls	83353	Sustaining	Replacement and upgrade of protections and controls to address deficiencies noted with current systems and adhere to current standards and specifications.	No	Nov-16	Jun-22	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Eastern	Otto Holden	OTO - Capital Project Scope G7 1st Unit	84385	Sustaining (Refurbishment)	Refubishment of station unit, including turbine stay ring realignment, field pole refurbishment and auxiliary system upgrades.	Yes	Sep-19	Sep-22	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	Eastern	Otter Rapids	OTR -T2/T1 Transformer Replacement	82255	Sustaining	Replacement of T1 and T2 transformers with uprated transformers to allow for increase in capacity of planned runner upgrades. Procurement of additional spare transformer.	Yes	Mar-17	Aug-20	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	Western	Pine Portage	PIN Sluicegate Replacement	82802	Sustaining	Replacement of existing auto sluice gates, hoist, structure and gains; these assets were at end of life. Project expanded to include replacement of deteriorated dam deck surface.	Yes	Mar-16	Oct-21	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	Western	Whitedog Falls	WHD Sluicegate Repl. - Dogged #1-#4- #5-#6	84446	Sustaining	Replacement of sluice gates #1, #4, #5 ad #6, including secondary concrete, embedded parts and associated electrical components, all at end of life.	Yes	Aug-19	Oct-21	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	Western	Caribou Falls	Sluicegate Replacement	82799	Sustaining	Replacement of existing auto sluice gates #8 and #9, which are at end of life. Conversion of pinned gate #7 to an auto sluice gate.	Yes*	Apr-18	Oct-23	17.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
21	Eastern	R.H. Saunders	SAU - Headwork Crane Replacement	83111	Sustaining	Replacement of headworks gantry crane. Design and installation of new crane consisting of 100-ton hoist, 15-ton auxiliary hoist and 10-ton debris-removal hoist.	No	Apr-16	Dec-22	10.9	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
22	Eastern	Des Joachims	Replace Generator Breakers and Station Service Brks.	80602	Sustaining	Replacement of existing switchgears at all 8 units, which are approaching end of life, with arc-resistant switchgear. Includes bus work, generator and station service breakers.	No	Nov-11	Dec-20	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	Eastern	Barrett Chute	Rewind Generators & Reinsulate Field Poles (G1-4) First Unit (G3)	80980	Sustaining (Refurbishment)	Refubishment of station unit G3, including stator rewind, field pole refurbishment and replacement of stator core, frame and key bars.	Yes	May-16	Nov-23	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	Eastern	Barrett Chute	Capital Refurb Rewind Generators & Reinsulate Field Poles (G1-4) Second Unit (G4)	84587	Sustaining (Refurbishment)	Refubishment of station unit G4, including stator rewind, field pole refurbishment and replacement of stator core, frame and key bars.	Yes	Jul-19	Nov-23	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	Eastern	Barrett Chute	Capital Refurb Rewind Generators & Reinsulate Field Poles (G1)	86082	Sustaining (Refurbishment)	Refubishment of station unit G1 including generator rewind and field pole reinsulation. Field poles are original to station and are at end of life.	Yes*	May-22	May-24	11.5	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
26	Eastern	Otter Rapids	Otter Runner Purchase	80684	Value Enhancing (Refurbishment)	Replacement of 8 (of 10) sluice gates, which are advanced in age and deterioration. New sluice gates have a design life of 50+ years and allow for improved operational reliability.	Yes*	Apr-10	Nov-29	17.9	13.2	4.4	0.0	4.4	4.4	4.4	0.0	0.0
27	Eastern	Otter Rapids	Otter Sluice Gate Upgrades	82246	Sustaining	Replacement of eight deteriorated sluice gates at station to allowfor improved operational reliability.	Yes*	Mar-19	Dec-24	23.9	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
28	Eastern	Abitibi Canyon	Abitibi - Transformer Deck Roof Replacement	82257	Sustaining	Replacement of degraded roof system and transformer foundations. Remedial work to ensure adequate structural integrity.	No	Feb-19	Dec-24	26.7	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
29	Eastern	Stewartville	Replace AC Station Service Transformers, Switchgear and Distribution Panels	83763	Sustaining	Replacement of AC station switchgear, transformers, panels, breakers and controls. Current AC station service equipment is original to station and is obsolete.	No	Jun-18	Dec-23	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	Eastern	Elliott Chute	Elliott - Service Gate and Gains Upgrade	84534	Sustaining	Replacement of deteriorated service gate, gains, sill beam and lifting device. Widening existing powerhouse approach access ramp.	No	Feb-21	Nov-24	13.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
31	Eastern	R.H. Saunders	Replacement of Excitation System All 16 Units	82986	Sustaining	Replacement of outdated excitation systems in all 16 units. Systems built with now-obsolete technology, diminishing ability for maintenance.	Yes*	Jul-16	Dec-26	17.2	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
32	Eastern	R.H. Saunders	Install Concrete Plug in Ice Sluice Drum Gate Openings	84202	Sustaining	Decommissioning of existing ice sluice gates. Installation of concrete plug and rehabilitation of ice sluice structure to restore loading capacity on the headworks deck.	No	Mar-17	Dec-26	22.6	0.0	0.8	3.6	0.0	0.0	0.0	0.0	0.0
33	Niagara	DeCew Falls 2	G1 Runner Shaft Replacement	84558	Sustaining (Refurbishment)	Replacement of unit G1 existing runner and shaft; repairing of draft tube and installation of new bottom ring. Project to reduce runner and shaft tube cavitation damage.	Yes	Aug-20	Nov-24	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	Niagara	Sir Adam Beck 1	BK1 Tailrace Deck	86053	Sustaining	Replacement of existing tailrace deck, which has deteriorated and is not in alignment with current regulations and standards.	No	Nov-20	May-25	18.9	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
35	Niagara	Sir Adam Beck 2	SAB2 Headgate Repl.	86376	Sustaining	Replacement of 31 (of 32) station headgates, which are advanced in age and have suffered from reduced operational performance.	No	Mar-21	Sep-24	23.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	Niagara	Sir Adam Beck 2	SAB2 Rock Cliff Conc. Rehab	86491	Sustaining	Substantial rehabilitation of SAB2 rock cliff to prevent rock and concrete debris from falling to lower levels.	No	Jul-21	Dec-24	22.8	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0
37	Niagara	Sir Adam Beck 2	Battery Banks and DC System Upgrade	80812	Sustaining	Replacement of 250 Vdc system battery banks, battery room upgrades and installation of new switchgears, panels and inverters.	No	Jul-18	Feb-24	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	Western	Alexander	Stn. Switchgear, Protections & Ctrls. Repl.	82378	Sustaining	Replace station switchgear, plant/unit controls and unit/transformer protections to ensure reliability of switchgear and bus system.	No	Nov-18	Dec-23	27.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
39	Western	Cameron Falls	T1 & T2 Replacement	82390	Sustaining	Replacement of T1 and T2 transformers, high-voltage insulators and bus work, high-voltage disconnects; repair of oil containment systems.	No	Feb-20	Feb-25	25.1	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
40	Niagara	Sir Adam Beck 2	BK2 Penstock Concrete Restoration	87951	Sustaining	Rehabilitation of penstock concrete at Sir Adam Beck 2. Reduces safety risk to assets and personnel by preventing concrete debris from falling to lower levels.	No	Jun-24	Aug-26	24.7	0.0	15.6	9.0	0.0	0.0	0.0	0.0	0.0
	Table continues on Ex. D1-1-2, Table 2b																	

Notes:

1 Projects with expenditures during forecast period OR In-Service Amounts in the historical, bridge, or forecast period AND Completed/Deferred Projects in the historical period (2016-2024) at the time of preparing the 2025-2031 Business Plan.
2 Total Project Cost reflects BCS amounts at the time of preparing the 2025-2031 Business Plan, with the exception of Completed/Deferred/Cancelled Projects (for which actual costs are shown). BCS amounts include minor removal costs and reflect point estimates or, if range estimate or no estimate is provided in lieu of a point estimate, the current estimate of total project cost.
3 Final In-Service Date means either the current forecast of the final date for in-service and close-out of project, or the historical final project in-service date (but not the final project close out date which may not have yet occurred).
4 Col.(g): "Yes" indicates identified CRVA-eligible projects with in-service amounts in the 2016-2024 period that do not also have in-service amounts in the 2025-2031 period, and therefore do not form part of the proposed 2027-2031 capital-related revenue requirement for the CRVA.
"Yes*" indicates identified CRVA-eligible projects with expected in-service amounts in the 2025-2031 period and forming part of the proposed 2027-2031 capital-related revenue requirement for the CRVA (Ex. H1-1-1, Att. 5). Additionally, this includes a preliminary assessment of CRVA eligibility, amongst unallocated projects, without expected in-service amounts in the 2025-2031 period.

Numbers may not add due to rounding.

Table 2b
Capital Project Listing - Regulated Hydroelectric and Hydro Common
Projects $10M - $30M Total Project Cost (Allocated)[1]

Line No.	Region	Facility	Project Name	Project Number	Category	Project Description	CRVA Eligible[4]	Start Date	Final In-Service Date[2]	Total Project Cost[3] ($M)	In-Service IR Term ($M)	In-Service 2025 ($M)	In-Service 2026 ($M)	In-Service 2027 ($M)	In-Service 2028 ($M)	In-Service 2029 ($M)	In-Service 2030 ($M)	In-Service 2031 ($M)
(a)	(b)		(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(u)	(v)	(w)	(x)	(y)	(z)	(aa)
41	Western	Caribou Falls	CAF 120/208V & Lighting Upgrade	84432	Sustaining	Replacement of the 120/208 VAC distribution system, 125 VDC infrastructure, unit headcover pump systems, HVAC system and lighting, as well as building renovations.	No	Sep-21	Jan-24	10.2	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
42	Eastern	R.H. Saunders	SAU - Concrete Rehabilitation	89543	Sustaining	Restoration of the integrity of powerhouse structural components adversely impacted by concrete expansion from Alkali-Aggregate Reaction.	No	Dec-24	Oct-26	16.6	0.0	7.0	0.8	0.0	0.0	0.0	0.0	0.0
43	Eastern	Bingham Chute	Bingham Chute GS Redevelopment	86385	Value Enhancing (Redevelopment)	Redevelopment of Bingham Chute GS to support continued operations.	Yes*	Jun-21	Apr-27	24.0	0.5	0.0	23.5	0.5	0.0	0.0	0.0	0.0
44	Eastern	Crystal Falls	Crystal Falls Elect./Controls Upgrade	82261	Sustaining	Replacement of electrical systems that are at end of life or obsolete in design.	No	Nov-20	Nov-26	20.8	0.0	0.0	16.2	0.0	0.0	0.0	0.0	0.0
45	Eastern	Stewartville	STW - G5 Cap. Refurb. - Rwnd Gen. & Reinsul.	82351	Sustaining (Refurbishment)	Refurbishment of station unit G5, including a generator rewind, field pole refurbishment, runner seal replacement and high pressure oil system replacement.	Yes*	Oct-24	May-27	19.1	17.1	0.0	0.0	17.1	0.0	0.0	0.0	0.0
46	Eastern	Otto Holden	OTO - New Turbine Runners	83356	Value Enhancing (Refurbishment)	Procurement and installation of new runners for units G1 to G4.	Yes*	Jan-17	Apr-30	15.5	15.4	0.0	0.0	6.9	3.9	3.1	1.5	0.0
47	Eastern	R.H. Saunders	SAU - Headgate Control Replacement	86220	Sustaining	Replacement of head gate controls for all 48 gates at RH Saunders GS.	No	Nov-23	Dec-30	19.0	11.4	0.8	1.9	2.1	3.3	3.4	2.6	0.0
48	Eastern	Coniston	Wanapitei Civil Upgrades	86310	Sustaining	Replacement or remediation of deteriorating elements of the control dam, which has been in operation since 1927 and has sustained damage to concrete structures.	No	Dec-21	Nov-26	29.1	0.0	4.1	18.3	0.0	0.0	0.0	0.0	0.0
49	Eastern	R.H. Saunders	SAU - Long Sault Dam Superstructure Automation (JW) (NYPA)	87140	Regulatory	NYPA-executed project to automate hoist operations at NYPA Long Sault Dam/Spillway.	No	Mar-23	Dec-29	19.1	15.8	0.0	0.0	0.0	9.0	6.8	0.0	0.0
50	Eastern	R.H. Saunders	SAU - 13.8KV Underground Feeder Eval. (JW) (NYPA)	87141	Regulatory	NYPA-executed project to replace Long Sault Spillway 13.8 kV underground feeder cables in order to correct operational inefficiencies.	No	Mar-23	Dec-25	20.8	17.5	0.0	0.0	0.0	0.0	0.0	17.5	0.0
51	Eastern	Otto Holden	OTO - G1 Refurb - Turbine & Generator	87545	Sustaining (Refurbishment)	Refurbishment of station unit G1, including turbine stay ring realignment, field pole refurbishment and installation of monitoring and diagnostic instrumentation.	Yes*	Jan-25	Apr-27	13.3	12.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
52	Eastern	Abitibi Canyon	ABI - Powerhouse Crane Refurb / Replace	89078	Sustaining	Refurbishment or replacement of two powerhouse cranes manufactured in 1931, both presenting mechanical and safety issues.	No	Dec-24	May-28	20.5	17.2	0.0	0.0	0.0	17.2	0.0	0.0	0.0
53	Eastern	Abitibi Canyon	ABI - Unloading Crane Refurb/Replacement	89079	Sustaining	Replacement of the station unloading crane components and support structure.	No	Nov-24	Jan-28	15.3	12.8	0.0	0.0	0.0	12.8	0.0	0.0	0.0
54	Western	Silver Falls	SLV Electrical Infrastructure Replacement	82005	Sustaining	Replacement of station service transformers near end of life in order to maintain station reliability.	No	Mar-21	Oct-28	18.8	18.7	0.0	0.0	0.0	18.7	0.0	0.0	0.0
55	Western	Caribou Falls	CAF Electrical Infrastructure Replacement	84430	Sustaining	Replacement of existing medium voltage switchgear, high voltage disconnect switch, protections, and unitsstation controls. Existing equipment is dated 1958 and is in poor condition.	No	Mar-21	Dec-27	23.5	22.8	0.0	0.0	22.8	0.0	0.0	0.0	0.0
56	Western	Manitou Falls	MOT T1 Replacement	84436	Sustaining	Replacement of T1 main output transformers and associated equipment to reduce forced unit outages and support reliable operation for 25-30 years.	No	Apr-22	Feb-27	12.6	10.7	0.0	0.0	10.7	0.0	0.0	0.0	0.0
57	Western	Whitedog Falls	WHD Electrical Infrastructure Replacement	84448	Sustaining	Replacement of existing medium voltage switchgear, high voltage disconnect switch, protections, and unitsstation controls. Existing equipment is dated 1958 and is in poor condition.	No	Mar-21	Oct-28	23.6	22.7	0.0	0.0	0.0	22.7	0.0	0.0	0.0
58	Western	Pine Portage	Black Sturgeon Dam	86369	Sustaining	Rehabilitation of the Black Sturgeon Dam and access road.	No	Feb-21	Dec-31	17.1	16.3	0.0	0.0	0.0	0.0	0.0	0.0	16.3
59	Western	Aguasabon	G2 Rewind & Core Replacement	86383	Sustaining (Refurbishment)	Replacement of existing stator frame, core and windings as well as the installation of a machine monitoring system to support a long, reliable service life.	Yes*	Aug-21	Oct-25	17.5	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0
60	Western	Cameron Falls	CAM - Block Dam 3-4 Life Extension	89000	Sustaining	Remediation of Cameron Falls GS block dams #3 and #4, 100-year-old earthfill embankments experiencing internal erosion within their timber pile cores.	No	Jun-25	Dec-27	15.4	9.6	5.0	0.0	9.6	0.0	0.0	0.0	0.0
61	Niagara	Sir Adam Beck 2	SAB OH Site Prep and Facility Rehab	86379	Sustaining	Rehabilitation and upgrade of Sir Adam Beck building infrastructure to address adverse conditions and optimize personnel occupancy in preparation for SAB Refurbishment Program.	No	Aug-21	Feb-26	17.7	0.0	15.7	0.0	0.0	0.0	0.0	0.0	0.0
62	Niagara	Sir Adam Beck 2	BK2 Phse. Cranes Replacement	89025	Sustaining	Replacement of two powerhouse overhead cranes, repair crane runway and replace crane rails.	No	Jan-25	Jan-31	14.7	14.5	0.0	0.0	7.9	6.5	0.0	0.0	0.0
63	Eastern	Arnprior	ARN - Repl. AC Stn. Serv. Switchgear & Brkrs.	80951	Sustaining	Upgrade of Arnprior GS AC station, including replacement of station service transformers,MV switchgear and PLC panels.	No	Jul-22	Sep-25	14.3	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0
64	Niagara	Sir Adam Beck Pump GS	Hatchcover and Drive System	82210	Sustaining	Replacement of all eight hatchcovers with a new and improved design, removal of asbestos, and replacement of hydraulic drive system with an electric drive system to eliminate oil leaks.	No	Apr-24	Feb-26	11.8	0.0	5.0	1.3	0.0	0.0	0.0	0.0	0.0
65	Eastern	Mountain Chute	MTN - Repl. AC Sta. Serv. Trnsfrmrs Switch	82987	Sustaining	Replacement of AC station switchgear ad addition of a separate enclosure, transformers, PLC equipment and software, 600V panels, breakers and controls.	No	Jul-22	Mar-28	11.7	3.3	0.0	7.3	3.3	0.0	0.0	0.0	0.0
66	Eastern	Abitibi Canyon	Abitibi - Breaker Roof Repl.	83153	Sustaining	Rehabilitation of deteriorated concrete on breaker roof, application of new roof membrane and replacement of guardrails and access doors.	No	Mar-23	Nov-26	10.8	0.0	0.5	8.0	0.0	0.0	0.0	0.0	0.0
67	Western	Cameron Falls	CAM G7 Capital Refurb	83257	Sustaining (Refurbishment)	Refurbishment of station unit G7, including replacement of generator windings, field poles, bearings and instrumentation.	Yes*	Aug-19	Dec-26	29.4	0.0	0.0	25.3	0.0	0.0	0.0	0.0	0.0
68	Eastern	R.H. Saunders	SAU - Repl. Iroquois Dam 2 Cranes (JW) (OPG)	86586	Sustaining	Replacement of original (1956) gantry cranes used to raise and lower dam gates. New cranes to have a minimum service life of 50 years.	No	May-24	Dec-28	20.1	8.5	0.0	8.5	8.5	0.0	0.0	0.0	0.0
69	Eastern	Barrett Chute	BAR - G2 Cap. Rfrb; Rwnd Gen. Reins. Fld. Pls.	86077	Sustaining (Refurbishment)	Refurbishment of station unit G2, including replacement of generator windings and thurst bearings as well as refurbishment of field poles.	Yes*	Jul-20	Apr-25	10.5	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0
70	Eastern	Chenaux	CHE - PH Cranes 2 - Cntrls & Cndctr Upgrade	86200	Sustaining	Replacement of two powerhouse overhead cranes originally installed in 1948 with new powerhouse cranes.	No	Dec-21	Sep-25	11.1	0.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0
71	Niagara	Sir Adam Beck 2	SAB2 N and S Phse Cranes	86438	Sustaining	Refurbishment of two 200-ton powerhouse cranes to ensure reliable operation in support of the Sir Adam Beck 2 maintenance and refurbishment program.	No	Sep-20	Aug-25	10.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
72	Eastern	Otto Holden	OTO - G8 Refurb - Turbine & Generator	86477	Sustaining (Refurbishment)	Refurbishment of station unit G8, including replacement of thurst bearings, refurbishment of field poles and turbine stay ring realignment.	Yes*	Feb-23	Apr-25	13.6	0.0	12.1	0.0	0.0	0.0	0.0	0.0	0.0
73	Eastern	Otto Holden	OTO - G6 Refurb - Turbine & Generator	86478	Sustaining (Refurbishment)	Refurbishment of station unit G6, including replacement of thurst bearings, refurbishment of field poles and turbine stay ring realignment.	Yes*	Feb-24	May-26	10.7	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0
74	Western	Caribou Falls	CAF Block Dam 4 Rehabilitation	86602	Sustaining	Installation of downstream rockfill toe berm at Caribou Block Dam #4 to resolve dam safety risks and reduce likelihood of failure.	No	Jul-21	Oct-24	10.4	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
75	Eastern	Stewartville	STW - Access Rd and Bank Stabilization	89572	Sustaining	Reconstruction of the single access road to Stewartville GS, including construction of a new turnaround area, stormwater drainage system and underground electrical duct bank.	No	Mar-25	Jun-26	10.7	0.0	6.8	0.9	0.0	0.0	0.0	0.0	0.0
76	Eastern	Arnprior	ARN - Replace T1 Main Output Transformer	87513	Sustaining	Replacement of main output transformer.	No	Dec-24	Oct-29	12.0	10.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
77	Niagara	Sir Adam Beck Pump GS	BKP Headworks Crane Replacement	86920	Sustaining	Replacement of the headworks crane and rails as well as repair of the headworks deck.	No	Dec-23	Oct-27	19.6	16.8	0.0	0.0	16.8	0.0	0.0	0.0	0.0
78	Eastern	Des Joachims	DEJ - Headpond and Tailrace Booms	86204	Regulatory	Installation of new headpond and tailrace booms to restrict boat access to main dam hazardous area.	No	Aug-22	Sep-28	10.8	5.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0
79	Niagara	Sir Adam Beck 2	BK2 Hoist Refurbishment G11-18	84568	Sustaining	Replacement of headgates and refurbishment of headgate gains and hoist system.	No	Sep-20	Sep-36	17.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80	Eastern	R.H. Saunders	Runner Replacement	83104	Value Enhancing (Refurbishment)	Design and procurement of turbine runners for installation within the R.H. Saunders Unit G9, G12 and G16 generating units.	Yes*	Aug-16	Mar-28	17.9	3.3	10.0	2.8	0.0	3.0	0.0	0.3	0.0
81	Eastern	Abitibi Canyon	Canyon Dam Downstream Concrete Rehab	87192	Sustaining	Rehabilitation of downstream concrete walls to extend life of wall surfaces and eliminate health and safety risks of falling concrete.	Yes*	May-23	Feb-26	24.8	0.0	1.4	2.3	0.0	0.0	0.0	0.0	0.0
			Total Regulated Hydroelectric							1,396.7	295.0	147.3	140.5	127.7	101.5	27.7	21.9	16.3
			Hydro Common															
82	Western	Kenora Common	NWK Work Centre Buidling	87139	Sustaining	Design and construction of a permanent work centre for Kenora staff supporting nearby hydroelectric stations.	No	Mar-23	Dec-27	16.5	16.5	0.0	0.0	16.5	0.0	0.0	0.0	0.0
			Total Hydro Common							16.5	16.5	0.0	0.0	16.5	0.0	0.0	0.0	0.0

Notes:
Refer to Notes in Table 2a

Numbers may not add due to rounding.

Table 3
Capital Project Listing - Regulated Hydroelectric and Hydro Common
Projects < $10M Total Project Cost[1]

Line No.	Prescribed Facility Category	Number of Projects	Total Project Cost ($M)	Average Cost of All Projects ($M)	In-Service IR Term ($M)	In-Service 2025 ($M)	In-Service 2026 ($M)	In-Service 2027 ($M)	In-Service 2028 ($M)	In-Service 2029 ($M)	In-Service 2030 ($M)	In-Service 2031 ($M)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
1	**Niagara Region**	168	414.4	2.5	80.9	22.7	34.9	50.0	10.0	11.9	7.8	1.1
2	**Eastern Region**	279	776.1	2.8	113.9	43.2	47.1	62.7	25.9	11.1	7.2	7.2
3	**Western Region**	180	442.6	2.5	69.8	37.3	52.1	20.6	17.4	16.3	12.7	2.8
4	**Total Regulated Hydroelectric**	627	1,633.2	2.6	264.6	103.2	134.1	133.2	53.3	39.3	27.7	11.0
5	**Total Hydro Common**	20	70.9	3.5	14.4	9.8	10.2	0.0	0.8	0.0	13.5	0.0

Notes:

1 Projects with expenditures during forecast period OR In-Service Amounts in the historical, bridge, or forecast period AND Completed/Deferred Projects in the historical period (2016-2024) at the time of preparing the 2025-2031 Business Plan.

Numbers may not add due to rounding.

Table 4

Comparison of In-Service Capital Additions - Regulated Hydroelectric and Hydro Common ($M)

Line No.	Prescribed Facility Category	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Actual	2024 Actual	2025 Budget	2026 Budget
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
	Portfolio Projects (Allocated)											
1	**Niagara Region**	10.7	49.7	34.4	21.6	19.0	17.0	35.7	44.9	69.6	55.3	45.2
2	**Eastern Region**	34.1	48.2	67.4	82.0	69.6	77.4	85.2	90.3	103.7	118.4	120.6
3	**Western Region**	4.3	13.8	24.2	46.5	40.8	98.0	55.4	61.4	67.9	52.5	52.1
4	**Subtotal Portfolio Projects (Allocated)**	49.1	111.7	126.0	150.1	129.4	192.4	176.3	196.6	241.2	226.2	217.9
	Portfolio Projects (Unallocated)											
5	**Niagara Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	7.6
6	**Eastern Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0
7	**Western Region**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.2
8	**Subtotal Supplemental In-Service Forecast**[1]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	19.8
9	**Total Portfolio In-Service Forecast**	49.1	111.7	126.0	150.1	129.4	192.4	176.3	196.6	241.2	231.6	237.7
10	**Refurbishments (Allocated)**	14.7	40.6	19.9	42.1	3.4	55.4	95.0	34.8	80.6	165.1	100.7
11	**Refurbishments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0				0.5	0.0
12	**Redevelopments (Allocated)**	0.0	0.0	0.0	0.0	0.0	0.0	133.0	30.8	1.8	16.8	165.2
13	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	**Sir Adam Beck 1 GS Canal Rehabilitation**[2]	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
15	**Expansion Projects**	0.0	0.0	0.0	53.7	11.7	0.0	118.4	5.2	0.0	0.0	0.0
16	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program**[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.6	1.4	27.3
17	**Minor Fixed Assets**	0.2	0.7	1.0	1.1	1.1	1.5	1.3	1.4	1.6	3.2	1.5
18	**Total Regulated Hydroelectric In-Service Capital Additions**	64.0	153.0	146.9	246.9	145.9	249.3	524.0	268.8	347.8	418.6	532.4
19	**Hydro Common**	0.0	3.7	0.0	2.6	2.9	3.7	4.4	4.2	4.4	9.8	10.2

Line No.	Prescribed Facility Category	2027 Plan	2028 Plan	2029 Plan	2030 Plan	2031 Plan	2017-2021 Actuals	(h)-(f) Change	2022-2026 Actuals & Budget	(j)-(h) Change	2027-2031 Plan
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Portfolio Projects (Allocated)										
20	**Niagara Region**	77.9	16.5	30.9	23.7	4.3	141.7	109.0	250.7	(97.4)	153.3
21	**Eastern Region**	81.6	77.6	118.8	55.1	38.2	344.6	173.6	518.2	(146.9)	371.3
22	**Western Region**	103.7	97.6	18.8	42.7	46.3	223.3	66.0	289.3	19.9	309.1
23	**Subtotal Portfolio Projects (Allocated)**	263.2	191.7	168.5	121.5	88.8	709.6	348.6	1,058.2	(224.5)	833.7
	Portfolio Projects (Unallocated)										
24	**Niagara Region**	(8.4)	35.5	43.1	53.4	26.4	0.0	11.5	11.5	138.5	150.0
25	**Eastern Region**	87.0	87.0	69.8	67.6	56.3	0.0	12.0	12.0	355.7	367.7
26	**Western Region**	(2.7)	21.4	83.2	55.3	158.0	0.0	1.7	1.7	313.5	315.2
27	**Subtotal Supplemental In-Service Forecast**[1]	75.9	143.9	196.1	176.3	240.7	0.0	25.2	25.2	807.7	832.9
28	**Total Portfolio In-Service Forecast**	339.1	335.6	364.6	297.8	329.5	709.6	373.8	1,083.4	583.3	1,666.6
29	**Refurbishments (Allocated)**	138.8	339.7	281.1	500.1	92.5	161.4	314.8	476.2	876.0	1,352.2
30	**Refurbishments (Unallocated)**	12.0	76.0	243.2	93.9	137.0	0.0	0.5	0.5	561.6	562.1
31	**Redevelopments (Allocated)**	350.1	351.8	15.0	0.0	0.0	0.0	347.6	347.6	369.3	716.9
32	**Redevelopments (Unallocated)**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	**Sir Adam Beck 1 GS Canal Rehabilitation**[2]	0.0	0.0	190.0	0.0	0.0	0.3	(0.3)	0.0	190.0	190.0
34	**Expansion Projects**	0.0	0.0	0.0	0.0	0.0	65.4	58.2	123.6	(123.6)	0.0
35	**Abitibi Canyon Concrete and Sluiceway Rehabilitation Program**[2]	0.0	0.0	20.0	45.0	66.4	0.0	51.3	51.3	80.1	131.4
36	**Minor Fixed Assets**	1.5	1.6	1.6	1.7	1.7	5.4	3.6	9.0	(1.0)	8.1
37	**Total Regulated Hydroelectric In-Service Capital Additions**	841.5	1,104.7	1,115.5	938.5	627.1	942.0	1,149.5	2,091.5	2,535.7	4,627.3
38	**Hydro Common**	16.5	48.5	30.8	13.5	0.0	12.9	20.2	33.1	76.3	109.4

Notes:

1 In-service amounts for unallocated projects (see Ex. D1-1-1, Section 3.0); reflects the difference between total approved portfolio budget and amount allocated to portfolio projects.

2 Includes forecast in-service amounts for both allocated and unallocated projects.

Table 5a
Capital Project Listing - Regulated Hydroelectric[1]
(Unallocated)[2]

Line No.	Facility	Project Name	Category	CRVA Eligible[3]	Potential Start Date
		(a)	(b)	(c)	(d)
		Projects With Potential Cost >$30M			
1	Abitibi Canyon	Abitibi - G3 Capital Upgrades	Sustaining (Refurbishment)	Yes*	7/20/1905
2	Abitibi Canyon	Abitibi - G4 Capital Upgrades	Sustaining (Refurbishment)	Yes*	7/22/1905
3	Abitibi Canyon	Abitibi - G5 Capital Upgrades	Sustaining (Refurbishment)	Yes*	7/23/1905
4	Aguasabon	AGU Upgrade Water Conveyance Capabilities	Value Enhancing	Yes*	7/19/1905
5	Alexander	ALX Spillwall Rehabilitation	Sustaining	No	7/20/1905
6	Sir Adam Beck 2	BK2 G16 G15 Refurbishment	Sustaining (Refurbishment)	Yes*	7/19/1905
7	Sir Adam Beck 2	BK2 G26 G25 Refurbishment	Sustaining (Refurbishment)	Yes*	7/20/1905
8	Sir Adam Beck Pump Generating Station	PGS Refurbishment	Sustaining (Refurbishment)	Yes*	7/21/1905
9	Chats Falls	CHF - Generator Rewinds (NET)	Sustaining (Refurbishment)	Yes*	7/18/1905
10	Des Joachims	DEJ - Capital Refurb Program Rewind Generators / Stators G2,4,6,7,8	Sustaining (Refurbishment)	Yes*	7/22/1905
11	Manitou Falls	MAN G4 - Capital Refurb	Sustaining (Refurbishment)	Yes*	7/20/1905
12	Manitou Falls	MAN G1 - Capital Refurb	Sustaining (Refurbishment)	Yes*	7/18/1905
13	Manitou Falls	MAN G2 - Capital Refurb	Sustaining (Refurbishment)	Yes*	7/18/1905
14	Manitou Falls	MAN G5 - Capital Refurb	Sustaining (Refurbishment)	Yes*	7/22/1905
15	DeCew Falls	DeCew Earth Structures Rehab	Sustaining	No	7/18/1905
16	Pine Portage	NWN Waboose Dam Life Extension	Sustaining	Yes*	7/23/1905
17	Otter Rapids	Otter G3 Capital Upgrade	Sustaining (Refurbishment)	Yes*	7/18/1905
18	Otter Rapids	Otter G4 Capital Upgrade	Sustaining (Refurbishment)	Yes*	7/18/1905
19	Pine Portage	PIN G1 Capital Refurb	Sustaining (Refurbishment)	Yes*	7/20/1905
20	Pine Portage	PIN G2 Capital Refurb	Sustaining (Refurbishment)	Yes*	7/22/1905
21	Pine Portage	PIN Main Dam Life Extension	Sustaining	Yes*	7/22/1905
22	R.H. Saunders	SAU - Replace Generator Breakers and Switchgear	Sustaining	No	7/17/1905
23	R.H. Saunders	SAU - G10 Capital Refurbishment	Sustaining (Refurbishment)	Yes*	7/18/1905
24	R.H. Saunders	SAU - G11 Capital Refurb Project Fifth Unit	Sustaining (Refurbishment)	Yes*	7/19/1905
25	R.H. Saunders	SAU - Iroquois Dam Env Mgmt	Regulatory	No	7/19/1905
26	R.H. Saunders	SAU - G2 Capital Refurb Project Sixth Unit	Sustaining (Refurbishment)	Yes*	7/21/1905
27	R.H. Saunders	SAU - G3 Capital Refurb Project Seventh Unit	Sustaining (Refurbishment)	Yes*	7/23/1905
28	Abitibi Canyon	Abitibi Canyon Sluiceway Rehabilitation	Sustaining	Yes*	7/17/1905
29	Abitibi Canyon	ABI - Upstream Concrete Liner	Sustaining	Yes*	7/17/1905
30	Abitibi Canyon	Abitibi Canyon Concrete Zone 1 2 4B 5 6	Sustaining	Yes*	2028
31	Chats Falls	Chats Falls GS Expansion	Value Enhancing (Expansion)	Yes*	2026
32	Sir Adam Beck 1	SAB1 Canal Isolation Preparedness Phase 2	Sustaining (Canal Rehabilitation)	Yes*	2029
33	DeCew Falls	DeCew I GS Refurbishment	Sustaining (Refurbishment)	Yes*	2025

Notes:
1 There are no unallocated Hydro Common projects in this category.
2 Unallocated includes projects with forecast expenditures during the 2027-2031 forecast period.
3 Col.(c): "Yes" indicates identified CRVA-eligible projects with in-service amounts in the 2016-2024 period that do not also have in-service amounts in the 2025-2031 period, and therefore do not form part of the proposed 2027-2031 capital-related revenue requirement for the CRVA.
"Yes*" indicates identified CRVA-eligible projects with expected in-service amounts in the 2025-2031 period and forming part of the proposed 2027-2031 capital-related revenue requirement for the CRVA (Ex. H1-1-1, Att. 5). Additionally, this includes a preliminary assessment of CRVA eligibility, amongst unallocated projects, without expected in-service amounts in the 2025-2031 period.

Table 5b
Capital Project Listing - Regulated Hydroelectric[1]
(Unallocated)[2]

Line No.	Facility	Project Name	Category	CRVA Eligible[4]	Potential Start Date
		(a)	(b)	(c)	(d)
		Projects With Potential Cost between $10M - $30M			
1	Abitibi Canyon	ABI - Intake Gantry Crane Refurb / Replacement	Sustaining	No	7/18/1905
2	Aguasabon	AGU Intake Plug	Sustaining	No	7/21/1905
3	Arnprior	ARN - Replace Sluice Gates	Sustaining	Yes*	7/23/1905
4	Arnprior	ARN - Replace Turbine Runners	Sustaining (Refurbishment)	Yes*	7/19/1905
5	Arnprior	ARN - Capital Refurb Project Re-insulate Rotor Field Poles First Unit	Sustaining (Refurbishment)	Yes*	7/21/1905
6	Sir Adam Beck 1	BK1 Headworks Curtain Wall Restoration	Sustaining	No	7/17/1905
7	Cameron Falls	CAM Spillway Training Wall Repl	Sustaining	No	7/19/1905
8	Chenaux	CHE - 1st Unit Capital Refurb	Sustaining (Refurbishment)	Yes*	7/17/1905
9	Chenaux	CHE - 2nd Unit Capital Refurb	Sustaining (Refurbishment)	Yes*	7/21/1905
10	Chenaux	CHE - 3rd Unit Capital Refurb	Sustaining (Refurbishment)	Yes*	7/22/1905
11	Chenaux	CHE - 4th Unit Capital Refurb	Sustaining (Refurbishment)	Yes*	7/23/1905
12	Chats Falls	CHF - Replace Powerhouse Cranes, Supply Bus, & Disc SW (NET)	Sustaining	No	7/17/1905
13	Chats Falls	CHF - Replace Screw Hoists on Sluice Gates (NET)	Sustaining	No	7/18/1905
14	Des Joachims	DEJ - Replace Powerhouse Cranes (2)	Sustaining	No	7/21/1905
15	Des Joachims	DEJ - Sluicegate Structure & Hoist Wire Rope, Controls Replacement McConnell Lake	Sustaining	Yes*	7/22/1905
16	DeCew Falls 2	DQ2 G2 Runner and Governor Upgrade	Value Enhancing (Refurbishment)	Yes*	7/21/1905
17	DeCew Falls 2	DQ2 G1 Electrical Refurbishment	Sustaining (Refurbishment)	Yes*	7/21/1905
18	Eastern Operations	EOP - Renfrew Office	Sustaining	No	7/22/1905
19	Kakabeka Falls	KAK Headgate and Building Replacement	Sustaining	No	7/17/1905
20	McVittie	McVittie - Headworks Upgrades	Sustaining	No	7/18/1905
21	McVittie	McVittie Service Gates and Gains Upgrades	Sustaining	No	7/18/1905
22	Niagara Region	NIA Upgrade PLC Equip	Sustaining	No	7/18/1905
23	International Niagara Control Works	ICD Gate Rehabilitation (13-16) (JW) (OPG)	Sustaining	No	7/21/1905
24	Otto Holden	OTO - Replace trash racks	Sustaining	No	7/18/1905
25	Otto Holden	OTO - G2 Refurb - Turbine & Generator	Sustaining (Refurbishment)	Yes*	7/19/1905
26	Otto Holden	OTO - Powerhouse Crane Replacement	Sustaining	No	7/20/1905
27	Otto Holden	OTO - G3 Refurb - Turbine & Generator	Sustaining (Refurbishment)	Yes*	7/20/1905
28	Otto Holden	OTO - G4 Refurb - Turbine & Generator	Sustaining (Refurbishment)	Yes*	7/21/1905
29	Pine Portage	PIN G4 Headgate, Hoist & Controls Repl	Sustaining	No	7/18/1905
30	Pine Portage	PIN G3 Headgate, Hoist & Controls Repl	Sustaining	No	7/18/1905
31	Pine Portage	PIN G2 Headgate, Hoist & Controls Repl	Sustaining	No	7/23/1905
32	Pine Portage	PIN G1 Headgate, Hoist & Controls Repl	Sustaining	No	7/21/1905
33	Pine Portage	PIN Tailrace Pier Rehab	Sustaining	No	7/19/1905
34	R.H. Saunders	SAU - Re-Insulate Field Poles	Sustaining (Refurbishment)	Yes*	7/18/1905
35	R.H. Saunders	SAU - Iroquois Dam 32 Control Gates (JW)(OPG) NET	Sustaining	No	7/19/1905
36	R.H. Saunders	SAU - Protection & Controls Refresh	Sustaining	No	7/21/1905
37	R.H. Saunders	SAU - Replace Generator, Transformer, Line and Station Service Bus Protections	Sustaining	No	7/21/1905
38	Stewartville	STW - Capital Refurb - Rewind Generator and Reinsulate Field Poles (Second Unit)	Sustaining (Refurbishment)	Yes*	7/18/1905
39	Stewartville	STW - Capital Refurb - Rewind Generator and Reinsulate Field Poles (Third Unit)	Sustaining (Refurbishment)	Yes*	7/19/1905
40	Stewartville	STW - Capital Refurb - Rewind Generators and Reinsulate Field Poles (Fourth Unit)	Sustaining (Refurbishment)	Yes*	7/21/1905
41	Stewartville	STW - Capital Refurb - Rewind Generator and Reinsulate Field Poles (Fifth Unit)	Sustaining (Refurbishment)	Yes*	7/22/1905
42	R.H. Saunders	Fisheries Act Compliance - Saunders	Regulatory	No	2031
43	Chats Falls	Fisheries Act Compliance - Chats Falls	Regulatory	No	2030
44	Dymond Service Centre[4]	Mistinikon Control Dam Upgrades	Regulatory	Yes*	2026
45	Eastern Operations	EOP - Correct IDF Flow Deficient MADA Syst.	Sustaining	No	2026

Notes:
Refer to Table 5a for Notes 1-3
4 Mistinikon Control Dam supports both the Chute GS and the Lower Notch GS.

Table 6
Capital Projects - Regulated Hydroelectric and Hydro Common
Listing of Business Case Summaries Filed

Line No.	Facility	Business Case Summary (BCS) Title	Project Number	BCS Approval Date	Project Stage	BCS Status
	(a)	(b)	(c)	(d)	(e)	(f)
1	Ranney Falls	Ranney Falls Expansion Project	80581	Mar-17	Closed	Full Release Execution
2	Sir Adam Beck Pump Generating Station	Sir Adam Beck Pump GS - Reservoir Refurbishment	80583	Aug-15	Closed	Full Release Execution
3	Sir Adam Beck 1	Sir Adam Beck I GS - G10 Major Overhaul & Upgrade	80649	Aug-16	Closed	Superseding Execution
4	DeCew Falls 2	G2 Overhaul & Upgrade	80851	Apr-16	Closed	Full Release Execution
5	Coniston/Stinson	Coniston/Stinson GS Redevelopment	82087	Nov-24	Execution	Full Release Execution
6	Calabogie	Calabogie GS - Redevelopment	82089	Oct-22	Closed	Superseding Execution
7	Alexander	G1 Capital Refurb	82391	Apr-23	Development	Full Release Development
8	Otter Rapids	Otter G1 Capital Upgrade	82542	Nov-24	Execution	Full Release Execution
9	Otter Rapids	Otter G2 Capital Upgrade	82543	Jul-25	Execution	Superseding Execution
10	Sir Adam Beck 1	Sir Adam Beck 1 GS - Unit G5 Upgrade	82777	Sep-21	Closed	Superseding Execution
11	Abitibi Canyon	ABI - G1 Capital Upgrades	83148	Mar-25	Development	Full Release Execution
12	Abitibi Canyon	Abitibi - G2 Capital Upgrades/HG	83155	Dec-19	Closed	Full Release Execution
13	Abitibi Canyon	Abitibi - G2 Capital Upgrades/HG	83155	Aug-24	Closed	Over-Variance Execution
14	Frederick House6	Frederick House Lake Dam Upgrades	83194	May-23	Execution	Full Release Execution
15	R.H. Saunders	SAU - G9 Capital Refurbishment	83495	Aug-24	Execution	Superseding Execution
16	Silver Falls	Surge Tank Replacement	83833	Mar-21	Development	Full Release Development
17	Sir Adam Beck 1	BK1 G1/G2 Replacement	84185	Oct-20	Closed	Full Release Execution
18	Sir Adam Beck 1	BK1 G1/G2 Replacement	84185	Oct-20	Closed	Over-Variance Execution
19	Chenaux	CHE - Limerick Isl. Spr Structure Sluice Gate Hoist	84494	Dec-20	Execution	Full Release Execution
20	Northwest Operations[1]	NWO Work Centre Building	84901	Jul-23	Execution	Full Release Execution
21	Otter Rapids	Otter Project Camp	84907	Apr-23	Execution	Full Release Execution
22	Sir Adam Beck 1	SAB1 Station Service Upgrade	86364	Jul-23	Definition	Full Release Definition
23	Sir Adam Beck 1	BK1 G6 G8 Refurbishment	86372	May-25	Definition	Full Release Definition
24	Kakabeka Falls	Kakabeka Falls GS	86386	Nov-24	Execution	Full Release Execution
25	Matabitchuan	Matabitchuan GS	86387	Mar-25	Execution	Full Release Execution
26	Sir Adam Beck 1	BK1 G4 Refurbishment	86570	Dec-24	Execution	Full Release Execution
27	R.H. Saunders	SAU - G12 Capital Refurbishment	86587	May-24	Execution	Full Release Execution
28	R.H. Saunders	SAU - LSD Capital Program (JW)(NYPA)	86595	Mar-23	Development	Full Release Development
29	Alexander	G2 Capital Refurb	86792	May-25	Development	Superseding Development
30	Alexander	G3 Capital Refurb	86793	Jun-23	Development	Full Release Development
31	Manitou Falls	MAN G3 Capital Refurb	86860	Dec-24	Development	Full Release Development
32	R.H. Saunders	SAU - G16 Capital Refurbishment	86937	Nov-24	Definition	Full Release Definition
33	R.H. Saunders	SAU - Massena Canal Dam (JW)(NYPA)(CAP)	87142	Mar-23	Definition	Full Release Definition
34	Timmins (Hydro Common)	Timmins Building Expansion	87197	Sep-24	Development	Full Release Development
35	Aguasabon	Aguasabon Dam Rehab. Hayes Lake Main Dam	87217	Aug-23	Development	Full Release Development
36	Dymond (Hydro Common)	Dymond Machine Shop Expansion	87329	Apr-25	Development	Superseding Development
37	Sir Adam Beck 2	BK2 G18 G17 Refurbishment	87356	May-25	Development	Full Release Development
38	Sir Adam Beck 2	BK2 G14 G13 Refurbishment	87357	May-25	Development	Full Release Development
39	Sir Adam Beck 2	BK2 230kV Conductor Replacement	87362	Mar-25	Development	Full Release Development
40	R.H. Saunders	SAU - Long Sault Dam Downstream Concrete JW NYPA	87575	Jun-24	Development	Full Release Development
41	Sir Adam Beck 2	BK2 G20/G19 Refurbishment	87768	Dec-24	Definition	Full Release Definition
42	Sir Adam Beck 1	SAB1 Canal Isolation Preparedness Phase 1 (SAB1 CIP1)	89252	Jul-25	Definition	Full Release Definition
43	Otto Holden	OTO - Refurbish Stop Log Sluice Piers	89354	Oct-24	Definition	Partial Release Definition
44	Abitibi Canyon	Abitibi Canyon Concrete Repair Zone 7	89505	Apr-25	Execution	Full Release Execution

Notes:
1 Supports generating stations in Thunder Bay and Kenora (refer to Ex. A1-4-2, Att. 1)