newfoundland labrador
hydro
a nalcor energy company

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July 27, 2017

Board of Commissioners of Public Utilities
Prince Charles Building
120 Torbay Road, P.O. Box 21040
St. John's, NL A1A 5B2

Attention: Ms. Cheryl Blundon
Director of Corporate Services & Board Secretary

Dear Ms. Blundon:

Re: Newfoundland and Labrador Hydro – 2018 Capital Budget Application

Please find enclosed ten (10) copies, plus the original, of Hydro's 2018 Capital Budget Application, in two volumes, filed in accordance with the Provisional Capital Budget Application Guidelines issued by the board in October of 2007 and in accordance with the guidelines and conditions for capital budget proposals as outlined by the Board in Order No. P.U. 7(2002-2003). Under this Application, Hydro is seeking approval of $206.2 million in capital expenditures.

The Application will be posted on Hydro's website at www.nlhydro.com in the coming days.

Hydro trusts that you will find the enclosed to be in order and satisfactory. Should you have any questions or comments about any of the enclosed, please contact the undersigned.

Yours truly,

NEWFOUNDLAND AND LABRADOR HYDRO

Michael Ladha
Legal Counsel & Assistant Corporate Secretary

ML/bs

cc: Gerard Hayes – Newfoundland Power
Paul Coxworthy – Stewart McKelvey Stirling Scales
Sheryl Nisenbaum – Praxair Canada Inc.
Dennis Browne, Q.C. – Consumer Advocate
Thomas J. O'Reilly, Q.C. – Cox & Palmer
ecc: Larry Bartlett – Teck Resources Limited

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VOLUME I

VOLUME II

1. Application

IN THE MATTER OF the *Public Utilities Act*, (the "*Act*"); and

IN THE MATTER OF an Application by Newfoundland and Labrador Hydro for an Order approving: (1) its 2018 capital budget pursuant to s.41(1) of the *Act*; (2) its 2018 capital purchases, and construction projects in excess of $50,000 pursuant to s.41(3) (a) of the *Act*; (3) its leases in excess of $5,000 pursuant to s. 41(3) (b) of the *Act*; and (4) its estimated contributions in aid of construction for 2018 pursuant to s.41(5) of the *Act.*

TO: The Board of Commissioners of Public Utilities (the Board)

THE APPLICATION OF NEWFOUNDLAND AND LABRADOR HYDRO (Hydro) STATES THAT:

1. Hydro is a corporation continued and existing under the Hydro *Corporation Act, 2007,* is a public utility within the meaning of the *Act* and is subject to the provisions of the *Electrical Power Control Act, 1994*.

2. Section A to this Application is Hydro's proposed 2018 Capital Budget in the amount of approximately $206.2 million prepared in accordance with the guidelines and conditions outlined in Order No. P.U. 7(2002-2003) and the Capital Budget Application Guidelines issued October 29, 2007.

3. Section B to this Application is Hydro's proposed 2018 Capital Budget with single and multi-year projects listed separately and prepared in accordance with the guidelines and

conditions outlined in Order No. P.U. 7(2002-2003) and the Capital Budget Application Guidelines issued October 29, 2007.

4. Section C to this Application is a list of the proposed 2018 Construction Projects and Capital Purchases for $500,000 and over, prepared in accordance with Order No. P.U. 7(2002-2003) and the Capital Budget Application Guidelines.

5. Section D to this Application is a list of the proposed 2018 Construction Projects and Capital Purchases for $200,000 and over, but less than $500,000, prepared in accordance with Order No. P.U. 7(2002-2003) and the Capital Budget Application Guidelines.

6. Section E to this Application is a list of the proposed 2018 Construction Projects and Capital Purchases in excess of $50,000 but less than $200,000 prepared in accordance with Order No. P.U. 7(2002-2003) and the Capital Budget Application Guidelines.

7. Section F contains no new leases proposed for 2018 in excess of $5,000 per year.

8. Section G to this Application is a Schedule of Hydro's Capital Expenditures for the period 2013 to 2022.

9. Section H to this Application is a report on the status of the 2018 capital expenditures including those approved by Order No. P.U. 33(2015), projects under $50,000 not included in these Orders, and the 2017 capital expenditures carried forward to 2018.

10. Volume II to this Application contains the supplementary reports referred to in various capital budget proposals.

11. The proposed capital expenditures for 2018 as set out in this Application are required to allow Hydro to continue to provide to its customers service and facilities which are reasonably safe, adequate and reliable as required by Section 37 of the *Act*.

12. Hydro has estimated the total of contributions in aid of construction for 2018 to be approximately $300,000 for distribution upgrades and service extensions. The information contained in the 2018 Capital Budget (Section A) takes into account this estimate of the contributions in aid of construction to be received from customers. All contributions to be recovered from customers shall be calculated in accordance with the relevant policies as approved by the Board.

13. Communications with respect to this Application should be forwarded to Michael S. Ladha, Legal Counsel and Assistant Corporate Secretary, Telephone: (709) 737-1268, P.O. Box 12400, St. John's, Newfoundland and Labrador, A1B 4K7, Fax: (709) 737-1782.

16. Hydro requests that the Board make an Order as follows:

(1) Approving Hydro's 2018 Capital Budget as set out in Section A hereto, pursuant to section 41(1) of the *Act;*

(2) Approving Hydro's 2018 Capital Purchases and Construction Projects in excess of $50,000 as set out in Sections C, D, and E hereto, and its leases as set in Section F, pursuant to section 41(3) of the *Act*; and

(3) Approving the proposed estimated contributions in aid of construction as set out in paragraph 13 hereof for 2018 as required by section 41(5) of the *Act,* with all such contributions to be calculated in accordance with the policies approved by the Board.

DATED at St. John's in the Province of Newfoundland and Labrador this 27th day of July 2017.

NEWFOUNDLAND AND LABRADOR HYDRO

Michael Ladha,
Counsel for the Applicant
Newfoundland and Labrador Hydro,
500 Columbus Drive, P.O. Box 12400
St. John's, Newfoundland, A1B 4K7
Telephone: (709) 737-12681
Facsimile: (709) 737-1782

IN THE MATTER OF the *Public Utilities Act*, (the "*Act*"); and

IN THE MATTER OF an Application by Newfoundland and Labrador Hydro for an Order approving: (1) its 2018 capital budget pursuant to s.41(1) of the *Act*; (2) its 2018 capital purchases, and construction projects in excess of $50,000 pursuant to s.41(3) (a) of the *Act*; (3) its leases in excess of $5,000 pursuant to s. 41(3) (b) of the *Act*; and (4) its estimated contributions in aid of construction for 2018 pursuant to s.41(5) of the *Act*.

AFFIDAVIT

I, James R. Haynes, Professional Engineer, of St. John's in the Province of Newfoundland and Labrador, make oath and say as follows:

1. I am President, Newfoundland and Labrador Hydro, the Applicant named in the attached Application.
2. I have read and understand the foregoing Application.
3. I have personal knowledge of the facts contained therein, except where otherwise indicated, and they are true to the best of my knowledge, information and belief.

SWORN at St. John's in the)
Province of Newfoundland and)
Labrador)
this 27 day of July, 2017,)
before me:)

____

Barrister – Newfoundland and Labrador

____

James R. Haynes

2018 Capital Projects Overview

2018 Capital Projects Overview

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador
hydro
a nalcor energy company

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1.0 Introduction

Pursuant to the provisions of the *Hydro Corporation Act, 2007*, the *Electrical Power Control Act, 1994*, and the *Public Utilities Act*, 1990, Hydro is required to provide reliable service to its customers. The provision of safe, reliable, least cost supply of electricity requires that Hydro continuously maintain, refurbish, renew, and expand its generation, transmission and distribution assets, and its other assets that support those systems. Hydro must also address changing environmental and regulatory requirements, challenges which often require the acquisition of new assets or improvements to existing assets. Hydro's long term planning initiatives are framed in the context of the following key drivers: the interconnection between Labrador and the Island via the HVdc link (Labrador Island Link), the interconnection of the Island with Nova Scotia system via the Maritime link, and continued load growth on the Avalon Peninsula. This Overview will discuss the projects proposed for 2018. Discussion of the five year plan is contained in the section entitled "*2018-2022 Capital Plan*".

2.0 2018 Plan Considerations

Maintaining Hydro's systems in reliable operating condition is accomplished through a combination of planned maintenance, rehabilitation of existing assets, and replacement of assets that have reached the end of their useful lives. Replacement of assets may also occur to lower life cycle costs, improve operational characteristics, increase capacity for load growth, or correct reliability criteria violations.

The majority of Hydro's installed assets, including the hydroelectric installation at Bay d'Espoir, the Holyrood Thermal Generating Station, the Stephenville Gas Turbine, the Hardwoods Gas Turbine, and much of Hydro's transmission and distribution systems, are more than 40 years old.

The sustaining capital proposals, focused on maintaining current assets, contained in this application and in previous applications, appropriately consider both the age and condition of Hydro's existing assets in determining whether to renew or replace them. The cost of these sustaining capital proposals can be expected to increase as a result of the continuous assessment of the condition of these aging assets. In other cases, the introduction of newer, more efficient technologies, such as LED lighting, justifies the replacement of equipment.

The age of Hydro's assets also has implications for efficient operating methods and safety. Some of Hydro's generating plants were constructed at a time when most systems and auxiliary equipment were manually operated. Today, most equipment is automated or remotely controlled, allowing operators to focus on maximizing efficiency and equipment monitoring. Included in this Application are proposals to improve the safety of Hydro's workplaces and to implement automation or improvements in the control and monitoring of equipment that enable the safe and efficient operation of assets. For example, the installation of remote operation of the Salmon River Spillway implements automation that enables efficient operation of the spillway and at the same time improves workplace safety for employees.

In the development of a capital proposal, consideration is given to:

- System performance and reliability criteria;
- Long term asset management strategy;
- Mandatory criteria (including Legislative, Board Orders, Safety, or Environmental Risks);
- Load growth and system planning criteria;
- Maintenance history;
- Condition assessment;
- Performance assessment;
- Cost efficiencies;
- Operating experience;
- Changing operating conditions;
- Familiarity with equipment;
- Operating and Maintenance cost; and
- Professional judgment.

There are three broad categories of replacement criteria:

- Time and condition based, such as diesel generators (100,000 hours of operation) and vehicles (combination of years and operating hours for some classes);
- Condition based, such as transmission line wood poles; and
- Technical assessment based, where an evaluation of reliability, performance, condition, costs and other factors results in a capital proposal, such as the inspection of fuel tanks and subsequent upgrade, where required.

3.0 2018 Capital Budget

This Application contains a capital plan in which the primary consideration is least cost and reliable generation, transmission, and distribution of electricity while at the same maintaining and enhancing safety and environmental performance.

This 2018 Capital Budget Application contains 68 new projects. These new projects include the refurbishment of generation facilities, planned life extension of gas turbines, and terminal station modernization and upgrades. Including budgets for previously approved projects, the 2018 capital expenditure totals $206.2 million. Expenditures in 2018 also include approximately $650,000 for Front End Engineering and Design (FEED) on a number of projects planned for 2018. All 2018 projects address both the need to sustain the existing asset base and to grow the asset base in response to growing customer demand, while improving reliability and adhering to Hydro's principles of safety and environmental responsibility.

Figure 1 shows the 2018 Capital Budget Summary by major category. The categories, other than the Allowance for Unforeseen Items, are discussed further in the following sections.

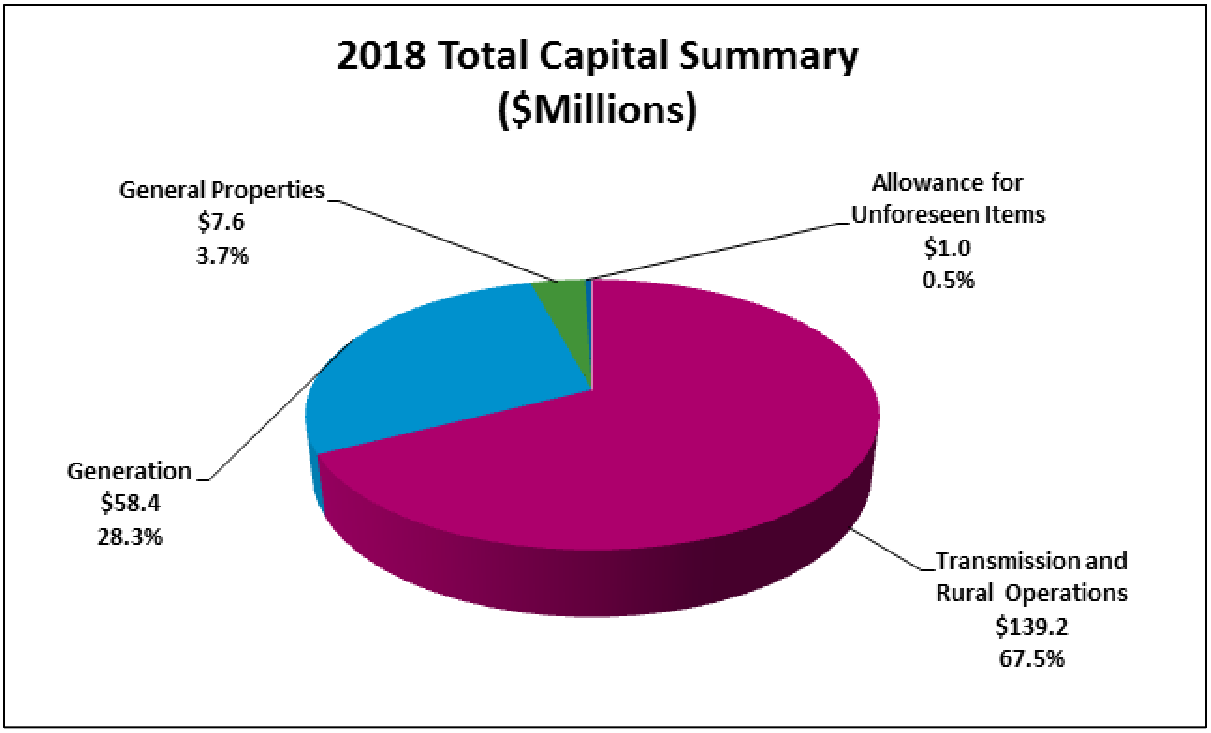


Figure 1: 2018 Capital Budget – Summary

3.1 Generation

On the Island Interconnected System, electricity is provided by Hydro through a mix of hydroelectric and fossil fuel fired generation, supplemented by power purchases. This energy production, along with the transmission system, is managed by the Energy Control Centre to ensure economic and reliable dispatch of available resources.

The Generation category expenditures of $58.4 million account for 28.3% of overall expenditures for 2018. The division of the 2018 Capital Budget for the Generation category among Hydraulic Plant, Thermal Plant, and Gas Turbines expenditures is shown in Figure 2. The five-year (2012 to 2016) average capital expenditures for generation are shown in Figure 3.

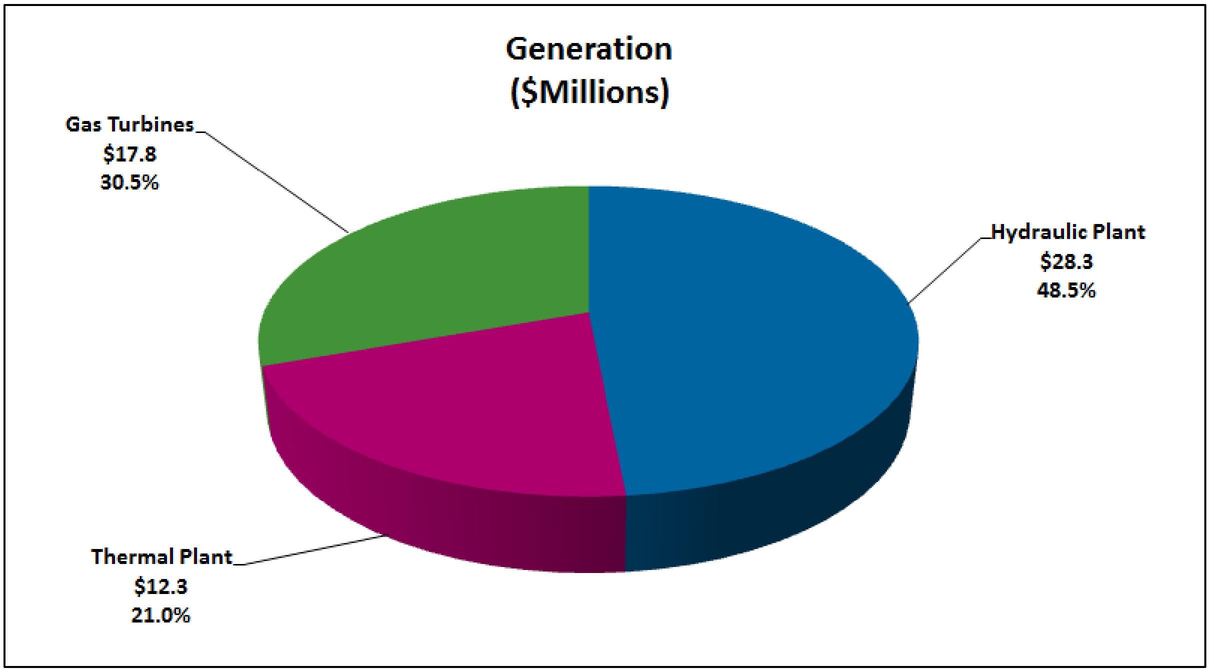


Figure 2: 2018 Capital Budget – Generation

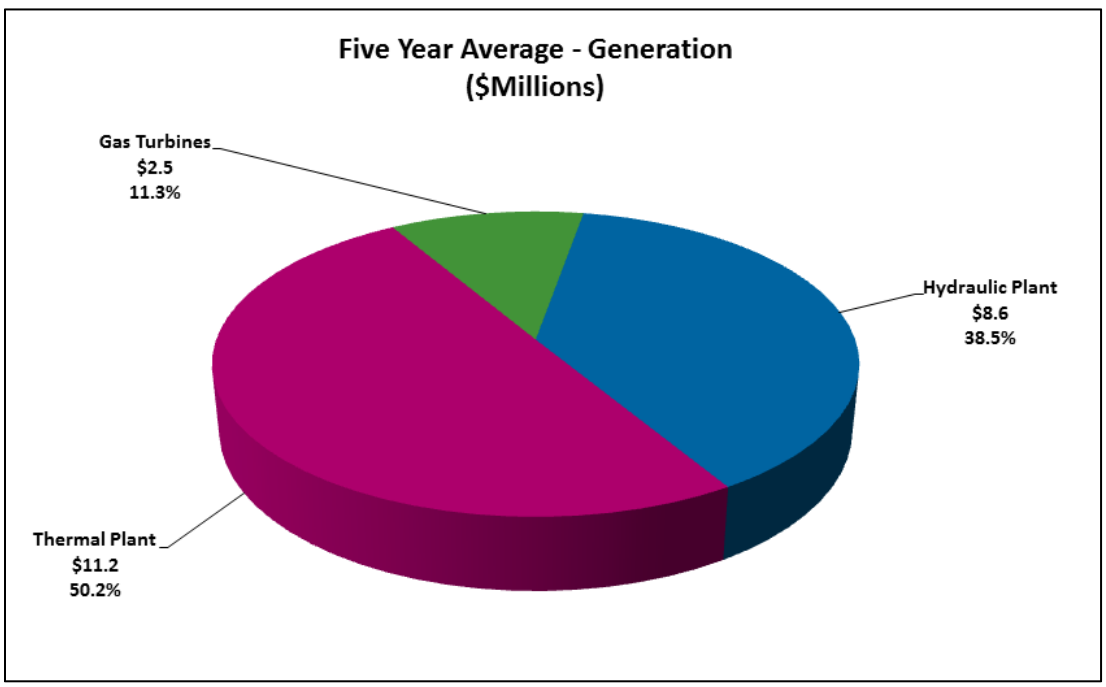


Figure 3: Five-Year Average Capital Expenditures – Generation (2012-2016)

Hydraulic Plant projects have significantly increased compared with the average over the past five years. As referenced in section 3.1.1, the increase in hydraulic plant expenditures is primarily a result of the need to refurbish aging assets, particularly at the Bay d'Espoir Hydroelectric Generation Facility (Bay d'Espoir).

For 2018, Thermal Plant budget estimates are similar to the five-year average. Thermal plant projects continue to require major capital expenditures as the majority of the equipment and systems have exceeded their expected life cycle and, in some cases, have undergone life extension. As referenced in Section 3.1.2, expenditures are required to ensure that these important generating assets can continue to operate reliably until they are retired and replaced.

Expenditures for Gas Turbines have increased for 2018, compared with the five-year average. The increase in Gas Turbine expenditures, as referenced in section 3.1.3, results from the need to ensure environmental compliance and reliability of the Holyrood gas turbine asset, which was added to Hydro's generation asset fleet in 2015.

3.1.1 Hydraulic Plant

Hydro's major hydraulic generating plants range from 14 to 50 years of age. Capital expenditures are required to ensure their continued reliability and to maximize the useful operating lives of these assets. Many components of the hydraulic generating stations are nearing, or have reached, the end of their expected service lives in the older plants.

In 2018, Hydro is introducing a new program called the "Hydraulic Generation Refurbishment and Modernization Project" that consolidates planned hydraulic generation-sustaining work into a single project. Additionally, this year's proposals include projects to improve reliability, efficiency, and safety of the hydraulic assets, including proposals to ensure the integrity of Penstock 1 at Bay d'Espoir, installation of remote operation of the Salmon River Spillway (near Bay d'Espoir), and implementation of energy efficiency improvements for heating and lighting at multiple hydraulic plants.

3.1.2 Thermal Plant

The three units of the Holyrood Thermal Generating Station (Holyrood) have now exceeded their generally expected service life of 30 years. Holyrood remains critical to the supply of reliable power to the Island Interconnected System, as it serves the base load of the system and will be required to do so in the short to medium term. No changes are expected in terms of the maintenance strategy for Holyrood, as the plant is expected to produce electricity with a high level of reliability during construction of the Muskrat Falls Project. Scheduled condition assessments and scheduled maintenance will continue to ensure the plant's reliability.

The long term operational plan for this facility has been developed in the context of the development of Muskrat Falls with a high voltage direct current (HVdc) transmission link to the Island (Labrador Island Link). Holyrood will remain a critical facility during the construction and commissioning of the Muskrat Falls Project. When the Labrador Island Link goes into service, the Holyrood plant will continue to be an essential component of the Island Interconnected System. Initially, the plant will function as a fully capable standby facility during the early years of operation of the HVdc system. After this initial period, the thermal assets will be decommissioned and the facility will be partially converted to a synchronous condensing facility.

The challenges faced by Hydro are complex as circumstances require that Holyrood operate in a manner quite different than that normally required of a thermal plant. The conventional practice is that a thermal plant is base loaded throughout its life until it reaches maturity and is then operated as a peaking or standby facility in its final years, operating at a very low capacity factor, often less than 10%. The Holyrood thermal plant has passed the age at which other utilities have performed condition assessment and life extension studies, similar to Hydro's approach, and have either retired their facilities or have initiated major life extension projects. However, until the Muskrat Falls Generating Plant is completed and power is brought to the Island Interconnected System via the Labrador Island Link, the Holyrood plant must continue to operate at or near its historical levels with annual capacity factor in the range of 35% to 45% and at higher levels through the winter period when availability is critical to meet peak demand. The Holyrood capital projects contained in this application are necessary to refurbish and renew assets that are at the end of their useful service lives, and which must be replaced to maintain reliability through to the completion of the Muskrat Falls development.

Please see the Holyrood Overview section for further discussion pertaining to the proposed 2018 Holyrood projects.

3.1.3 Gas Turbines

Located at the Holyrood Thermal Generating Station site, the Holyrood Gas Turbine is a 123.5 MW gas turbine that has been in service since February 2015. It was installed to provide long term generation capacity for the Island Interconnected System. As referenced in this year's "Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine" proposal, since being placed in service the gas turbine has been utilized more frequently and for longer durations than was originally foreseen. To ensure the continued reliability of this unit, capital expenditures are required for a scheduled inspection and overhaul of the unit and an additional proposal seeks to increase the onsite fuel storage and increase water production for the Holyrood Gas Turbine to ensure peak energy demands can be met.

Hydro's gas turbine plants at Stephenville and Hardwoods are more than 40 years of age, exceeding the generally accepted life expectancy of 25 to 30 years for gas turbine plants. Until their expected retirements in 2025 and 2028, for Hardwoods and Stephenville respectively, the maintenance of these assets will remain part of Hydro's integrated generation plan. Based on the results of condition assessments of both the Hardwoods and Stephenville gas turbines, capital expenditures are required to refurbish equipment at these facilities to ensure that they operate reliably and that their useful service lives can be extended as long as can be financially justified.

3.2 Transmission And Rural Operations

Hydro owns and operates diesel and gas turbine generators with 32.1 MW of net capacity on the Labrador Interconnected system; 14.7 MW of diesel generation on the Island Interconnected system; and diesel generation assets with 33.7 MW of net capacity in 21 isolated rural systems. On the Island Interconnected System, Hydro owns and operates 3,473 kilometers of transmission lines and more than 50 high voltage terminal stations operating at voltages of 230, 138 and 69/66 kV. On the Labrador Interconnected System, Hydro owns and operates 269 kilometers of 138 kV transmission line and the associated terminal stations interconnecting Happy Valley/Goose Bay to Churchill Falls. As per P.U. 37 (2016) and P.U. 7(2017), Hydro now owns and operates the Wabush Terminal Station and has long-term subleases on the two 230 kV transmission lines Between Churchill Falls and Wabush, all of which were previously owned by Twin Falls Power Corporation Limited (TwinCo). In addition, Hydro owns and operates approximately 3,400 kilometers of distribution lines, principally in rural Newfoundland and Labrador.

Hydro's Transmission and Rural Operations assets are replaced based on condition, and require ongoing capital expenditures to maintain reliable service, to comply with environmental regulations, and to ensure the safety of employees, contractors, and the general public. Capital expenditures to provide service extensions remain significant in many areas; however, capital expenditures to provide service extensions on the Labrador Interconnected System have softened, with average expenditures in the past two years (2015-2016) amounting to approximately half of the average expenditures in the previous three years (2012-2014).

Expenditures in the Transmission and Rural Operations category account for 67.5% of overall expenditures for 2018, totaling $139.2 million. The division of the 2018 Capital Budget for Transmission and Rural Operations shown in Figure 4 and Figure 5 provides the five year average expenditures for this category. The increase in expenditures related to Transmission in 2018, over the five year average expenditure, is largely attributable to the Muskrat Falls to Happy Valley Interconnection.

The increase in expenditures at Terminal Stations over the five year average is largely a result of the Wabush Terminal Station refurbishment proposal, refurbishment and upgrade of power transformers and the protection, control, and monitoring equipment, and replacement of instrument transformers, disconnect switches, and insulators, which are all encompassed within the "Terminal Station Refurbishment and Modernization Project".

The increase in Rural Generation over the five year average expenditure is primarily attributable to the proposed overhaul and upgrade of diesel generators in multiple communities required for continued reliability and also a result of the proposed installation of a secondary fuel containment system liner in Nain for environmental protection reasons. Other efficiency and automation improvements are also proposed.

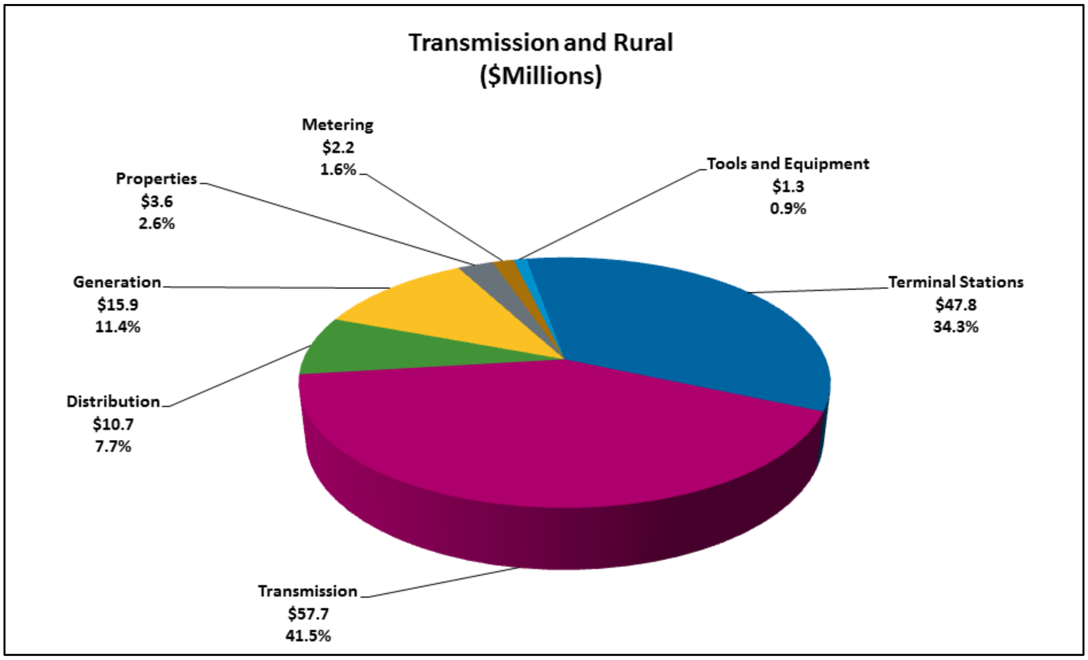


Figure 4: 2018 Capital Budget - Transmission and Rural Operations

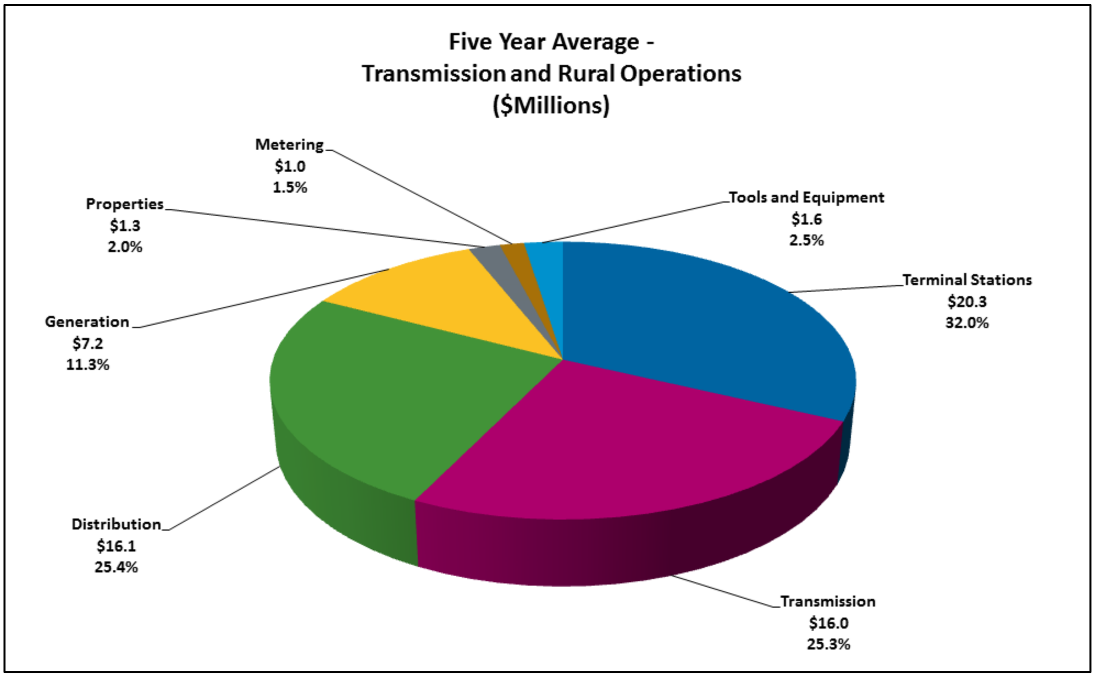


Figure 5: Five-Year Average Capital Expenditures – Transmission and Rural Operations (2012-2016)

3.2.1 Terminal Stations and Transmission

Many of Hydro's transmission lines and terminal stations were constructed in the 1960s with expected useful lives in the range of 40 years. Annual reconstruction and general upgrades are needed to ensure that Hydro can continue to provide customers with reliable electrical service. Within the 2018 submission, projects are proposed for the continued upgrade of power transformers and circuit breakers, as well as the replacement of surge arrestors, instrument transformers, and disconnect switches. The transmission line projects include the continuation of the Wood Pole Line Management Program and the interconnection of Muskrat Falls and Happy Valley required for continued reliability and future load growth of the Labrador Interconnected Transmission System.

3.2.2 Distribution and Rural Generation

The 21 remote electrical systems along the coasts of Labrador and on the Island of Newfoundland are primarily served by diesel generation. Providing service to customers in these communities requires that the fuel storage, diesel generating units, facilities, and distribution systems all be kept in safe, reliable, and environmentally responsible working order. This application includes projects specifically directed towards safely meeting load growth requirements, including the additions for load growth in isolated generation stations and the ongoing installation of fire protections systems in diesel plants. In addition, engine overhauls and replacements will be completed in various diesel plants. This Application also includes proposals that target efficiency improvements and other projects focused on the reduction of environmental risks.

Hydro also provides service to residential and general service customers on the Island and Labrador interconnected systems. Hydro has included projects in this Application that are intended to ensure that distribution lines and equipment that requires replacement due to age and condition are replaced prior to failure, thereby reducing the probability of interrupting service to customers. These projects include the upgrade of the distribution systems in various locations. This Application also includes projects to provide service extensions to new customers throughout Hydro’s service area.

3.3 General Properties

The General Properties classification’s expenditures account for 3.7% of the overall expenditures for 2018, with $7.6 million in proposed capital projects. The General Properties classification includes projects related to Hydro’s information systems, where technology is strategically deployed in a wide variety of business applications. This section of the Application also includes proposals for vehicle replacements and telecommunications system replacements, which are all necessary for the provision of reliable and cost effective service to customers. Figure 6 and Figure 7 show the breakdown of the General Properties Capital Budget for 2018 and the previous five year average, respectively.

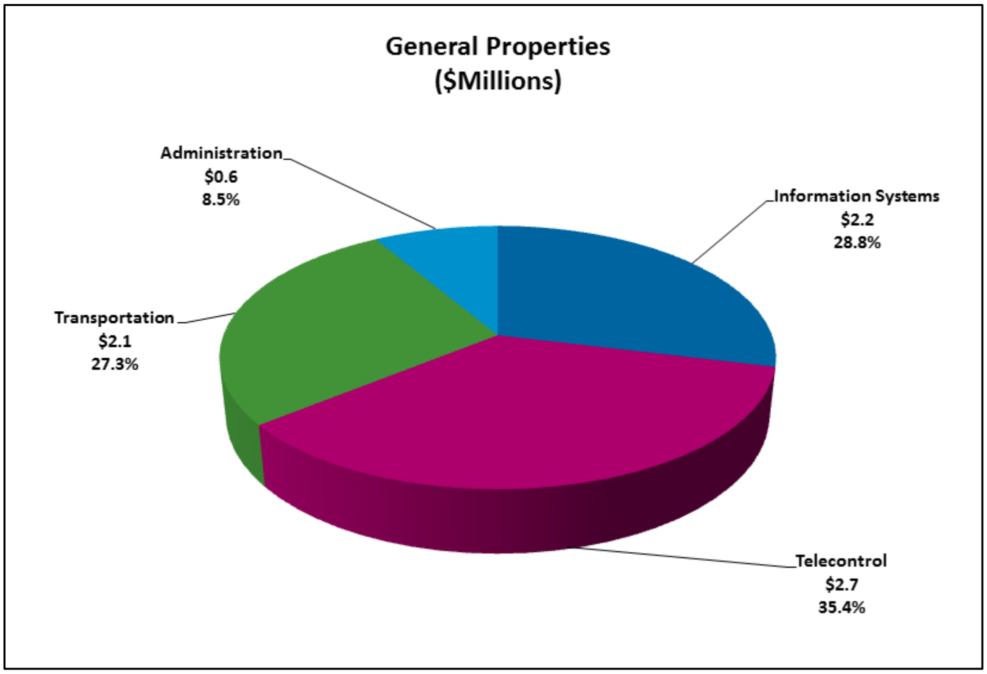


Figure 6: 2018 Capital Budget - General Properties

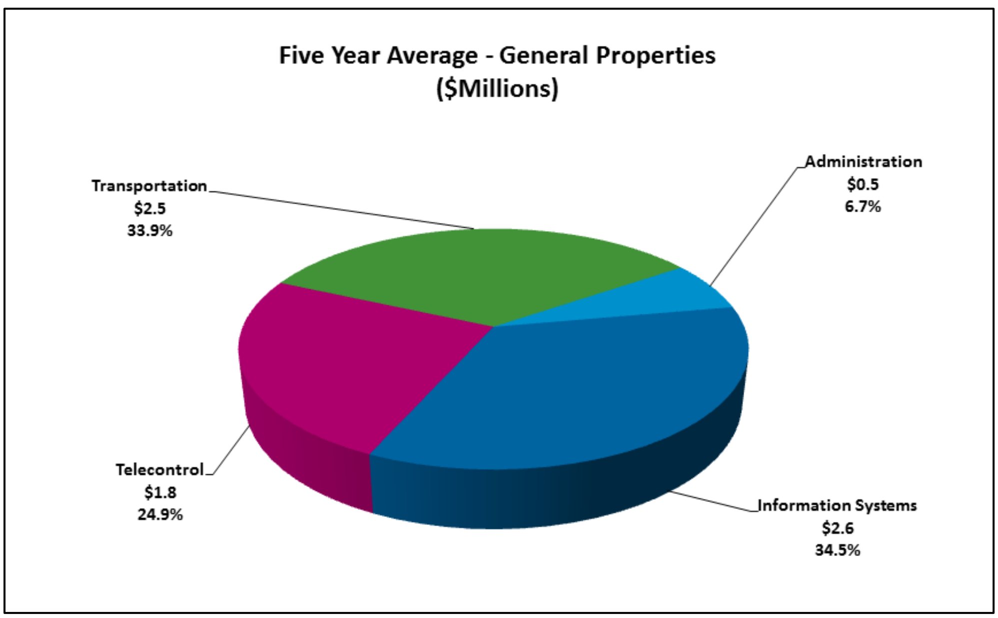


Figure 7: Five-Year Average Capital Expenditures - General Properties (2012-2016)

3.3.1 Information Systems

The Information Systems proposals are directed towards maintaining Hydro's computing capacity and associated infrastructure, ensuring that it remains current and reliable. Projects include upgrades to the software applications used throughout Hydro, upgrades to the energy management system, as well as the replacement of personal computers and peripheral infrastructure.

3.3.2 Telecontrol

Operating an integrated electrical system requires reliable communication systems across Hydro's province-wide facilities both to control equipment and to support employee communications, many of whom work in remote locations. The 2018 capital budget proposals in this category include infrastructure replacements, ongoing replacement or refurbishment programs for such items as battery banks and chargers, network communications equipment, and other equipment that supports the communication's infrastructure.

4.0 General

4.1 Project Prioritization and Ranking

An overall ranking of 2018 projects is attached as Appendix A.

4.2 Projects by Definition and Classification

Table 1 and Table 2 list the 2018 proposed projects by definition and classification, respectively.

Table 1: Projects by Definition

Type	Number	($x1,000)
Clustered	0	0.0
Pooled	10	23,317.1
Other	97	625,203.6
Total	**107**	**648,520.7**

Table 2: Projects by Classification

Type	Number	($000)
Normal	99	337,127.3
Justifiable	7	308,303.8
Mandatory	1	3,089.6
Total	**107**	**648,520.7**

4.3 Phase 1 Engineering Costs

Hydro has tracked the Front End Engineering and Design (FEED) costs specific to each project and these costs form part of the 2018 capital budget submission. Therefore, Hydro's 2018 capital projects include Phase 1 engineering costs that were incurred in association with the related 2018 capital projects and Hydro proposes that the inclusion of these costs be approved.

Hydro has included Phase 1 costs in its capital budget proposals only in those cases where the Phase 1 costs exceed $1,000 for that specific project. Phase 1 costs related to any specific project not receiving Board approval will not be capitalized. The total of these costs included in the 2018 capital budget submission is approximately $650,000.

Appendix A

2018 Project Prioritization

PRIORITIZATION EXPLANATIONS

The following table shows the ranking of Hydro's 2018 capital projects. Rank 1 indicates the projects of the highest importance and in 2018; no projects with a ranking of more than 38 were included in the Application. Projects that received the same score through the prioritization process have the same ranking. The seven projects which are Rank 1 are considered high priority projects required to address safety, mandatory or system load issues. Please note that the non-prioritized projects in the table are multi-year projects and necessary programs.

2018 Capital Budget and Five Year Plan 2018 Project Prioritization			
Project Description	**Cost ($000)**	**Rank**	**Cumulative Project Costs ($000)**
Multi-Year Projects (2018 is 2nd or 3rd Year)	97,120.3	******	97,120.3
TRO Service Extensions and Upgrades	8,170.0	******	105,290.3
Transportation	2,878.9	******	108,169.2
Tools & Equipment	1,083.9	******	109,253.1
Allowance for Unforeseen Items	1,000.0	1	110,253.1
Additions for Load Growth – Happy Valley	505.0	1	110,758.1
Additions for Load Growth – Makkovik and Rigolet	730.1	1	111,488.2
Inspect Fuel Storage Tanks (2018) – Black Tickle	818.7	1	112,306.9
Replace Secondary Containment System Liner – Nain	1,639.2	1	113,946.1
Install Fall Protection Equipment (2018) – Various	46.7	1	113,992.8
Remove Safety Hazards (2018) – Various	199.4	1	114,192.2
Install Automated Meter Reading (2018-19) – Bottom Waters	75.2	2	114,267.4
Hydraulic Generation Refurbishment and Modernization	10,325.4	3	124,592.8
Overhaul Pumps – Holyrood	438.3	4	125,031.1
Overhaul Unit 1 Turbine Valves – Holyrood	2,485.7	5	127,516.8
Overhaul Unit 1 Generator – Holyrood	1,005.0	5	128,521.8

2018 Capital Budget and Five Year Plan 2018 Project Prioritization			
Project Description	**Cost ($000)**	**Rank**	**Cumulative Project Costs ($000)**
Overhaul Diesel Units (2018) – Various	2,852.4	5	131,374.2
Condition Assessment and Miscellaneous Upgrades – Holyrood	2,749.6	6	134,123.8
Hydraulic In-Service Failures	1,251.1	6	135,374.9
Thermal In-Service Failures	1,250.0	6	136,624.9
Purchase Capital Spares – Gas Turbines	626.9	6	137,251.8
Wood Pole Line Management Program – Various	3,532.9	7	140,784.7
Terminal Station Refurbishment and Modernization	8,170.6	8	148,955.3
Upgrade Line Depots (2018) – Various	1,233.0	8	150,188.3
Terminal Station In-Service Failures	1,000.0	9	151,188.3
Upgrade Office Facilities and Control Buildings (2018) – Various	1,180.6	9	152,368.9
Upgrade Energy Management System (2018) – Hydro Place	336.8	10	152,705.7
Replace Personal Computers (2018) – Hydro Place	493.0	10	153,198.7
Replace Peripheral Infrastructure (2018) – Hydro Place	258.4	10	153,457.1
Upgrade Software Applications (2018) – Hydro Place	114.7	10	153,571.8
Perform Minor Enhancements (2018) – Hydro Place	49.4	10	153,621.2
Refresh Security Software (2018) – Hydro Place	62.2	10	153,683.4
Upgrade Core IT Infrastructure (2018) – Hydro Place	352.4	10	154,035.8
Replace RTUs (2018) – Various	118.3	11	154,154.1
Replace Battery Banks and Chargers – Various	382.1	11	154,536.2
Replace Network Communications Equipment (2018) – Various	199.5	11	154,735.7
Upgrade Site Facilities (2018) – Various	49.0	11	154,784.7
Replace Radomes (2018) – Various	360.3	11	155,145.0
Replace Air Conditioners (2018) – Various	74.4	11	155,219.4
Install Remote Operation of Salmon River Spillway – Bay d'Espoir	645.9	12	155,865.3
Refurbish Backfill Penstock 1 – Bay d'Espoir	1,630.4	13	157,495.7
Install Plant Heating System – Holyrood	1,465.0	13	158,960.7
Diesel Plant Fire Protection – Postville	505.6	14	159,466.3

2018 Capital Budget and Five Year Plan 2018 Project Prioritization			
Project Description	**Cost ($000)**	**Rank**	**Cumulative Project Costs ($000)**
Replace Teleprotection – TL261	57.6	14	159,523.9
Install Raw Water Line – Holyrood	1,252.6	15	160,776.5
Distribution System Upgrades (2018-19) – Various	383.8	16	161,160.3
Install Recloser Remote Control (2018-19) – English Harbour West and Barachoix	63.7	17	161,224.0
Replace Transformer T1 – Buchan's	249.0	18	161,473.0
Increase Fuel and Water Treatment System Capacity – Holyrood Gas Turbine	8,829.9	19	170,302.9
Upgrade Aluminium Support Structure – Holyrood	287.6	20	170,590.5
Replace MDR 6000 Microwave Radio – Various	64.0	21	170,654.5
Replace PBX Phone Systems – Various	91.7	21	170,746.2
Turbine Hot Gas Path Level 2 Inspection and Overhaul – Holyrood Gas Turbine	6,538.8	22	177,285.0
Muskrat Falls to Happy Valley Interconnection	23,513.9	23	200,798.9
Gas Turbine Equipment and Refurbishment – Hardwoods and Stephenville	997.9	24	201,796.8
Implement Terminal Station Flood Mitigation – Springdale	186.2	25	201,983.0
Energy Efficiency Improvements – Various	276.2	26	202,259.2
Install Sub-Surface Drainage System – Paradise River	524.9	27	202,784.1
Replace Human Machine Interface (2018) – St. Lewis	280.8	28	203,064.9
Install Energy Efficiency Lighting in Diesel Plants – Various	104.0	29	203,168.9
Purchase Mobile DC Power Systems	270.9	30	203,439.8
Diesel Plant Engine Cooling System Upgrades – Various	638.4	30	204,078.2
Replace Automation Equipment (2018-2019) – St. Anthony Diesel Plant	307.4	30	204,385.6
Diesel Genset Replacements – Makkovik	604.1	31	204,989.7
Install Fire Detection in Outbuildings – Holyrood	198.6	32	205,188.3
Upgrade Ventilation – Cartwright	465.7	33	205,654.0
Upgrade Cranes and Hoists – Holyrood	80.3	34	205,734.3
Install Breaker Bypass Switches – Howley	83.1	35	205,817.4

2018 Capital Budget and Five Year Plan 2018 Project Prioritization			
Project Description	**Cost ($000)**	**Rank**	**Cumulative Project Costs ($000)**
Upgrade Exterior of Building – Hydro Place	260.2	36	206,077.6
Security Improvements – Hydro Place	45.5	37	206,123.1
Replace Washroom Fixtures – Hydro Place	49.5	38	206,172.6

The table below presents the prioritization criteria and the assigned weights used for the 2018 budget.

Criteria		Factors	Factor Weights
1	Work Classification (maximum weight = 85)	Normal Justifiable: Payback (70) Justifiable: Payback (40) Justifiable: Payback (10)	5 15 45 85
2	Net present Value (maximum weight = 85)	NPV ($0) NPV (<$100K) NPV (<$500K) NPV (<1M) NPV (>1M)	0 5 15 45 85
3	Goal 1: Safety (maximum weight = 100)	Minor Treatment Lost Time Disability	10 50 80 100
4	Goal 2: Environment (maximum weight = 100)	None Minor	10 50

Criteria		Factors	Factor Weights
		Moderate	80
		Significant	100
5	Goals 3-5: Alignment	None	15
	(maximum weight = 65)	Maps but no documentation	40
		Maps but with documentation	65
6	Schedule Risk	External and internal conflicts	10
	(maximum weight = 65)	Externals affecting completion	20
		No external but internal conflicts	40
		No conflicts	65
7	Continue service to customers	Can	20
	(maximum weight = 70)	Can but with high costs	50
		Cannot	70

Criteria		Factors	Factor Weights
8	Number of customers impacted	<100	10
	(maximum weight = 70)	<1000	30
		<10,000	50
		>10,000	70
9	System Impact: Critical to …	None specific	5
	(maximum weight = 90)	System with standby unit	50
		Plant or station	70
		Entire system	90
10	Impact intensity	Minor	4
	(maximum weight = 90)	Moderate	40
		Significant	70

		High	90
11	Loss Type: Loss of … (maximum weight = 90)	No type Equipment Facility Production Customer delivery	5 40 50 70 90
12	Loss mitigation (maximum weight = 90)	Redundant unit Backup option Nothing	30 60 90
13	Percent Improvement in 5-Year Average SAIDI or SAIFI (maximum weight = 50)	% SAIDI or SAIFI (0) % SAIDI or SAIFI (<1) % SAIDI or SAIFI (<2) % SAIDI or SAIFI (<3) % SAIDI or SAIFI (>3)	0 10 15 30 50
14	Estimated Project Cost Range (maximum weight = 50)	N.R.P. Cost (>$1M) Cost ($500K - $1M) Cost ($200K - $500K) Cost (<$200K)	0 5 15 30 50

A. <u>Level 1</u>

<u>Immediate HIGH Priority Projects</u>

- **Extreme Safety**

  The project is required to prevent an incident that could cause a fatality or correct a condition that otherwise left unattended may lead to a fatality.

- **Mandator**y

  A capital expenditure that Hydro is obliged to carry out as a result of Legislation, Board Order, Environmental or Safety risk.

- **Load Driven**

  The project is needed to meet load requirements determined by Hydro's latest load forecasts. Without the project, Hydro's firm load and/or reliability criteria will be compromised.

B. <u>Level 2</u>

1. <u>Work Classification</u>

- **Normal**

A capital expenditure which is required based on an identified need or historical patterns of repair and replacement.

- **Justifiable**

A capital expenditure which is justified based on a positive cost savings for Hydro. A cost-benefit analysis is required for the project.

- **Payback (70)**

A cost-benefit analysis indicates that the payback period for the project is within 70% of the anticipated life of the project.

- **Payback (40)**

A cost-benefit analysis indicates that the payback period for the project is within 40% of the anticipated life of the project.

- **Payback (10)**

A cost-benefit analysis indicates that the payback period for the project is within 10% of the anticipated life of the project.

2. <u>Net Present Value</u>

- **NPV ($0)**

The capital proposal generates $0 cost savings to Hydro.

- **NPV (<$100K)**

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $100K for Hydro.

- **NPV (<$500K)**

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $500K for Hydro.

- **NPV (<$1M)**

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $1M for Hydro.

- **NPV (>$1M)**

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of more than $1M for Hydro.

3. Goal 1: Safety

- **Minor**

The project has no or minor safety issues that are insignificant in impact.

- **Treatment**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in the need for medical treatment.

- **Lost Time**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in worker(s) incurring lost time for a short duration.

- **Disability**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in worker(s) incurring long time leave due to inability to continue working on the job.

4. Goal 2: Environment

- **None**

The project has no environmental issues.

- **Minor**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in an environmental impact that:

  - Is irreversible within 2 years; and/or
  - Will cost more than $10,000 to mitigate; and/or
  - Has aspects observed on Hydro's property (at point of impact); and/or
  - Is perceived as in conflict with specific individuals in the local community.

- **Moderate**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in an environmental impact that:

  - Is irreversible within 4 years; and/or
  - Will cost more than $25,000 to mitigate; and/or
  - Has aspects observed within a 1 km radius of Hydro's property (from point of impact); and/or
  - Is perceived as in conflict with the local community or other industries.

- **Significant**

The project is required to prevent an incident or correct a condition that otherwise left unattended may result in an environmental impact that:

  - Is irreversible within the foreseeable future; and/or
  - Will cost more than $50,000 to mitigate and/or
  - Has aspects observed at more than 5 km radius of Hydro's property (from point of impact); and/or
  - Is perceived as in conflict with the local community and the general public and other industries.

5. **Goals 3-5 Alignment**

- **None**

This project does not align with or support any department or corporate goals or objectives.

- **Maps but no Documentation**

This project does align with or support a department or corporate goal or objective but no documentation exists to describe how it maps to the goal or objective.

- **Maps but with Documentation**

This project does align with or support a department or corporate goal or objective and there is documentation that clearly describes how.

6. **Schedule Risk**

- **Externals and Internal Conflicts**

The project has external (to Hydro) dependencies that affect the completion of the project on time and on budget and has major interfaces with other internal initiatives. Examples of external dependencies are: non-Hydro projects that interfere with Hydro proceeding with its project; unavailability of external contractors.

- **Externals Affecting Completion**

The project has only external dependencies that affect the completion of the project on time and on budget.

- **No Externals but Internal Conflicts**

The project conflicts with other internal initiatives that affect the completion of the project on time and on budget.

- **No Conflicts**

The project will not encounter any external or internal conflicts that affect its completion.

7. **Continue Service to Customers**

- **Can**

Service to customers can continue whether or not this project proceeds. Customers can be defined as either internal or external to Hydro.

- **Can but with High Costs**

Service to customers can continue whether or not this project proceeds but a delay in the project will result in Hydro incurring costs. Customers can be defined as either internal or external to Hydro.

- **Cannot**

Service to customers cannot continue without this project. Customers can be defined as either internal or external to Hydro.

8. <u># Customers Impacted</u>

- **<100**

The project will impact up to 100 customers.

- **<1000**

The project will impact up to 1000 customers.

- **<10000**

The project will impact up to 10,000 customers.

- **>10000**

The project will impact more than 10,000 customers.

9. <u>System Impact: Critical to.....</u>

- **None Specific**

The project is not critical to any particular system.

- **System with Standby Unit**

The project is critical to a system that has a standby unit which could be used to maintain operation or support continued service in the event of failure.

- **Plant or Station**

The project is critical to the proper operation of a generating plant or a terminal station.

- **Entire System**

The project is critical to ensure the reliable operation of the Hydro system.

10. Impact Intensity

- **Minor**

If this project does not proceed, the repair time is ***less than half*** the Maximum Acceptable Downtime (MAD) of 830 MWh of unsupplied energy or 2 days (whichever comes first).

- **Moderate**

If this project does not proceed, the repair time is ***greater than the half but less than 90%*** of the Maximum Acceptable Downtime (MAD) of 830 MWh of unsupplied energy or 2 days (whichever is comes first).

- **Significant**

If this project does not proceed, the repair time is ***within plus or minus 10%*** of the Maximum Acceptable Downtime (MAD) of 830 MWh of unsupplied energy or 2 days (whichever is comes first).

- **High**

If this project does not proceed, the repair time ***exceeds by more than 10%*** the Maximum Acceptable Downtime (MAD) of 830 MWh of unsupplied energy or 2 days (whichever is comes first).

11. Loss Type: Loss of.....

- **No Type**

If the project does not proceed, no loss is expected.

- **Equipment**

If the project does not proceed, there exists a risk of the loss of some equipment.

- **Facility**

If the project does not proceed, there exists a risk of the loss of a facility.

- **Production**

If the project does not proceed, there exists a risk of the loss of production at a Hydro generating plant.

- **Customer Delivery**

If the project does not proceed, there exists a risk of being unable to deliver power to Hydro customer(s).

12. <u>Loss Mitigation</u>

- **Redundant Unit**

If the project does not proceed the expected loss will be mitigated by a redundant unit present on the system.

- **Back-up Option**

If the project does not proceed the expected loss will be mitigated by a back-up option which ensures that service continues.

- **Nothing**

This project is required because there is no available means to mitigate the expected loss.

13. Percent Improvement in 5-Year Average SAIDI or SAIFI

- **% SAIDI or SAIFI (0)**

This project will have no effect on the System Average Interruption Duration Index (SAIDI) or System Average Interruption Frequency Index (SAIFI). All non-reliability projects will receive this rating.

  - **% SAIDI or SAIFI (<1)**

This project is expected to improve the SAIDI or SAIFI factor by less than one percent.

- **% SAIDI or SAIFI (<2)**

This project is expected to improve the SAIDI or SAIFI factor by less than two percent but greater than five percent is implied.

- **% SAIDI or SAIFI (<3)**

This project is expected to improve the SAIDI or SAIFI factor by less than three percent but greater than ten percent is implied.

- **% SAIDI or SAIFI (>3)**

This project is expected to improve the SAIDI or SAIFI factor by at least three percent.

14. Estimated Project Cost Range

- **N.R.P.**

This project is a Non Reliability Project.

- **Cost (>$1M)**

The cost of the project is estimated to be more than a million dollars.

- **Cost ($500K - $1M)**

The cost of the project is estimated to be between five hundred thousand and a million dollars.

- **Cost ($200K - $500K)**

The cost of the project is estimated to be between two hundred and five hundred thousand dollars.

- **Cost (<$200K)**

The cost of the project is estimated to be less than two hundred thousand dollars.

PROBABILITY

- **Not Likely**

The risk of the impact is very low if the project does not proceed. It would be surprising that there is an impact.

- **Low Likelihood**

The risk of the impact is low if the project does not proceed. There is about 30% chance of the impact in the proposal year. It’s less likely to happen than not.

- **Likely**

The risk of the impact is possible if the project does not proceed. There is about 50% chance of the impact in the proposal year. It’s as likely to happen as not.

- **Highly Likely**

The risk of the impact is considerable if the project does not proceed. There is about 75% chance of the impact in the proposal year. It's more likely to happen than not.

- **Near Certain**

The risk of the impact is almost certain if the project does not proceed. There is more than 90% chance of the impact in the proposal year. It would be surprising if the impact did not occur.

CONFIDENCE LEVEL

- **Low**

The confidence in the assessment of the impact is low. There are some uncertainties that could significantly change the assessment. The projects risks are not well defined.

- **Medium**

The confidence in the assessment of the impact is uncertain but most likely correct. There are some uncertainties that might moderately change the assessment. The project risks are defined but with some uncertainty.

- **High**

The confidence in the assessment of the impact is very high. The uncertainties won't measurably change the assessment. The project risks are well defined and well controlled.

3. 2018 – 2022 Capital Plan

2018 - 2022 Capital Plan

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
a nalcor energy company

Table of Contents

1.0 Introduction

Newfoundland and Labrador Hydro (Hydro) has a responsibility to provide safe, reliable, and least-cost service to meet the needs of its customers. Providing a reliable supply of electrical energy depends on maintaining assets in sound condition. Utility assets are kept in safe and reliable working condition by performing routine maintenance and completing refurbishments and replacements as necessary. Asset additions are also determined through analysis of long-term requirements to address future demands for power and energy.

In Order No. P.U. 30(2007), Hydro was directed to file a five year capital expenditure plan. The Board of Commissioners of Public Utilities (the Board) indicated the plan should focus on strategic spending priorities beginning with the current year of the Capital Budget Application. As well, the capital expenditure plan should identify shifts in spending priorities over the five year period, the circumstances contributing to these shifts, and alternative approaches under consideration. Additionally, the Board requested a separate section concerning the Holyrood Thermal Generating Station (Holyrood), which at the time had an uncertain future due to alternative developments under consideration. With the sanction of the Muskrat Falls Project in December 2012, the future of the Holyrood plant has been established. The Holyrood section of this plan addresses Hydro's forecasted maintenance and capital requirements for the plant for the next five years.

As of December 2016, Hydro maintains an asset base of $1.7 billion. Some assets have reached or exceeded their expected service lives and many others are approaching that juncture. Other major assets have not reached their expected service lives but some of their components, auxiliary equipment and systems have, or are about to do so. This includes components of major facilities such as the Bay d'Espoir Generating Station (Bay d'Espoir), the Holyrood Thermal Generating Station (Holyrood), the Hardwoods and Stephenville gas turbines and much of Hydro's transmission and distribution systems. Hydro uses an asset management framework to manage these assets.

Hydro has a Five Year Capital Plan, which includes details on the costs and timing of asset replacements and refurbishments. The five year plan is a living document and is revised on an ongoing basis as new asset condition information becomes available, as asset management strategies evolve, and as demands and priorities change within asset classes. The five year plan supports Hydro's responsibility to maintain its infrastructure providing safe, reliable and least cost electricity for home and business use.

2.0 Five Year Plan Overview

Hydro plans to invest $808.9 million in plant and equipment over the 2018 to 2022 period for an average annual capital expenditure of $161.8 million. Individual year expenditures will range from a low of $143.3 million in 2021 and a high of $206.2 million in 2018. Over the period 2012 to 2016, the average annual capital expenditure was $138.3 million. The levelling of capital expenditures reflects Hydro's shift from the growth in the asset base over the past several years, including 2018, to sustaining the asset base into the foreseeable future. Overall capital expenditures reflect the requirement for projects related to replacement and upgrade of deteriorating facilities, ensuring compliance with legislation, and inflation.

The transmission expenditures in 2018 reflect the newly proposed transmission asset from Muskrat Falls to the Happy Valley Terminal Station, which will increase transfer capacity and meet the load requirements of Labrador East. Introduced in 2017, the Terminal Station Refurbishment and Modernization Project consolidates Hydro's asset management philosophies for terminal stations and will guide expenditures over the next five years, including the replacement of end of service life circuit breakers. A new Breaker Bypass Switch Installation Program is being introduced in this year's Application, and will continue as part of the Terminal Station Refurbishment and Modernization Project. This new program will oversee the installation of breaker bypass switches into the future, thus improving system reliability. The Wood Pole Line Management Program will also continue over the next five years.

In 2018, Hydro is introducing the Hydraulic Generation Refurbishment and Modernization Project, which consolidates Hydro's asset management philosophies for Hydroelectric Generation Stations and ensures that equipment is replaced or refurbished in a planned approach. This project will be ongoing over the next five years.

The In-service Failures project for Terminal Stations, and the newly proposed In-service Failures projects for Hydraulic Generation and Thermal Generation, will ensure that failed equipment can be replaced in an expedited manner.

Gas Turbines will continue to be relied upon to provide stand-by and spinning reserve power, and (with the exception of the Holyrood Gas Turbine) to function as synchronous condensers to help control voltage on the Island and Labrador interconnected systems. The five year plan proposes several major projects for the Holyrood Gas Turbine to ensure its availability and reliability, starting in 2018 with a Turbine Hot Gas Path Inspection and Overhaul, a scheduled overhaul requirement based on starts and operating hours, and a project to increase the onsite fuel storage and water production capabilities. A two-year Combustor Inspection Major and Overhaul project is also in the five year plan for this unit, also based on starts and operating hours. Projects for Hardwoods and Stephenville gas turbine plants continue in order to extend their reliable economic service lives.

3.0 Strategic Spending Priorities

Hydro's strategic spending priorities over the next five years address the following areas:

- Mandatory Issues:
    - Ensuring the safety of Hydro personnel, its contractors, and the general public;
    - Compliance with legislative and regulatory requirements; and
    - Managing environmental risks.
- Meeting projected load growth and customer requests;

- Applying a consistent asset maintenance philosophy to ensure system reliability and maintain acceptable asset performance as identified by:
  - Operating experience;
  - Maintenance history;
  - Condition assessments; and
  - Performance evaluation and monitoring.
- Achieving cost efficiencies.

Hydro's detailed Five Year Capital Plan is presented in Appendix A. Over this period, the level of capital expenditure is primarily driven by:

- Age and condition of current infrastructure and assets; and
- Growth in system demand.

4.0 Generation

The requirement to invest sustaining capital in generation facilities increased several years ago as parts of Hydro's generating plants approached or surpassed their normal expected service lives. Primary drivers for these projects are the end of service lives for equipment, deterioration causing reductions in reliability or performance, the availability of more efficient technology, and considerations for safety.

4.1 Hydraulic

The condition of key components of Hydro's hydraulic facilities, including auxiliary systems and equipment as well as the water control structures, have deteriorated and some have reached the end of their service lives. Capital investment is required in these areas to ensure the safe reliable operation of the system. The 2018 Capital Plan introduces a new project called Hydraulic Generation Refurbishment and Modernization, which consolidates program-based projects into a single project, and ensures that equipment is replaced or refurbished in a planned approach. Hydro has had success in introducing asset management programs and is confident that efficiencies will be realized by improving the coordination of capital and maintenance work on the hydraulic generation assets.

4.2 Thermal

On December 17, 2012, the Government of Newfoundland and Labrador announced official sanction of the Muskrat Falls Project. Holyrood will be required for prime power production until the Labrador Island Link (LIL) is in service and it is intended that the Holyrood facility will remain fully available for generation in stand-by mode until the post winter 2021 timeframe. Unit 3 will operate in synchronous condenser mode during this stand-by production phase, with the option to return to full generating mode, if required. Post winter 2021, Units 1 and 2 and the steam components of Unit 3 at Holyrood will be decommissioned and Unit 3 will continue to operate in synchronous condenser mode, with no generation capability.

Holyrood Units 1 and 2 are 47 years old and Unit 3 is 38 years old. The generally accepted life expectancy for thermal plants is 30 years. Holyrood remains critical to the reliable power supply on the Island Interconnected System and especially to the Avalon Peninsula load center. The capital work contained in this plan is necessary to replace or refurbish assets that are approaching the end of their useful service lives.

Please see the "Holyrood Overview" section of this Application for further discussion pertaining to the five year plan for Holyrood and Section I, "Plan of Projected Operating Maintenance Expenditures 2018 – 2027 For Holyrood Generating Station", for future operational and maintenance expenditure forecasts.

4.3 Gas Turbines

Maintaining the reliability of Hydro's gas turbine assets, which are relied upon to provide stand-by and spinning reserve power, and (with the exception of the Holyrood gas turbine) to function as synchronous condensers to help control voltage on the Island and Labrador interconnected systems, is a priority. These facilities accumulate fewer operating hours than other generation sources, but are crucial sources of electricity during emergencies and system peaks and provide voltage support, especially when operating as synchronous condensers.

The new 123.5 MW gas turbine located at the Holyrood site has been in service since February 2015 and is part of Hydro's fleet. It was installed to provide long term generation capacity for the Island Interconnected System. Since being placed in service, the gas turbine has been utilized more frequently and for longer durations than was originally foreseen. To ensure the continued reliability, capital expenditures are required this year to complete a Turbine Hot Gas Path Inspection and Overhaul of the unit. Additionally, Hydro proposes increasing the onsite fuel storage and water production capabilities for the Holyrood Gas Turbine to ensure that peak energy demands can be met. A two-year Combustor Inspection Major and Overhaul project for the Holyrood Gas Turbine is scheduled to start in 2020.

The 50 MW plants at Hardwoods and Stephenville have required relatively little capital expenditure until recent years. Despite their lower operating hours, these units are beyond their normal life expectancy and are deteriorating, requiring an increase in capital expenditures to extend their reliable economic service lives. Multiyear life extension projects for the Hardwoods plant began in 2010. Similar projects for Stephenville began in 2014. Notable projects for these two plants include an upgrade to Stephenville's control system scheduled for 2020-2021 and an overhaul of gas turbine End A at Hardwoods in 2021.

Hydro's gas turbine plant located at Happy Valley was constructed in 1992. This plant has required only minor upgrades since that time, and an overhaul in 2017. An inspection of power turbine clutch is scheduled for 2020 and several projects, including the replacement of the plant's snow doors, voltage regulator, replace lube oil pump and installation of infrared scanning ports, are scheduled for 2021.

5.0 Transmission and Rural Operations

The total investment of capital in transmission and rural operations facilities will begin to see a reduction in expenditures after 2018, primarily as result of the completion of major transmission projects, including the upgrade of the transmission line corridor between Bay d'Espoir and Western Avalon (TL267), the installation of the transmission line between Soldiers Pond and Hardwoods (TL266), and the proposed 2018 project for interconnection between Muskrat Falls and Happy Valley.

Other categories of assets are being replaced or refurbished based on condition assessments and a number of components in various facilities have reached or surpassed their normally expected service lives. Projects in the Transmission and Rural Operations category are to address assets that are at, or near the end of, their service lives, to improve reliability or performance, to improve safety, or to implement more efficient technology.

5.1 Terminal Stations

Maintaining reliability is the principal driver for terminal station expenditures over the next five years. Aging equipment is considered when reviewing short and long term plans. The five year plan contains expenditures such as programs to upgrade power transformers, install on-line transformer gas monitoring units, replace circuit breakers, and replace disconnect switches. The plan also contains station-specific projects such as performing site work at various terminal stations to accommodate mobile substations and installation of fire protection. Hydro continues with its Terminal Station Refurbishment and Modernization Program, which consolidates Hydro's asset maintenance philosophies for terminal stations and will guide expenditures over the next five years, including the replacement of aging circuit breakers.

A new Breaker Bypass Switch Installation Program is being introduced in this year's Application, as part of the Terminal Station Refurbishment and Modernization Project. This new program will oversee the installation of breaker bypass switches into the future, which will reduce unplanned outages and improve overall system reliability.

5.2 Transmission

Transmission investment in the Five Year Capital Plan reflects the anticipated completion of several major projects early in this five year period, followed by a focus on improving reliability and sustaining the transmission asset base.

The major projects to upgrade the transmission line corridor between Bay d'Espoir and Western Avalon (TL267) and the installation of the transmission line between Soldiers Pond and Hardwoods (TL266) are both underway and anticipated to be in-service in 2017 and 2018, respectively. Hydro received approval for TL267 in Order No. P. U. 53(2014). As part of that approval, Hydro is required to file, with each capital budget application filed until the completion of the project, a report on the construction of TL267 addressing the work progress, the expenditure and budget status, and an explanation for any deviations from the project scope and budget. This report is presented in Appendix B.

In 2018, Hydro proposes interconnection between Muskrat Falls and the Happy Valley Terminal Station that will increase transfer capacity and address load growth and reliability for the Labrador Interconnected System, specifically Labrador East. Once this project has been completed, sustaining the existing base and completing reliability improvements will be key drivers of the transmission investment.

The Wood Pole Line Management Program forms the backbone of Hydro's asset management strategy for these facilities. This strategy has been in place for 13 years and its effectiveness and value have been tested and demonstrated, enabling Hydro to realize the maximum useful life from these transmission systems. This Program is based on periodic assessment of the wood transmission poles and facilitates their replacement before failure, while extracting the maximum possible reliable life from each pole. Hydro is also continuing to replace insulators and associated hardware on transmission lines, reducing the risk of service interruptions for customers due to insulator failure.

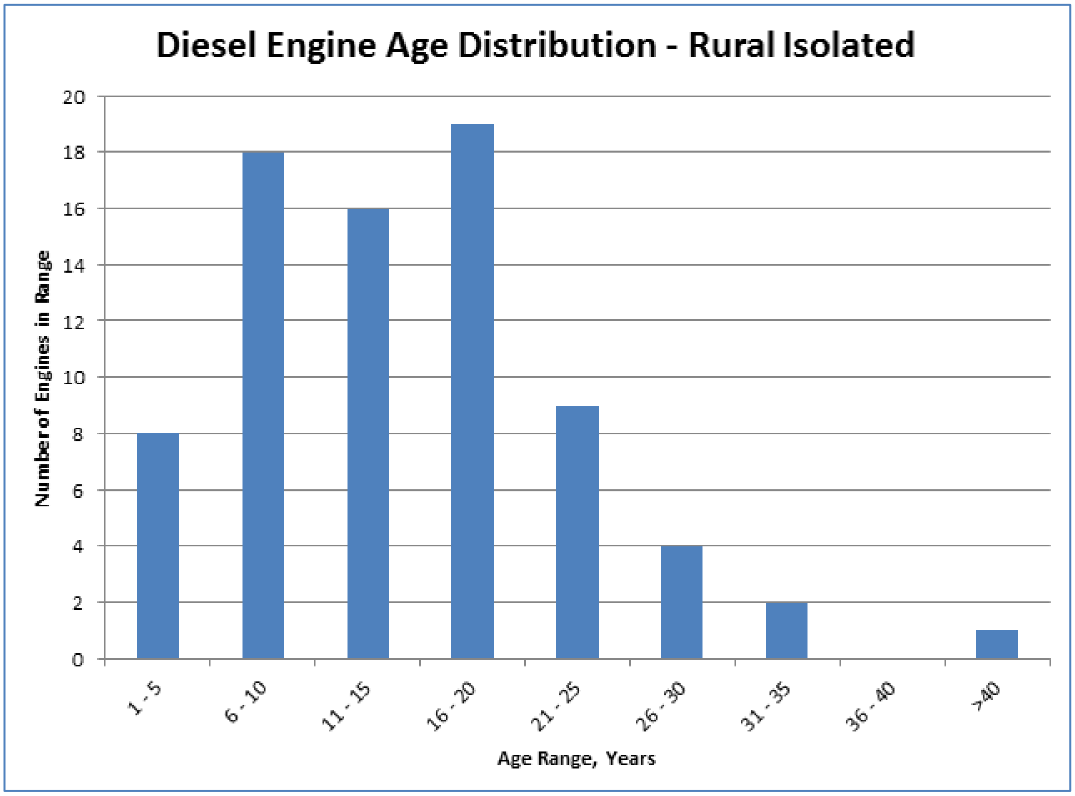
5.3 Distribution

New customer additions and maintaining reliability are the strategic areas addressed by the Five Year Capital Plan for distribution assets. Deteriorated portions of distribution assets must be replaced to ensure reliable service. The majority of the distribution system expenditures for the next five years will consist of service extensions and upgrades to distribution systems, distribution pole replacement, and substation upgrading. A significant project for the next five years is the replacement of the submarine cables between Farewell Head, Change Islands, and Fogo.

5.4 Rural Generation

The replacement of aging infrastructure is required to ensure reliability for Hydro's 21 isolated electrical systems, which are primarily supplied with electricity by diesel generating sets. Hydro's diesel generating sets have the shortest lives of all its generating assets, requiring overhaul after each 20,000 hours and replacement after approximately 100,000 hours of operation. Chart 1 provides the age distribution of the diesel engines in Hydro's rural generating plants. During the next five years Hydro plans to replace or add generating sets in various isolated diesel plants, with the replacement of unit 2059 in Makkovik proposed for 2018. These replacements and additions are required to ensure that reliable service is provided to Hydro's isolated rural customers. Many of Hydro's diesel plants will require refurbishment or replacement in the near to medium term. Hydro is continuing with its prioritization process to assist in planning the replacement or modification in a logical sequence. Projects for the replacement and upgrade of diesel plant infrastructure and auxiliary systems are included over the coming five years. Significant expenditures in this category will include a three-year project to increase capacity for the Labrador South Generation system planned for 2020.

Chart 1: Diesel Engine Age Distribution – Rural Isolated System



6.0 General Property

Hydro's category of general properties is a broad ranging group of assets, and includes assets such as vehicles, facilities of all size, and information systems infrastructure. Similar to other categories, the assets in general properties require replacement or refurbishment due to deterioration, age, obsolescence, and at times, due to growth constraints.

6.1 Information Systems

Obsolete technology and aging hardware are the strategic drivers that most significantly contribute to the five year plan for information systems. Hydro's information systems provide the data required to effectively manage and control the activities of the business. Projects in this category include personal computer and software replacements, and this type of replacement is expected to continue over the next five years.

6.2 Telecontrol

Obsolete technology and aging hardware are the most significant contributions to the five year plan for Telecontrol assets. Hydro's communications network is vital to the operation and control of the power systems. Communications must be reliable and rapid to protect and control the generation, transmission and distribution equipment. The five year plan contains expenditures in the form of several programs to replace battery banks and chargers, replace air conditioners, refurbish microwave sites, and replace obsolete radio equipment. The plan also includes site-specific projects to replace obsolete teleprotection equipment, upgrade telecontrol facilities, and replace uninterruptable power supply units.

6.3 Transportation

Hydro's vehicles and mobile equipment must continue to be both safe and reliable. Hydro operates a diversified and dispersed fleet of mobile equipment throughout the Province that is required to operate and maintain our facilities in a challenging and sometimes harsh physical environment. Hydro selects, operates and maintains this equipment in a manner designed to achieve the least life cycle cost and replacements are scheduled in accordance with criteria previously submitted to the Board.

6.4 Administration

Safety, cost efficiencies, reliability and security are the primary drivers of the five year administration capital plan. Hydro expects to spend $0.95 million annually, on average, over the next five years on items such as office equipment, building auxiliary systems, and building infrastructure.

APPENDIX A

Five-Year Capital Plan

	Expended to 2017	2018	2019	2020	2021	2022	Total
GENERATION	16,917.0	58,397.7	44,627.8	39,873.2	33,126.4	32,287.3	225,229.4
TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	91,150.6	116,741.4	99,283.5	108,032.9	876,650.4
GENERAL PROPERTIES	3,349.7	7,565.8	9,878.9	7,413.4	9,935.8	6,331.9	44,475.5
ALLOWANCE FOR UNFORESEEN ITEMS	0.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	5,000.0
TOTAL CAPITAL BUDGET	342,499.6	206,172.6	146,657.3	165,028.0	143,345.7	147,652.1	1,151,355.3

	Expended to 2017	2018	2019	2020	2021	2022	Total
GENERATION							
Hydraulic Plant	9,121.2	28,072.8	19,914.0	25,109.8	23,577.4	24,219.3	130,014.5
Thermal Plant	6,273.0	12,292.6	15,247.1	11,073.3	3,126.9	6,875.0	54,887.9
Gas Turbines	1,522.8	17,780.6	9,367.4	3,650.0	6,381.0	1,150.0	39,851.8
Tools and Equipment	0.0	251.7	99.3	40.1	41.1	43.0	475.2
TOTAL GENERATION	16,917.0	58,397.7	44,627.8	39,873.2	33,126.4	32,287.3	225,229.4
TRANSMISSION AND RURAL OPERATIONS							
Terminal Stations	29,603.4	47,763.3	51,208.0	46,986.2	25,832.2	35,049.7	236,442.8
Transmission	290,447.9	57,746.2	4,489.3	4,109.1	6,901.2	14,132.8	377,826.5
Distribution	111.3	10,672.0	12,983.9	29,120.2	34,735.2	25,166.5	112,789.1
Generation	1,569.7	15,953.3	16,212.6	29,792.8	22,311.1	26,976.2	112,815.7
Properties	422.0	3,598.4	2,828.9	3,844.8	5,231.9	3,392.7	19,318.7
Metering	78.6	2,165.3	1,409.5	1,444.0	1,925.9	1,683.3	8,706.6
Tools and Equipment	0.0	1,310.6	2,018.4	1,444.3	2,346.0	1,631.7	8,751.0
TOTAL TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	91,150.6	116,741.4	99,283.5	108,032.9	876,650.4
GENERAL PROPERTIES							
Information Systems	877.8	2,180.2	1,408.3	925.2	1,298.0	1,321.0	8,010.5
Telecontrol	470.5	2,675.0	4,717.6	3,103.5	5,655.3	1,852.2	18,474.1
Transportation	2,001.4	2,066.0	2,053.7	2,796.0	2,141.3	2,199.7	13,258.1
Administrative	0.0	644.6	1,699.3	588.7	841.2	959.0	4,732.8
TOTAL GENERAL PROPERTIES	3,349.7	7,565.8	9,878.9	7,413.4	9,935.8	6,331.9	44,475.5
ALLOWANCE FOR UNFORESEEN ITEMS	0.0	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	5,000.0
TOTAL CAPITAL BUDGET	342,499.6	206,172.6	146,657.3	165,028.0	143,345.7	147,652.1	1,151,355.3

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
HYDRAULIC PLANT							
Replace Site Facilities - Bay d'Espoir	5,664.6	6,316.7					11,981.3
Control Structure Refurbishments - Various	1,735.3	452.9					2,188.2
Install Asset Health Monitoring System - Upper Salmon	438.0	203.4					641.4
Refurbish Powerhouse Station Services - Bay d'Espoir	413.2	2,473.3	1,460.6				4,347.1
Replace Slip Rings Units 1-6 - Bay d'Espoir	312.6	159.7					472.3
Water System Replacements - Bay d'Espoir and Cat Arm	265.5	2,288.3					2,553.8
Upgrade Ventilation in Powerhouse 1 and 2 - Bay d'Espoir	134.1	863.8					997.9
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	119.2	921.2	877.0	1,429.6			3,347.0
Refurbish Sump Level System for Powerhouse 2 - Bay d'Espoir	38.7	264.5					303.2
Hydraulic Generation Refurbishment and Modernization (2018-2019)		10,325.4	4,283.1				14,608.5
Refurbish Backfill Penstock 1 - Bay d'Espoir		1,630.4					1,630.4
Hydraulic In-service Failures		1,251.1	1,250.0	1,250.0	1,250.0	1,250.0	6,251.1
Install Remote Operation of Salmon River Spillway - Bay d'Espoir		645.9	1,862.5				2,508.4
Energy Efficiency Improvements - Various		276.2	168.9				445.1
Hydraulic Generation Refurbishment and Modernization			10,011.9	6,108.4			16,120.3
Hydraulic Generation Refurbishment and Modernization				16,321.8	8,819.5		25,141.3
Hydraulic Generation Refurbishment and Modernization					13,507.9	9,778.6	23,286.5
Hydraulic Generation Refurbishment and Modernization						13,190.7	13,190.7
TOTAL HYDRAULIC PLANT	9,121.2	28,072.8	19,914.0	25,109.8	23,577.4	24,219.3	130,014.5

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
THERMAL PLANT							
Upgrade Powerhouse Building Envelope - Holyrood	5,693.7	784.1					6,477.8
Upgrade Holyrood Access Road - Holyrood	579.3	583.4					1,162.7
Condition Assessment and Miscellaneous Upgrades - Holyrood		2,749.6	1,858.8				4,608.4
Overhaul Unit 1 Turbine Valves - Holyrood		2,485.7					2,485.7
Install Plant Heating System - Holyrood		1,465.0	4,220.0				5,685.0
Install Raw Water Line - Holyrood		1,252.6					1,252.6
Thermal In-Service Failures		1,250.0	1,330.0	1,250.0	1,250.0	1,250.0	6,330.0
Overhaul Unit 1 Generator - Holyrood		1,005.0					1,005.0
Overhaul Pumps - Holyrood		438.3					438.3
Install Fire Detection in Outbuildings - Holyrood		198.6					198.6
Upgrade Cranes and Hoists - Holyrood		80.3	300.3				380.6
Overhaul Unit 3 Turbine Valve - Holyrood			3,000.0				3,000.0
Replace Stage II Electrical Distribnution Equipment - Holyrood			2,446.2	2,208.6			4,654.8
Rewind Unit 3 Stator - Holyrood			1,359.6	5,789.0			7,148.6
Overhaul Unit 3 Boiler Feed Pump West - Holyrood			374.0				374.0
Replace Unit 3 258VDC Battery Charger and Batteries - Holyrood			358.2				358.2
Replace Stage 1 4160V AC Breakers - Holyrood				750.0			750.0
Upgrade Cooling Water System Wet Well Stop Log Unit 3 - Holyrood				300.0			300.0
Upgrade UPS 3 and 4 - Holyrood				266.7			266.7
Install New Lube Oil / Seal Oil Systems Unit 3 - Holyrood				255.0	765.9		1,020.9
Upgrade UPS 1 and 2 - Holyrood				254.0			254.0
Replace One of North or South Instrument Air Receiver System Unit 3 - Holyrood					753.0		753.0
Replace One of North or South Service Air Receivers Unit 3 - Holyrood					308.0		308.0
Upgrade Property Fencing - Holyrood					50.0	50.0	100.0
Overhaul Unit 3 Generator - Holyrood						3,100.0	3,100.0
Upgrade Unit 3 Generator (slip rings, bushings, bearings) - Holyrood						1,000.0	1,000.0
Upgrade On Site Roads - Holyrood						500.0	500.0
Upgrade Unit 3 Protective Relaying - Holyrood						500.0	500.0
Upgrade Fire System - Holyrood						275.0	275.0
Inspect and Upgrade Light Oil System - Holyrood						100.0	100.0
Upgrade Bio-Green/Sewage Treatment System - Holyrood						100.0	100.0
TOTAL THERMAL PLANT	6,273.0	12,292.6	15,247.1	11,073.3	3,126.9	6,875.0	54,887.9

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
GAS TURBINES							
Gas Turbine Life Extension - Stephenville	847.5	505.7					1,353.2
Gas Turbine Life Extension - Hardwoods	675.3	281.4					956.7
Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine		8,829.9	3,012.7				11,842.6
Turbine Hot Gas Path Level 2 Inspection and Overhaul - Holyrood Gas Turbine		6,538.8	4,607.7				11,146.5
Gas Turbine Equipment Replacement and Refurbishment - Hardwoods and Stephenville		997.9	429.3				1,427.2
Purchase Capital Spares - Gas Turbines		626.9	300.0	300.0	300.0	300.0	1,826.9
Upgrade Control System - Hardwoods			326.9				326.9
Purchase Spare Parts and Heated Lube Oil Storage - Hardwoods and Stephenville			308.0				308.0
Refurbish Bus Duct - Hardwoods			270.5				270.5
Replace 15kV Cable to 750kVA Transformer - Hardwoods			112.3				112.3
Perform Combustor Inspection - Holyrood				2,500.0	2,500.0		5,000.0
Install Infrared Scanning Ports - Stephenville				250.0			250.0
Inspect Power Turbine Clutch - Happy Valley				200.0			200.0
Refurbish Bus Duct - Stephenville				150.0			150.0
Upgrade Control System - Stephenville				100.0	1,531.0		1,631.0
Inspect Power Turbine Clutch A and B - Hardwoods				100.0	100.0		200.0
Replace Fuel Unloading Pumps - Hardwoods and Stephenville				50.0	50.0		100.0
Overhaul Gas Turbine End A - Hardwoods					1,100.0		1,100.0
Replace Snow Doors - Happy Valley					350.0		350.0
Install Infrared Scanning Ports - Happy Valley					250.0		250.0
Replace Lube Oil and Glycol Pumps - Happy Valley					100.0	300.0	400.0
Inspect Power Turbine - Happy Valley					50.0	250.0	300.0
Replace Voltage Regulator - Happy Valley					50.0	250.0	300.0
Replace Lube Oil / Glycol Cooler Radiator Coil - Happy Valley						50.0	50.0
TOTAL GAS TURBINES	1,522.8	17,780.6	9,367.4	3,650.0	6,381.0	1,150.0	39,851.8
TOOLS AND EQUIPMENT							
Purchase Tools and Equipment less than $50,000 - Bay d'Espoir		235.2	82.5	22.9	23.5	25.0	389.1
Purchase Tools and Equipment less than $50,000 - Holyrood		16.5	16.8	17.2	17.6	18.0	86.1
TOTAL TOOLS AND EQUIPMENT	0.0	251.7	99.3	40.1	41.1	43.0	475.2
TOTAL GENERATION	16,917.0	58,397.7	44,627.8	39,873.2	33,126.4	32,287.3	225,229.4

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TERMINAL STATIONS							
Upgrade Circuit Breakers (2016-2020) - Various	17,777.8	15,408.6	15,247.3	13,026.8	5,200.0	3,600.0	70,260.5
Terminal Station Refurbishment and Modernization - Various	10,831.3	16,550.8					27,382.1
Replace Substation - Holyrood	439.4	758.6					1,198.0
Replace Power Transformers - Oxen Pond	297.5	850.1					1,147.6
Upgrade Frequency Converter - Corner Brook	194.6	2,749.2					2,943.8
Replace 66 kV Station Service Feed - Holyrood	62.8	1,198.6					1,261.4
Terminal Station Refurbishment and Modernization (2018-2019)		8,170.6	18,625.1				26,795.7
Terminal Station In-Service Failures		1,000.0					1,000.0
Upgrade Aluminium Support Structures - Holyrood		287.6					287.6
Purchase Mobile DC Power Systems		270.9	695.6				966.5
Replace Transformer T1 - Buchans		249.0	2,086.1				2,335.1
Implement Terminal Station Flood Mitigation - Springdale		186.2	787.8				974.0
Install Breaker Bypass Switch - Howley		83.1	1,440.9				1,524.0
Terminal Station Refurbishment and Modernization			9,630.4	19,445.9			29,076.3
In-Service Failures			1,000.0	1,000.0	1,000.0	1,000.0	4,000.0
Purchase New Mobile Substation - Bishop Falls			809.4	3,714.1			4,523.5
Install Alternate Station Service - Grand Falls			351.8				351.8
Upgrade Reclosing for Circuit Breakers - Various			233.2	100.0	300.0	200.0	833.2
Install Fire Barriers Between T10 and T12 and Between T10 and T11 - Bay d'Espoir			157.3	1,175.1			1,332.4
Install Firewall Between Transformer and GT - Stephenville			143.1	632.4			775.5
Terminal Station Refurbishment and Modernization				4,831.7	11,623.1		16,454.8
Install Data Acquisition and Trending - Corner Brook				500.0	200.0		700.0
Install Telephone System - Bottom Waters				500.0			500.0
Upgrade Control Building for Staff Working Spaces - South Brook, Doyles				453.4	773.5		1,226.9
Replace Capacitor Bank C1 - Oxen Pond				363.6	369.8		733.4
Construct Fire Separation Wall between Transformers - Happy Valley				300.0			300.0
Upgrade Access Road with New Topping - Buchans				243.4			243.4
Replace Corroded Junction Boxes - Various				200.0	200.0	200.0	600.0
Upgrade Station Lighting - Various				200.0	200.0	200.0	600.0
Install Fire Barriers between T1, T2 and T3 and the Substation - Massey Drive				100.0	400.0	300.0	800.0
Upgrade AC/DC Station Service (2020-2021) - Various				75.0	75.0		150.0
Install Drainage to Stop Surface Flooding - Various				67.8	457.2		525.0
Replace Telecontrol Building and Upgrade Equipment - Daniels Harbour				57.0	764.0		821.0
Terminal Station Refurbishment and Modernization					3,594.6	9,817.9	13,412.5
Upgrade Station Access Road - Various					400.0	200.0	600.0
Upgrade Drainage to Stop Frost Heaving - Various					200.0	400.0	600.0
Upgrade AC/DC Station Service (2021-2022) - Various					75.0	75.0	150.0

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TERMINAL STATIONS (cont'd)							
Replace Transformers - Various						12,200.0	12,200.0
Terminal Station Refurbishment and Modernization						3,844.3	3,844.3
Modify 230kV Bus Height - Western Avalon						2,500.0	2,500.0
Install Remote Control Sectionalizer TL251 - Hampden						437.5	437.5
Upgrade AC/DC Station Service (2022-2023) - Various						75.0	75.0
TOTAL TERMINAL STATIONS	29,603.4	47,763.3	51,208.0	46,986.2	25,832.2	35,049.7	236,442.8

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TRANSMISSION							
Construct 230 kV Transmission Line - Bay d'Espoir to Western Avalon	274,239.7	17,418.3					291,658.0
Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	14,684.4	11,876.5					26,560.9
Transmission Line Upgrades - TL212 and TL218	1,378.2	1,133.3					2,511.5
Replace Insulators - TL227	145.6	271.3					416.9
Muskrat Falls to Happy Valley Interconnection		23,513.9	381.3				23,895.2
Wood Pole Line Management Program - Various		3,532.9	2,722.4	2,156.8	3,198.4	3,272.1	14,882.6
Upgrade Tower Foundations - Various			1,077.6	1,085.2	1,130.4	1,150.0	4,443.2
Upgrade 230 kV L23 and L24 - Churchill Falls to Wabush			308.0	616.3	616.0		1,540.3
Conduct LIDAR Surveys - Various				250.8	256.4		507.2
Replace Line (2021-2023) - TL218					1,700.0	5,743.8	7,443.8
Reliability Improvements for Terminal Station - Hawks Bay						1,542.6	1,542.6
Replace Line - TL203						1,327.2	1,327.2
Construct Transmission Line Equipment Off-Loading Areas - Various						1,097.1	1,097.1
TOTAL TRANSMISSION	290,447.9	57,746.2	4,489.3	4,109.1	6,901.2	14,132.8	377,826.5

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
DISTRIBUTION							
Distribution Upgrades (2017-2018) - Various	64.2	1,130.9					1,195.1
Install Recloser Remote Control - Bottom Waters	47.1	418.6					465.7
Provide Service Extensions - All Regions		4,520.0	4,555.0	4,720.0	4,895.0	5,080.0	23,770.0
Upgrade Distribution Systems - All Regions		3,650.0	3,640.0	3,630.0	3,610.0	3,600.0	18,130.0
Additions for Load Growth - Happy Valley		505.0					505.0
Distribution System Upgrades (2018-2019) - Various		383.8	2,771.2				3,155.0
Install Recloser Remote Control (2018-2019) - English Harbour West and Barachoix		63.7	275.0				338.7
Additions for Load Growth - Distribution Systems			1,000.0	500.0	500.0	500.0	2,500.0
Replace Burgeo Substation Transformer - Various			200.6	841.7			1,042.3
Replace Submarine Cable Farewell Head to Change Islands - Fogo			121.7	11,867.4	16,748.7		28,737.8
Upgrade Distribution System - South Brook			50.0	771.3			821.3
Install Recloser Remote Control (2019-2020) - Various			44.8	158.9			203.7
Upgrade Distribution System - Hawks Bay			44.3	1,185.5			1,229.8
Upgrade Distribution System - Barachoix			44.3	1,050.4			1,094.7
Upgrade Cooper Hill - Labrador City			37.8	686.1			723.9
Upgrade Distribution System (Line 4) - Happy Valley			33.2	765.8			799.0
Upgrade Distribution System - Cow Head			33.2	561.9			595.1
Install Sectionalizer and Replace Poles, L3 - Bottom Waters			33.2	442.1			475.3
Upgrade Distribution System - Hampden			33.2	441.7			474.9
Upgrade Distribution System - Bear Cove			33.2	305.5			338.7
Upgrade Distribution System - Jacksons Arm			33.2	305.5			338.7
Install Sectionalizing for Cold Load Pickup - Port Hope Simpson				250.0			250.0
Upgrade Distribution System (Various Lines) - Happy Valley				125.0	1,000.0		1,125.0
Upgrade Distribution System - Glenburnie				110.0	1,130.0		1,240.0
Implement Geographical Information System - Various				100.0	100.0		200.0
Upgrade Distribution System - Bay d'Espoir				80.0	720.0		800.0
Additions for Load - Labrador South Interconnection				56.4	821.6	6,911.4	7,789.4
Install Recloser Remote Control (2020-2021) - Various				50.0	500.0		550.0
Upgrade Distribution System (Line 7) - Bottom Waters				50.0	470.0		520.0
Convert La Scie L7 to 25 kV - Bottom Waters				35.0	315.0		350.0
Upgrade Distribution System - South East Bight				30.0	295.0		325.0
Upgrade Distribution System - Wabush					1,600.0	1,800.0	3,400.0
Upgrade Distribution System - Mary's Harbour					941.0		941.0
Upgrade Distribution System - Postville					740.0		740.0
Additions for Load (2021) - Dist. Sys. - Relocate Voltage Regulator - Hawks Bay					178.9		178.9
Upgrade Distribution System - Charlottetown					60.0	729.4	789.4
Upgrade Distribution System - Plum Point					60.0	729.4	789.4

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
DISTRIBUTION (cont'd)							
Install Recloser Remote Control (2021-2022) - Various					50.0	513.3	563.3
Distribution System Upgrades (2022-2023)						4,505.0	4,505.0
Replace Submarine Cable to Gaultois - Barachoix						625.0	625.0
Convert L2 to 25kV - Little Bay						173.0	173.0
TOTAL DISTRIBUTION	111.3	10,672.0	12,983.9	29,120.2	34,735.2	25,166.5	112,789.1

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
GENERATION							
Diesel Plant Engine Auxiliary Upgrades - Various	790.6	416.3					1,206.9
Diesel Genset Replacements - Port Hope Simpson and Charlottetown	658.8	5,148.0					5,806.8
Replace Automation Equipment - Mary's Harbour	120.3	1,021.7					1,142.0
Overhaul Diesel Engines - Various		2,852.4	2,319.8	2,370.3	2,424.2	2,500.0	12,466.7
Replace Secondary Containment System Liner - Nain		1,639.2	1,450.4				3,089.6
Inspect Fuel Storage Tanks - Black Tickle		818.7					818.7
Additions for Load Growth - Makkovik and Rigolet		730.1					730.1
Diesel Plant Engine Cooling System Upgrades - Various		638.4	671.6				1,310.0
Diesel Genset Replacements - Makkovik		604.1	4,703.3	3,592.8			8,900.2
Install Sub-Surface Drainage System - Paradise River		524.9					524.9
Diesel Plant Fire Protection - Postville		505.6	336.4				842.0
Upgrade Ventilation - Cartwright		465.7					465.7
Replace Automation Equipment (2018-2019) - St. Anthony		307.4	1,565.9				1,873.3
Replace Human Machine Interface - St. Lewis		280.8					280.8
Replace Unit 2052 - Cartwright			1,009.5	2,665.4			3,674.9
Increase Fuel Storage - Makkovik			1,008.9				1,008.9
Additions for Load Growth - Isolated Generation Stations			1,000.0		500.0	500.0	2,000.0
Inspect Fuel Storage Tanks (2019) - Various			856.3	714.8	700.0	100.0	2,371.1
Replace Unit 2037 - Mary's Harbour			369.0	1,464.9			1,833.9
Replace Automation Equipment (2019-2020) - Various			254.3	957.6			1,211.9
Replace Diesel Plant - Rigolet			205.1	2,050.3	2,101.1		4,356.5
Replace Human Machine Interface (2019-2020) - Various			162.2	192.6			354.8
Replace Unit 2039 - St. Lewis			150.0	1,300.0			1,450.0
Replace Unit 3033 - Makkovik			100.0	2,400.0			2,500.0
Install Fire Protection in Diesel Plants (2019-2020) - Black Tickle			49.9	899.7			949.6
Additions for Load - Labrador South Generation - Super Diesel				2,567.4	8,072.6	11,574.2	22,214.2
Addition for Load Growth - Upgrade S/S Transformer and Increase Capacity - Makkovik				1,853.6			1,853.6
Purchase Mobile Diesel - Bishop Falls				1,400.0			1,400.0
Install Unit Fuel Metering -Various				600.0			600.0
Replace Existing Bus with 1,600 Amp Bus - Hopedale				500.0			500.0
Replace Main Breaker and Extend Plant - Little Bay Island				500.0			500.0
Upgrade Septic System - Nain				500.0			500.0
Build Roadway for Freight Delivery - Norman Bay				307.0			307.0
Install Sequence of Events Monitor in Diesel Plants - Various				281.0	289.1		570.1
Replace Programmable Logic Controllers - Various				250.0	250.0	250.0	750.0
Construct Site Fencing - Port Hope Simpson				250.0			250.0
Upgrade Water Line to Diesel Plant - Makkovik				250.0			250.0

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
GENERATION (cont'd)							
Purchase and Install Sewage Lift System - Rigolet				210.1			210.1
Install Automatic Oil Filling System -Various				200.0			200.0
Install Engine Starting System - Various				200.0			200.0
Replace Unit Breakers - Port Hope Simpson				200.0			200.0
Upgrade and Add Site Fencing - Lanse Au Loup				200.0			200.0
Install Waste Oil Storage Tank - Various				150.0			150.0
Upgrade Fuel Storage - Little Bay Island				125.3			125.3
Construct Lube Oil Ramp For Waste Oil - Nain				120.0			120.0
Replace Unit 5056 - St. Brendans				110.0	1,590.0		1,700.0
Replace Unit 577 - Postville				110.0	1,590.0		1,700.0
Install Fire Protection in Diesel Plants (2020-2021) - Paradise River				100.0	900.0		1,000.0
Replace Human Machine Interface (2020-2021) - Various				100.0	300.0		400.0
Build Fire Separation Wall Between Transformers - St. Anthony, Lanse Au Loup				50.0	250.0		300.0
Construct Site Fencing - Norman Bay				50.0			50.0
Perform Plant Improvements (2021-2022) - Various					1,039.1	2,076.0	3,115.1
Replace PLCs and Software - Various					300.0	300.0	600.0
Replace Bulk Storage Piping - Black Tickle					300.0		300.0
Replace Fuel Lines and Control Valves to Bulk Storage.- Various					250.0	250.0	500.0
Replace PML 3800 Series Mini RTUs - Various					250.0	250.0	500.0
Upgrade Fuel Piping Bulk Tanks to Units - Grey River					200.0		200.0
Replace Unit Breakers - Various					150.0	200.0	350.0
Install Infrared Scanning Ports - Various					150.0	150.0	300.0
Increase Plant Storage - PDR, Makkovik, Norman Bay					150.0		150.0
Replace Unit 2053 - Hopedale					130.0	2,470.0	2,600.0
Install Fire Protection in Diesel Plants (2021-2022) - Charlottetown					100.0	923.4	1,023.4
Replace Human Machine Interface (2021-2022) - Various					100.0	307.6	407.6
Replace DSLC and MSLC - Various					100.0	100.0	200.0
Install Electric Trolly on Jib Crane - Various					75.0	75.0	150.0
Replace Radiator Stands - Black Tickle					50.0	150.0	200.0
Replace Diesel Engine - Various						3,300.0	3,300.0
Install Fire Protection in Diesel Plants (2022-2023) - Various						500.0	500.0
Perform Plant Improvements (2022-2023) - Various						250.0	250.0
Upgrade Old Diesel Plant For Storage Area - Nain						250.0	250.0
Replace Human Machine Interface (2022-2023) - Various						150.0	150.0
Replace Unit 2054 - Hopedale						150.0	150.0
Automate Diesel Plant - Postville						100.0	100.0
Replace Unit 2058 - Little Bay Island						100.0	100.0
TOTAL GENERATION	1,569.7	15,953.3	16,212.6	29,792.8	22,311.1	26,976.2	112,815.7

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
PROPERTIES							
Construct Facilities - Various	422.0	1,034.1					1,456.1
Line Depot Condition Assessment and Refurbishment - Various		1,233.0	1,077.9	1,000.0	1,138.4	1,170.1	5,619.4
Upgrade Office Facilities and Control Buildings - Various		1,180.6	1,102.6	1,000.0	1,164.4	1,196.7	5,644.3
Install Energy Efficiency Lighting in Diesel Plants - Various		104.0	119.0	122.2			345.2
Install Fall Protection Equipment - Various		46.7					46.7
Install Pole Storage Ramps - Various			415.5	500.0	500.0	500.0	1,915.5
Upgrade Fire System - Bishop Falls			113.9	889.8			1,003.7
Construct Storage Building - Springdale				132.8	730.0		862.8
Replace Roof on Garage - Bishop Falls				100.0			100.0
Upgrade HVAC System - Stephenville				100.0			100.0
Replace In-Floor Drains and Sanatiry Lines - Bishop Falls					746.7		746.7
Upgrade Outside Property - Various					650.0	405.9	1,055.9
Upgrade Classroom and Boardroom in Main Office - Bishop Falls					179.4		179.4
Upgrade Outside Property - Deer Lake					123.0		123.0
Upgrade Outside Property - Happy Valley						120.0	120.0
TOTAL PROPERTIES	422.0	3,598.4	2,828.9	3,844.8	5,231.9	3,392.7	19,318.7
METERING							
Install Automated Meter Reading (2017-2018) - Happy Valley	78.6	1,891.6					1,970.2
Purchase Meters and Metering Equipment- Various		198.5	199.1	198.4	198.9	199.3	994.2
Install Automated Meter Reading (2018-2019) - Bottom Waters		75.2	1,001.0				1,076.2
Install Automated Meter Reading (2019-2020) - Various			209.4	1,030.6			1,240.0
Install Automated Meter Reading (2020-2021) - Various				215.0	1,500.0		1,715.0
Install Automated Meter Reading (2021-2022) - Various					227.0	1,250.0	1,477.0
Install Automated Meter Reading (2022-2023) - Various						234.0	234.0
TOTAL METERING	78.6	2,165.3	1,409.5	1,444.0	1,925.9	1,683.3	8,706.6
TOOLS AND EQUIPMENT							
Replace Light Duty Mobile Equipment - Various		429.0	469.6	484.4	620.6	625.0	2,628.6
Replace Off-Road Track Vehicles - Bishop Falls and Bay d'Espoir		213.7	986.3				1,200.0
Purchase Tools and Equipment Less than $50,000		257.4	166.5	139.9	109.1	59.0	731.9
Purchase Tools and Equipment less than $50,000		93.9	96.0	98.2	80.3	81.0	449.4
Purchase Tools and Equipment less than $50,000		146.4	113.0	62.3	63.6	64.0	449.3
Replace Front End Loader Unit No. 9628 - Bay d'Espoir		170.2					170.2
Replace Back Hoe Unit No. 9813 - Holyrood			173.0				173.0
Replace Off-Road Track Vehicle Unit No. 7565 - Stephenville			14.0	441.9			455.9
Replace Off-Road Track Vehicle Unit No. 7799 - Springdale				200.0			200.0

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TOOLS AND EQUIPMENT (cont'd)							
Replace Off-Road Track Vehicle Unit No. 7974 - Stephenville				8.8	741.2		750.0
Replace Off-Road Track Vehicle Unit No. 7698 - Stephenville				8.8	455.2		464.0
Replace Excavator Unit No. 7063 - Bay d'Espoir					92.0		92.0
Replace Excavator Unit No. 7064 - Springdale					92.0		92.0
Replace Excavator Unit No. 7065 - Bay d'Espoir					92.0		92.0
Replace Off-Road Track Vehicles V7067, V7601, V9829						802.7	802.7
TOTAL TOOLS AND EQUIPMENT	0.0	1,310.6	2,018.4	1,444.3	2,346.0	1,631.7	8,751.0
TOTAL TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	91,150.6	116,741.4	99,283.5	108,032.9	876,650.4

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
INFORMATION SYSTEMS							
SOFTWARE APPLICATIONS							
Upgrade Microsoft Office Products - Hydro Place	1,637.1	957.3					2,594.4
Cost Recovery	(759.3)	(444.0)					(1,203.3)
Upgrade Energy Management System - Hydro Place		336.8	346.0	371.5	381.5	391.0	1,826.8
Upgrade Software Applications - Hydro Place		114.7	118.1	100.0	100.0	100.0	532.8
Refresh Security Software - Hydro Place		62.2	50.0	50.0	50.0	50.0	262.2
Perform Minor Enhancements - Hydro Place		49.4	64.0	60.0	60.0	60.0	293.4
TOTAL SOFTWARE APPLICATIONS	877.8	1,076.4	578.1	581.5	591.5	601.0	4,306.3
COMPUTER OPERATIONS							
Replace Personal Computers - Hydro Place		493.0	425.9	76.5	371.2	380.0	1,746.6
Upgrade Core IT Infrastructure - Hydro Place		352.4	88.8	142.2	210.3	215.0	1,008.7
Replace Peripheral Infrastructure - Hydro Place		258.4	315.5	125.0	125.0	125.0	948.9
TOTAL COMPUTER OPERATIONS	0.0	1,103.8	830.2	343.7	706.5	720.0	3,704.2
TOTAL INFORMATION SYSTEMS	877.8	2,180.2	1,408.3	925.2	1,298.0	1,321.0	8,010.5

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TELECONTROL							
NETWORK SERVICES							
Replace Battery Banks and Chargers (2017-2018) - Various	379.3	566.2					945.5
Upgrade Telecontrol Facilities - Mary March Hill and Blue Grass Hill	91.2	665.9					757.1
Replace Battery Banks and Chargers - Various		382.1	555.8				937.9
Replace Radomes - Various		360.3	253.6	185.0	180.0	180.0	1,158.9
Replace Network Communications Equipment - Various		199.5	198.1	185.0	180.0	180.0	942.6
Replace RTUs - Various		118.3	112.0	100.0	100.0	100.0	530.3
Replace PBX Phone Systems - Various		91.7	1,150.6				1,242.3
Replace Air Conditioners - Various		74.4	173.9	150.0	150.0	150.0	698.3
Replace Massey Drive 6000 Microwave Radio - Various		64.0	1,137.0				1,201.0
Replace Teleprotection - TL261		57.6	459.8				517.4
Upgrade Site Facilities - Various		49.0	48.9	49.1	48.0	48.0	243.0
Purchase Tools and Equipment less than $50,000		46.0	47.1	48.2	49.3	50.0	240.6
Replace Battery Banks and Chargers (2019- 2020) - Various			268.0	463.5			731.5
Upgrade Access Roads - Microwave Sites			127.6	127.2	132.0	132.0	518.8
Upgrade Telecontrol Facilities - Gull Pond Hill, BDH			96.0	698.9			794.9
Replace Teleprotection (Bay d'Espoir to SSD) - TL202 and TL206			89.2	848.6			937.8
Replace Battery Banks and Chargers (2020- 2021)- Various				200.0	600.0		800.0
Upgrade Telecontrol Facilities - GDH				48.0	350.0		398.0
Replace VHF Mobile Radio System - Various					2,800.0		2,800.0
Replace SCADA Communications Equipment - Peters Barren to Hawks Bay - TL221					666.0		666.0
Replace Battery Banks and Chargers (2021- 2022) - Various					200.0	612.2	812.2
Replace Back-up Generators - Microwave Sites					200.0	200.0	400.0
Replace Battery Banks and Chargers (2022- 2023) - Various						200.0	200.0
TOTAL TELECONTROL	470.5	2,675.0	4,717.6	3,103.5	5,655.3	1,852.2	18,474.1

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
TRANSPORTATION							
Replace Vehicles and Aerial Devices (2017-2018) - Various	2,001.4	398.8					2,400.2
Replace Vehicles and Aerial Devices (2018-2019) - Various		1,667.2	753.7				2,420.9
Replace Vehicles and Aerial Devices - Hydro System (2019-2020) - Various			1,300.0	643.0			1,943.0
Replace Vehicles and Aerial Devices - Hydro System (2020-2021) - Various				2,153.0	745.0		2,898.0
Replace Vehicles and Aerial Devices - Hydro System (2021-2022) - Various					1,396.3	799.7	2,196.0
Replace Vehicles and Aerial Devices - Hydro System (2022-2023) - Various						1,400.0	1,400.0
TOTAL TRANSPORTATION	2,001.4	2,066.0	2,053.7	2,796.0	2,141.3	2,199.7	13,258.1
ADMINISTRATION							
Upgrade Exterior of Building - Hydro Place		260.2	405.7				665.9
Remove Safety Hazards - Various		199.4	197.9	214.2	219.6	220.0	1,051.1
Purchase Office Equipment		90.0	39.1	40.1	71.6	44.0	284.8
Replace Washroom Fixtures - Hydro Place		49.5	49.5	49.6			148.6
Security Improvements - Hydro Place		45.5	82.8	84.8			213.1
Replace Transfer Switch - Hydro Place			427.5				427.5
Pave Middle Parking Lot and Replace Curb and Drainage - Hydro Place			323.1				323.1
Refurbish Stairways, Railings and Entrance Ways - Hydro Place			126.3				126.3
Replace Domestic Water Entrance - Hydro Place			47.4				47.4
Replace Elevator Motors and Controls Equipment - Hydro Place				200.0			200.0
Replace Roof on Office Building - Bishop Falls					300.0		300.0
Upgrade HVAC System - Bishop Falls and Whitbourne					200.0		200.0
Replace Warehouse Ramps - Port Saunders					50.0		50.0
Replace Lower East Parking Lot Curbs, Catch Basins and Drainage - Hydro Place						500.0	500.0
Replace Domestic Water Valves - Hydro Place						100.0	100.0
Replace Cabinets in Kitchenettes - Hydro Place						60.0	60.0
Replace Overhead Doors - Hydro Place						35.0	35.0
TOTAL ADMINISTRATION	0.0	644.6	1,699.3	588.7	841.2	959.0	4,732.8
TOTAL GENERAL PROPERTIES	3,349.7	7,565.8	9,878.9	7,413.4	9,935.8	6,331.9	44,475.5
Total (Including Allowance for Unforeseen Items)	342,499.6	206,172.6	146,657.3	165,028.0	143,345.7	147,652.1	1,151,355.3

APPENDIX B

TL 267 PROJECT – 230 kV Transmission

Bay d'Espoir to Western Avalon

Annual Report

Summary

The Board of Commissioners of Public Utilities (the Board) approved the Newfoundland and Labrador Hydro Upgrade of Transmission Line Corridor (the Project) on December 12, 2014, with a total capital expenditure of approximately $291M and an in-service date of May 1, 2018. As TL267 has a material impact on system reliability and eliminates system constraints relating to power flow to the Avalon Peninsula, the schedule was accelerated to be in service October 31, 2017.

The project includes expansion of the Bay d'Espoir (BDE) Terminal Station, the Western Avalon (WAV) Terminal Station (located in Chapel Arm), and 188 km of 230 kV transmission line.

The environmental assessment (EA) process was longer than anticipated, with the project submitted for registration on July 16, 2015, and environmental assessment release granted on June 15, 2016. Given the timing of the release from the EA process, the schedule is considered challenging.

The first construction activity began on June 27, 2016, with the commencement of transmission line clearing, which is now complete. The right-of-way access road construction is approximately 91% complete. 525 of 583 tower foundations have been installed and 360 of 583 towers have been assembled. Anchor drilling for 420 of 517 structures is complete to date. 239 towers have been erected to date. Stringing operations are approximately 20% complete.

Work in the Bay d'Espoir Terminal Station began late October 2016, with civil works. Work is tracking on schedule. Foundation work is complete, with the civils contractor scheduled to demobilize on July 5, 2017. Erection of terminal station structures and placement of

breakers and disconnect switches on their foundations is ongoing. The large gantry structures were erected during May 2017.

Work in the Western Avalon Terminal Station began in September 2016. The Gas Insulated Switchgear (GIS) arrived during June 2017. Installation of building services is substantially complete and construction activities are now focused on installation of the GIS. All foundation construction for the terminal station structures is complete and preparations are underway for work associated with the first major outage on July 7, 2017.

Procurement plans are on track with all major purchase orders and contracts in place. The primary focus continues to be on monitoring production progress and material deliveries.

An incident on June 19, 2017, during construction of the transmission line resulted in the fatality of two contractor employees. An investigation into the incident is currently being carried out by Occupational Health and Safety, with full support and cooperation provided by Hydro and our Contractor. All guyed tower activities have been suspended; however, other ground activities and station work are resuming in a phased approach. Hydro is continuing to assess the impact that this incident will have on the in-service date. Hydro will inform the Board, within the established process, with any updates as they become available.

Cost expenditure is tracking as expected, with expenditure to date of approximately $164M.

It should be noted that project activities such as access road and environmental reclamation, material and inventory reconciliation, demobilization of construction forces, as-built submittals, and project close out documentation will continue beyond the energization date into 2018.

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1.0 Introduction

The Board of Commissioners of Public Utilities (the Board) approved the Project on December 12, 2014. The Project, now known as TL267, involves design and construction of 188 km of 230 kV steel tower transmission line, as well as station expansions at Bay d'Espoir and Chapel Arm (Western Avalon Station). The approved capital expenditure is $291,658,000. As directed by the Board as part of the release of the Project, an annual report shall be filed with each capital budget application until completion of the Project.

2.0 Project Description

On April 30, 2014, Hydro filed an application for approval to construct a 230 kV transmission line between Bay d’Espoir (BDE) Hydroelectric Generation Station and Western Avalon Terminal Station (WAV) at Chapel Arm, including upgrades at both stations to accommodate the new infrastructure. The Project was justified based on maintaining system reliability and meeting the long-term power requirements of the Island Interconnected System. It will provide additional capacity, enhance resiliency to system faults, and relieve congestion on the existing transmission system. Based on the information supplied by Hydro as part of the Project review process, the Board released Board Order P.U. 53(2014) on December 12, 2014, approving the Project as described.

The Project is comprised of three distinct projects, and two sub-projects. The three distinct projects are:

1. The addition of portions of an air insulated breaker and one half station diameter at Bay d’Espoir Terminal Station 2, including:
    a. Two circuit breakers and associated disconnect switches; and
    b. Electrical and protection and control (P&C) equipment.
2. The addition of gas insulated switchgear (GIS) ring bus in WAV at Chapel Arm; and
3. A new 230 kV transmission line 188 km in length linking the two stations.

The two sub-projects are:

1. Modifications to BDE TS2 to allow for independent isolation of TL 206, converting the existing ring bus to a breaker and one half scheme; and
2. Modifications to WAV to connect TL 208, which currently services the Vale site, to the new station expansion.

Given limited outage opportunities, the two sub-projects will be executed as second priority to TL267 and will be completed as outage coordination and limitations permit.

3.0 Engineering

The Project, including all station modifications and line designs, utilizes all of the latest industry standards, practices, and design criteria currently in use by Hydro. Modifications to the terminal stations include the latest electrical and protection and control equipment that is currently maintained in the system and form the basis of new designs going forward. Transmission line design utilizes Hydro's operational experience and design criteria applicable along the existing corridor to ensure a reliable addition to the Island Interconnected grid.

The engineering for TL267 involved the creation of a new tower family capable of structurally maintaining reliable service with the inclusion of shield wire for lighting outage protection. These towers follow the Guyed-Y configuration (see Section 9) with the A-Type tower capable of 0° to 1° line angles, and a B-Type tower designed for angles of 0° to 6°. Two new strain towers are required, with a self-supported C-Type tower capable of angles from 0° to 30°, and a full-tension dead-end D-Type tower for 0° to 45°. The D-Type tower is capable of anti-cascade failure containment within the range of angles of the tower. The existing Hydro NDD-Type tower, designed for the Avalon Upgrade in the early 2000s, has been verified as adequate for this application and will be utilized for angles between 45° and 90°. Shield wires, including one standard overhead ground wire and one optical ground wire, which include optical fibres for the communication system, are utilized along the entire length.

Design for the new tower family commenced in January 2015 and foundation design began in May 2015, once tower loads and reaction forces were finalized. Tower designs and foundation designs are 100% complete, as is prototype assembly and full scale tower testing. Tower and foundation fabrication is also complete and all materials have been delivered to the Project.

Detailed design for the terminal stations is also complete. For the Bay d'Espoir Station, the original station design included space for an additional electrical breaker-and-one-half diameter and therefore expansion outside the existing station footprint was not required. The new station diameter includes standard AIS using modern circuit breakers and associated equipment and infrastructure. Support equipment, including take-off structures for the overhead lines, are similar to the existing infrastructure. New protection and control panels have been designed and fabricated. Connection to the Supervisory Control and Data Acquisition (SCADA) system for communication with the Energy Control Centre is also required.

The Western Avalon Station involves a new GIS module given the lack of easily usable space around the station, and the cost of developing new land in the area. An investigation confirming the requirement for GIS was completed and verified that GIS is the most economical solution for Western Avalon. Hydro currently has a GIS at the Cat Arm Generating Station, which has operated reliably for the past 30 years, and GIS solutions are common in areas when the footprint is limited.

Western Avalon Terminal Station will be executed as an Engineer, Procure and Construct (EPC) contract. This contract has been tendered and awarded and the detailed engineering phase is nearing completion. Engineering for Bay d'Espoir Terminal Station is complete and the procurement package for the AIS circuit breakers has been awarded. Engineering for the protection, control, and communications panels is complete and the tender for this equipment has been awarded.

4.0 Environmental Assessment

Given the size and nature of the Project, registration for environmental assessment (EA) under the Environmental Protection Act was required. Environmental assessment is an evaluation of a project's potential environmental risks and effects before it is carried out. EA also identifies ways to improve project design and implementation to prevent, minimize, mitigate, or compensate for adverse environmental effects and to enhance positive effects. The EA Registration Document for this project was an enhanced registration document, which included baseline studies for key environmental components such as caribou, avifauna, historic resources, rare plants, and an assessment of the effects of the Project on these components.

Consultation is a cornerstone of the EA process. Hydro consulted with key stakeholders and held open house sessions in June 2015 in select communities including Bay d'Espoir, Come By Chance, and Chapel Arm to inform stakeholders about the new line and to have meaningful discussions and identify concerns.

The Project was submitted for registration as an undertaking under Part 10 of the Provincial *Environmental Protection Act* on July 16, 2015. Following a public review period, the Minister of Environment and Conservation normally has 45 days from registration to notify the proponent of release, or that an environmental preview report or environmental impact statement is required. However, the preferred and primary routing through the Bay Du Nord Wilderness Reserve (BDNWR) delayed the decision by the Minister until the process described in the following paragraph was completed.

The primary route for TL267 is parallel and adjacent to existing transmission lines along the entire 188 km to minimize the environmental impact. The primary route is located within the BDNWR for 13 km. The reserve was established as a Wilderness Reserve under the Newfoundland and Labrador Wilderness and Ecological Reserve Act in 1990. Although it contains two existing transmission lines constructed in the mid-1960s, the Wilderness Reserve

Regulations do not allow for the construction of a new transmission line through the BDNWR. Provisions in the Act outline the process to allow for the Lieutenant-Governor in Council to reduce the size of the reserve. In order to allow for line construction through the BDNWR, the proposed right of way, 40 m wide and 13 km long, would have to be removed from the reserve. The process required for this removal was initiated in May 2015, and was concluded in early June 2016. The release from further Environmental Assessment was subsequently issued by the Department of Environment and Conservation on June 15, 2016.

5.0 Procurement

Procurement activities are substantially complete with all of the packages tendered and awarded (refer to Table 1).

The contract for the supply of the towers and tower foundations, which was on the critical path for the Project, is substantially complete. The tower and foundation steel began arriving in Newfoundland during August 2016, with the last shipment received in March 2017.

The transmission line clearing contract was executed by Newfoundland and Labrador Vegetation Control between June and November 2016, and is now closed.

The tender for the transmission line construction contract closed on June 1, 2016. The successful bidder was Forbes Brothers Ltd. and the contract was awarded July 28, 2016. This work is ongoing.

The tender for the EPC Contract for the WAV GIS module was awarded to Siemens in June 2016 and engineering for the module was initiated immediately upon award. All major items, including the GIS, required for the successful execution of this project have been procured with the vast majority having been received on site.

The tender for the AIS electrical equipment was awarded to GE/Alstom. The order for the four AIS breakers was placed immediately upon award, and the breakers were received on site on January 16, 2017.

The package for supply of protection and control equipment for BDE-TS2 was awarded to Rising Edge Technologies (RET) on October 5, 2016. Fabrication and Factory Acceptance Testing of the panels is complete. Delivery of these panels was received on site June 12, 2017, at Bay d'Espoir and June 13, 2017, at Western Avalon terminal stations.

Currently all procurement activities remain on track to support the 2017 in-service date.

Table 1: Procurement Summary

Item	Contract Name	Contractor
1	Supply of Steel Towers and Foundations	Mitas Energy
2	Supply of Line Conductor	Midal Cables International (Canada) Ltd.
3	Supply of 220 kN Insulator	Seves Canada Inc.
4	Supply of Steel Towers (2 - NDD, 3 - AA)	SA-RA Group
5	Supply of Line Hardware	Mosdorfer GmbH and Slacan Industries Inc.
6	Supply of Steel Wire	Wire Rope Industries Limited
7	Supply of Anchor Materials	Williams Form Hardware & Rockbolt (Canada) Ltd.
8	Supply of Optical Ground Wire	Suzhou Furukawa Power Optic Cable Co. Ltd.
9	Supply of Dampers	Mosdorfer GmbH
10	TL267 - Line Clearing Contract	Newfoundland and Labrador Vegetation Control
11	TL267 - Line Construction Contract	Forbes Bros. Ltd.
12	Four - 245kV AIS Circuit Breakers for Bay D'Espoir	GE-Alstom Grid Canada
13	Western Avalon - TS GIS Turnkey Solution	Siemens Canada Ltd.
14	Protection and Control Equipment Supply	Rising Edge Technologies Ltd.
15	Bay D'Espoir Installation Contract	Rising Edge Technologies Ltd.

6.0 Construction

Construction started with the commencement of the line clearing on June 27, 2016. Good progress was made with the clearing contractor demobilizing on November 15, 2016. The transmission line construction contractor, Forbes Brothers Ltd. (FBL), mobilized crews to begin access construction and geotechnical investigation during August 2016. These activities paved the way for the installation of the first tower foundation on October 14, 2016, with the first foundations for a self-support tower installed December 1, 2016.

A variety of challenges were encountered during the execution of these activities resulting in slower than planned production rate. Consequently, a recovery and acceleration plan was drawn up and implemented in order to maintain the planned in-service date of October 31, 2017. With the goal of increasing productivity through improved work methods and changing methods of construction, the following specific changes were implemented:

- Introduction of three additional foundation subcontractors, each with several crews;
- Opening multiple work faces in the central and western sections of the line;
- Addition of multiple tower assembly crews; and
- Introduction of helicopter tower erection techniques.

Helicopter erection operations allow tower assembly to move ahead of foundation installation and access construction, which facilitate schedule recovery during erection operations. These measures have all been initiated and productivity improvements are being realized. Contractor progress will continue to be monitored closely to ensure that schedule recovery continues.

An incident on June 19, 2017, during construction of the transmission line resulted in the fatality of two contractor employees. An investigation into the incident is currently being carried out by Occupational Health and Safety, with full support and cooperation provided by Hydro and our contractor. All guyed tower activities have been suspended; however, other ground activities and station work are resuming in a phased approach. Hydro is continuing to assess the impact that this incident will have on the in-service date.

The following is an overview of progress to date:

- Access construction is complete to 528 of 583 structures; approximately 91%. This is slightly behind planned progress. Progress will be monitored to determine if further additional crews will need to be mobilized;
- Foundation installation is 90% complete. This is slightly behind the planned progress;
- Anchor installation for 420 of 517 structures is complete (81%);
- Tower assembly for 360 towers has been completed (61%). Self-support tower erection for 40 of 66 towers is complete (61%). Tangent tower erection is approximately 46% complete (239 of 517 towers);
- Vegetation clearing is now complete with all 188 km cleared;
- Stringing is complete for 122 of 583 structures (20%). Counterpoise has been installed for 310 of 583 structures; and
- Critical path activities include tangent tower assembly, self-support tower erection and stringing activities.

At Western Avalon Terminal Station, construction began on September 29, 2016, with the construction of the new building that will house the GIS and associated equipment. The building achieved weathertight status by December 23, 2016, as per schedule. Casting of the building floor slab began in January 2017 and was followed by building services (heat, light, ventilation, fire protection) installation and interior fit-out. Installation of these systems is substantially complete. Trucks transporting the GIS equipment began arriving at site on June 15, 2017. Installation of the GIS began on June 20, 2017.

In parallel to the work inside the GIS building, civil works have been ongoing in the terminal station yard. Key activities include casting of concrete foundations for a new gantry structure, disconnect switches and post insulators. Civil works are progressing well with the final concrete pours occurring during the first week of June.

Critical path analysis identifies GIS installation and testing and commissioning activities as critical to maintaining the energization date. These items are currently tracking on schedule.

At the Bay d'Espoir Terminal Station 2, construction began on October 24, 2016, with civil works to install foundations for the new equipment. Construction is ongoing and progressing per schedule. Placement of terminal station structures, disconnect switches, and breakers on their foundations is ongoing. The two large steel gantry structures were erected during planned outages on May 26 and 27, 2017. Final concrete pour occurred at the end of June.
The extension to the control building was completed and interior fit-out is ongoing.

Critical path analysis identifies Air Insulated Circuit Breaker installation, and testing and commissioning activities as critical to maintaining the energization date. These items are currently tracking on schedule.

7.0 Cost

A significant portion of the expenditure for this Project occurred in 2016 and is forecasted to occur in 2017. Expenditures over the last 12 months covered by this annual report primarily include engineering, material procurement, and construction-related costs. The rate of spend across the project duration has increased along with the ramp-up of construction.

As part of the project execution, a re-baseline of the cash flow was completed, based on the revised in-service date of the project, and to reflect greater certainty in material delivery and contractor schedules. This re-baseline will include expenditures of \$2.1M (2015), \$59.3M (2016), \$212.9M (2017), and \$17.4M (2018). Approximately \$28M has been expended to date on the project on transmission and station engineering, environmental work, and project management. $96M in clearing and construction has been expended on the transmission line portion of the project, along with a combined $8M in construction at both stations. $32M of material has been received. The project S-Curve (Figure 1) reflects expenditures to the end of June 2017. Overall, $164M has been expended on the project to date.

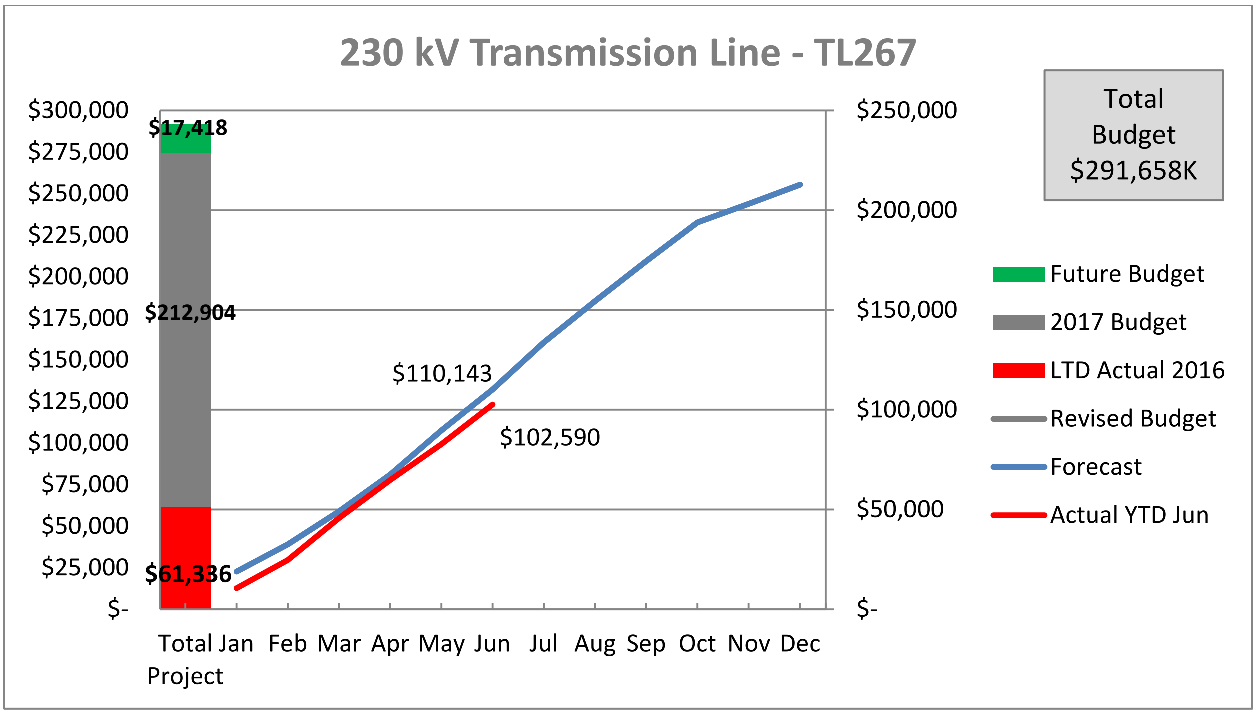


Figure 1: Project S-Curve

Current contract values for both the major equipment and construction contracts support the advancement of the in-service date, and demonstrate that the budget expectation is accurate and that the acceleration of the schedule has no negative impact to overall project cost. The project remains forecasted to be on budget at $291,658,000.

8.0 Schedule

The schedule Work Breakdown Structure is comprised of three main components; the transmission line, Western Avalon Terminal Station and Bay d'Espoir Terminal Station.

Each contractor is responsible for submitting a bi-weekly schedule update capturing all progress achieved to date. These schedules are then collated into a single, integrated “Master”, which is used to track the progress of the project holistically.

This “Master” schedule is embedded into NL Hydro’s Integrated Annual Work plan ensuring alignment with all other aspects of Hydro’s work, including key elements such as outages. Key activities requiring Hydro resources are also identified.

Progress is monitored against baseline with variances analyzed and reported upon. Trends are then established using s-curves, from which estimates to complete are derived.

All engineering is complete and engineering support will continue throughout construction.

For the line construction, all major long- lead items have been procured and have been received. At Bay d’Espoir, all major, long-lead items have been procured, many of which have been received on site. The last major items received at Bay d’Espoir were the Protection and Control panels. These were received June 12, 2017. At Western Avalon, all major long-lead items have been procured, many of which have been received on site. The last major items received at Western Avalon were the GIS and the Protection and Control panels. The GIS began arriving on site is June 15, 2017. The Protection and Control panels were received June 13, 2017.

Regarding transmission line construction, as noted earlier in this report, due to the serious incident, work on or near towers remains on stand down. Progress on the non-tower related tasks is being monitored and impacts on the in-service date are being assessed.

At Bay d’Espoir, progress is tracking in accordance with schedule to meet the energization date.

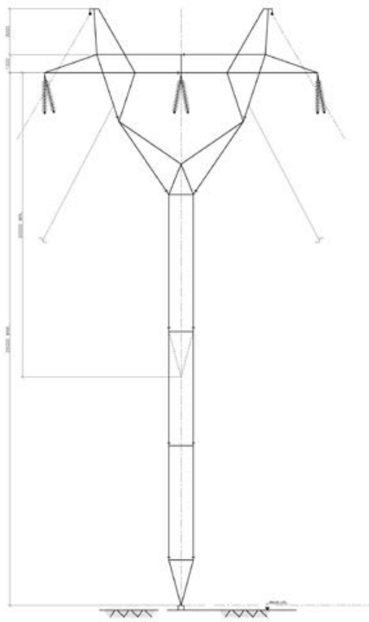
At Western Avalon, there is some slight delay in certain non-critical activities but overall, the project is on track to achieve the energization date.

Currently, all activities critical to maintaining the in-service date of October 31, 2017, are on schedule.

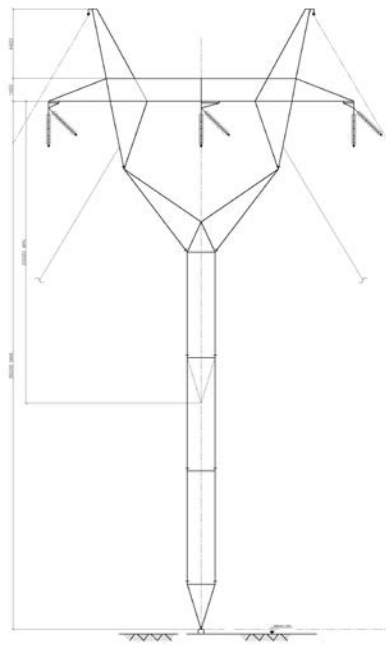
The current stand down on work on and around towers may result in delay of the in service date. This continues to be monitored.

The updated milestone schedule is in Schedule A.

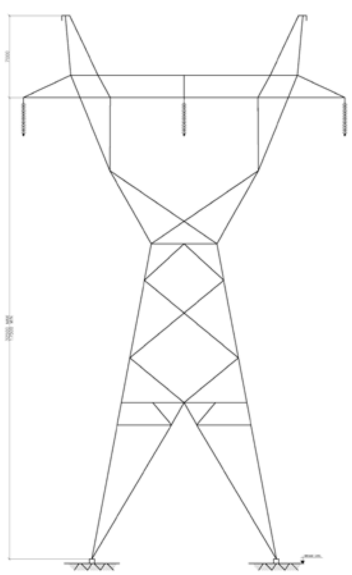
9.0 Drawings and Photos



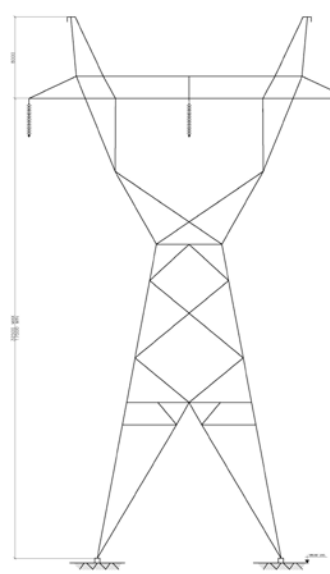
Tower Type A



Tower Type B



Tower Type C



Tower Type D

Self-support Tower Erection

Erickson Air-Crane

Tangent Tower Erection by Air-Crane

Tangent Tower Assembly Yard (Fly-yard)

Completed Tangent Tower

Helicopter Stringing Operations

Anchor Drilling Operations

Western Avalon Terminal Station – Station Service Transformer on Pad

Western Avalon Terminal Station – GIS Equipment Installation

Western Avalon Terminal Station – Disconnect Switch Installation

Western Avalon Terminal Station – GIS Building Interior Fit-up

Bay d'Espoir Terminal Station 2 – Circuit Breaker Installation

Bay d'Espoir Terminal Station 2 – Disconnect Switch Installation

Bay d'Espoir Terminal Station 2 – Equipment Installation

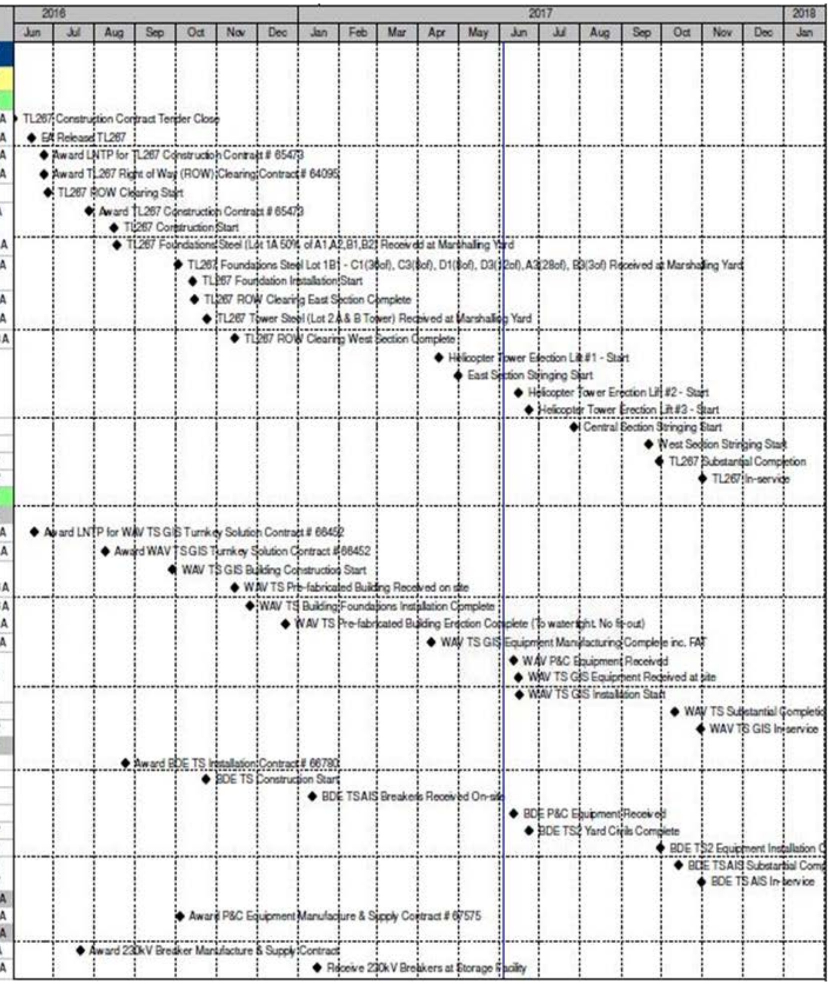
Finishing Building Interior in Bay d'Espoir Terminal Station 2

Bay d'Espoir Terminal Station 2 – Gantry Construction

APPENDIX A

Milestone Schedule

Activity ID	Activity Name	Physical % Complete	Start	Finish
System Upgrades - TL267			01-Jun-16A	31-Oct-17
Key Project Milestones			01-Jun-16A	31-Oct-17
TL267 Milestones			01-Jun-16A	31-Oct-17
267.MS.200	TL267 Construction Contract Tender Close	100%		01-Jun-16A
267.MS.100	EA Release TL267	100%		15-Jun-16A
267.MS.280	Award LNTP for TL267 Construction Contract # 65473	100%		24-Jun-16A
267.MS.140	Award TL267 Right of Way (ROW) Clearing Contract # 64095	100%		24-Jun-16A
267.MS.150	TL267 ROW Clearing Start	100%	27-Jun-16A	
267.MS.120	Award TL267 Construction Contract # 65473	100%		29-Jul-16A
267.MS.130	TL267 Construction Start	100%	16-Aug-16A	
267.MS.160	TL267 Foundations Steel (Lot 1A 50% of A1,A2,B1,B2) Received at Marshalling Yard	100%		18-Aug-16A
267.MS.260	TL267 Foundations Steel Lot 1B1 - C1(36of), C3(8of), D1(8of), D3(12of),A3(28of), B	100%		03-Oct-16A
267.MS.380	TL267 Foundation Installation Start	100%	14-Oct-16A	
267.MS.290	TL267 ROW Clearing East Section Complete	100%		15-Oct-16A
267.MS.170	TL267 Tower Steel (Lot 2A & B Tower) Received at Marshalling Yard	100%		24-Oct-16A
267.MS.300	TL267 ROW Clearing West Section Complete	100%		15-Nov-16A
267.MS.390	Helicopter Tower Erection Lift #1 - Start	100%	17-Apr-17 A	
267.MS.400	East Section Stringing Start	100%	01-May-17	
267.MS.410	Helicopter Tower Erection Lift #2 - Start	0%	15-Jun-17	
267.MS.420	Helicopter Tower Erection Lift #3 - Start	0%	23-Jun-17	
267.MS.430	Central Section Stringing Start	0%	27-Jul-17	
267.MS.440	West Section Stringing Start	0%	21-Sep-17	
267.MS.180	TL267 Substantial Completion	0%		29-Sep-17
267.MS.190	TL267 In-service	0%		31-Oct-17*
TL267 Terminal Station Milestones			17-Jun-16A	30-Oct-17
WAV GIS Design & Build			17-Jun-16A	30-Oct-17
TS.MS.280	Award LNTP for WAV TS GIS Turnkey Solution Contract # 66452	100%		17-Jun-16A
TS.MS.110	Award WAV TS GIS Turnkey Solution Contract # 66452	100%		09-Aug-16A
TS.MS.150	WAV TS GIS Building Construction Start	100%	29-Sep-16A	
TS.MS.330	WAV TS Pre-fabricated Building Received on site	100%		15-Nov-16A
TS.MS.340	WAV TS Building Foundations Installation Complete	100%		26-Nov-16A
TS.MS.350	WAV TS Pre-fabricated Building Erection Complete (To water tight. No fit-out)	100%		22-Dec-16A
TS.MS.130	WAV TS GIS Equipment Manufacturing Complete inc. FAT	100%		11-Apr-17 A
TS.MS.230	WAV P&C Equipment Received	0%	12-Jun-17	
TS.MS.140	WAV TS GIS Equipment Received at site	0%		15-Jun-17
TS.MS.380	WAV TS GIS Installation Start	0%	16-Jun-17	
TS.MS.240	WAV TS Substantial Completion	0%		10-Oct-17
TS.MS.250	WAV TS GIS In-service	0%		30-Oct-17*
BDE Installation			24-Aug-16A	30-Oct-17
TS.MS.170	Award BDE TS Installation Contract # 66780	100%	24-Aug-16A	
TS.MS.190	BDE TS Construction Start	100%	24-Oct-16A	
TS.MS.180	BDE TS AIS Breakers Received On-site	100%	12-Jan-17 A	
TS.MS.220	BDE P&C Equipment Received	0%	12-Jun-17	
TS.MS.360	BDE TS2 Yard Civils Complete	0%		23-Jun-17*
TS.MS.370	BDE TS2 Equipment Installation Complete	0%		29-Sep-17
TS.MS.260	BDE TS AIS Substantial Completion	0%		13-Oct-17
TS.MS.270	BDE TS AIS In-service	0%		30-Oct-17*
P&C Equipment Manufacture & Supply			05-Oct-16A	05-Oct-16A
TS.MS.210	Award P&C Equipment Manufacture & Supply Contract # 67575	100%		05-Oct-16A
230kV AIS Circuit Breakers (GE/Alstom)			22-Jul-16A	16-Jan-17 A
TS.MS.300	Award 230kV Breaker Manufacture & Supply Contract	100%		22-Jul-16A
TS.MS.320	Receive 230kV Breakers at Storage Facility	100%		16-Jan-17 A



4. Holyrood Overview

Holyrood Overview

Future Operation and Capital Expenditure Requirements

July 2017

A Report to the Board of Commissioners of Public Utilities

Table of Contents

1.0 Background

In Orders No. P.U. 5(2012) and No. P.U. 4(2013), the Board of Commissioners of Public Utilities (the Board) directed Newfoundland and Labrador Hydro (Hydro) to file, in conjunction with its 2014 Capital Budget Application, an overview in relation to the proposed capital expenditures for the Holyrood Thermal Generating Station (Holyrood). The Board required that the overview include the following: [1]

1. *An updated outlook regarding anticipated changes in the role of Holyrood on the system;*
2. *An updated schedule of anticipated changes in Holyrood operations that may reasonably be expected to have an impact on capital expenditure requirements;*
3. *A summary description of all proposed Holyrood capital projects, including an explanation of how such projects relate to one another and whether such projects may be impacted by decisions yet to be taken regarding Holyrood's role on the system;*
4. *A summary guide to all internal and external reports filed in support of the capital expenditure proposals, summarizing alternatives considered and recommendations made; and*
5. *An explanation of the necessity of all proposed capital expenditures in the context of the anticipated changes in Holyrood operations.*

In Order No. P.U. 42(2013), the Board further required Hydro to update and file the Holyrood Overview report with future capital budgets. This report contains the update to the future operation and capital expenditure requirements for the Holyrood Thermal Generating Station.

[1] *Order No. P.U. 5(2012)*

2.0 Introduction

Hydro's Holyrood Thermal Generating Station (Holyrood) is a critical part of the Island Interconnected System (IIS). With three oil fired generating units providing an installed capacity of 490 MW (465 MW net), the plant represents approximately one third of Hydro's total IIS generating capacity and approximately one quarter of the total IIS capacity, when included with all other customer owned generation. Units 1 and 2 were commissioned in 1970 and 1971, respectively, and Unit 3 in 1979. Units 1 and 2 were originally designed to produce 150 MW, but were upgraded to 170 MW in 1988 and 1989, respectively. Unit 3 retains its original configuration and is rated at 150 MW. In 1986, Unit 3 was retrofitted with synchronous condensing capability to provide voltage support on the eastern area of the IIS during periods when power generation from this unit is not required.

The three major components of the thermal generating process are the boiler, the turbine, and the generator, with supporting systems such as fuel storage and delivery, controls, and cooling and feed water supply systems. Through combustion of No. 6 heavy fuel oil, the power boiler provides high energy steam to the turbine. The turbine is directly coupled to the generator and provides the rotating energy necessary for the generator to produce rated output power to the IIS. The generator itself is pressurized and cooled by hydrogen gas to provide maximum efficiency both in heat transfer and reduced windage losses.[2]

Holyrood is essential for meeting both winter peak demand and annual energy requirements. Holyrood supplies the balance of customer load that cannot be met by Hydro's hydroelectric generating facilities and purchases from non-utility generators. Annual production at Holyrood will vary depending on hydroelectric reservoir storage and inflows. In the existing system configuration, Holyrood units are also critical for securing the transmission and providing voltage support for the major load centre on the Avalon Peninsula.

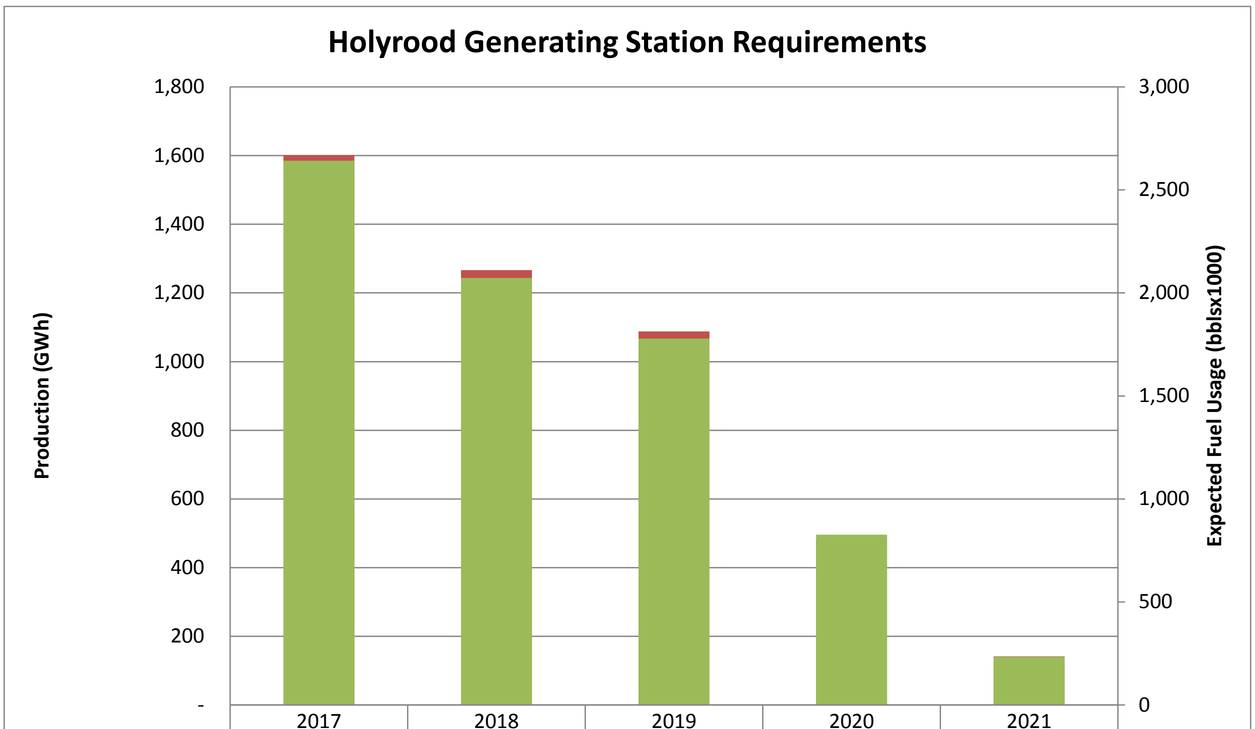
[2] Windage losses refer to the losses sustained by a machine due to the resistance offered by air to the rotation of the shaft. Windage Losses occurs in electric rotating machines such as motors and generators.

Figure 1: Holyrood Thermal Generating Station

3.0 Current Operational Outlook and Schedule

On December 17, 2012, the Government of Newfoundland and Labrador announced official sanction of the Muskrat Falls (MF) development. As per the most recent schedule update, the Labrador Island Link (LIL) is expected to be in service by the end of the second quarter of 2018. The construction activities and final commissioning of the Muskrat Falls Project are expected to be completed in 2020. In addition, the Maritime Link (ML) and the transmission line between Bay d'Espoir and Western Avalon, TL267, are scheduled to be in-service in the fourth quarter of 2017. Once the LIL and the ML are in-service, there may be an opportunity to reduce Holyrood production by importing energy from off-island supply. During this period, Hydro will continue to use Holyrood to provide reliable service to customers, and as satisfactory operating experience is obtained over the LIL and the ML, the Holyrood units will be placed in standby mode. The number of units placed in standby mode will depend on the availability of reliable capacity and energy of off-island supply, and sustained reliable operation of the interconnections.

While in standby mode, the plant will remain fully available for generation and will be periodically operated to ensure availability until the end of the winter of 2021. At the end of the winter of 2021, it is projected that the remaining fuel in the tanks will be consumed, Units 1 and 2 and the steam components of Unit 3 will be decommissioned, and Unit 3 will continue to operate in synchronous condenser mode only, with no generation capability.



	2017	2018	2019	2020	2021
Production (GWh)	1,601	1,267	1,088	482	142
Barrels (x1000)	2,642	2,073	1,779	827	234

Figure 2: Holyrood Annual Production Requirements 2017 to 2021

Figure 2 indicates Holyrood's forecasted annual production requirements for the five year period from 2017 to 2021. Forecasts are based on average hydrologic inflow conditions. By the end of the second quarter of 2018, the LIL is expected to be in service to supplement the supply to the IIS by delivering recall power[3] in excess of Labrador Interconnected System (LIS) requirements from Churchill Falls. The Holyrood production shown for 2018 and 2019 assumes that only recall energy is available to reduce Holyrood production. While there may be other opportunities to secure off-island supply to further reduce Holyrood production, at this time it is prudent to assume that only recall power in excess of LIS requirements is available.

In 2020 the construction activities and final commissioning of the Muskrat Falls Project are expected to be completed. Holyrood units will be operated as required to support successful integration and commissioning of these assets. Once the assets have been successfully commissioned and placed in-service and proven reliable, the Holyrood generating units will be placed in standby mode until their subsequent decommissioning.

The production at Holyrood may vary from the forecast depending on customer requirements, the timing of in-service of the Lower Churchill assets, the availability of off-Island supply, and hydrologic conditions impacting Hydro’s hydraulic supply capabilities.

In summary, the specific phases of operation and the timeframes for each phase are anticipated to be as follows:

- **Phase 1** - Normal Production Phase (2016 through to the second quarter 2018): All three units are available for prime power generation with Unit 3 also available for synchronous condenser operation, as required;
- **Phase 2** - Standby Production Phase (second quarter 2018 through to the end of the winter 2021): Units will be placed in Standby Mode as appropriate off-Island supply is secured, Unit 3 will be operated in synchronous condenser mode, as required; and

[3] On May 12, 1969, Hydro-Quebec (HQ) and the Churchill Falls (Labrador) Corporation (CF(L)Co) entered into a power contract for the purchase of power from the CF(L)Co plant by HQ (the 1969 Power Contract). Pursuant to section 6.6 of the 1969 Power Contract, CF(L)Co has exercised its right to recapture 300 MW of power (Recapture Energy) generated at the CF power plant. Under the terms of a Power Purchase Agreement (PPA) between Hydro and CF(L)Co (the NLH-CF(L)Co PPA) dated March 9, 1998, and amended on April 1, 1999, Hydro is able to, and does, purchase up to 300 MW of Recapture Energy from CF(L)Co for use outside of the Province of Quebec.

- **Phase 3** – Post Interconnection Phase (Post winter 2021): All Muskrat Falls Units have been placed in-service and both the plant and the LIL have operating experience. Holyrood Units 1 and 2 have been placed in Standby Mode, until decommissioning is appropriate. Holyrood Unit 3 continues to operate as a synchronous condenser. There will be no power production from Holyrood after remaining excess fuel has been burnt.

3.1 Phase 1 – Normal Production Phase

In the existing system configuration, Holyrood continues to be required to meet customer requirements.

3.2 Phase 2 – Standby Production Phase

Following the in-service of the LIL and the ML, and prior to full availability of MF generation, the Holyrood plant will continue to be an essential component of the Provincial electrical grid. Until the end of the winter 2021, the plant will function as a standby facility and depending on the availability of off-island supply, will operate at some level of base loading. While in standby mode, Holyrood can be called upon to provide energy and capacity to the Island Interconnected System as required.

During the period of standby operation, Unit 3 is expected to operate primarily in synchronous condenser mode as required for system security, with the option to return to full generating mode if required.

Table 1 provides the forecasted Holyrood unit operating data from 2017 to 2021.

3.3 Phase 3 – Synchronous Condenser Operation Phase

Following the Standby Production Phase, remaining fuel inventory will be consumed and then Hydro will commence decommissioning of the thermal aspect of the station that were required for power production. At this time, all Lower Churchill Project assets will have been placed in service and sufficient operational experience has occurred. Unit 3 will continue to operate as a synchronous condenser, but there will be no power generation at Holyrood to meet system requirements. The end of power production is currently projected to be at the end of the winter 2021.

The systems to be decommissioned when no longer required include the following:

- The fuel storage and delivery system, including the tank farm and day tank;
- The boilers, including air systems and emission monitoring systems;
- The feedwater and condensate systems, including the deaerator systems; and
- The marine terminal.

The systems required for synchronous condenser operation following the standby phase include:

- Unit 3 synchronous condenser specific equipment including the unit generator and exciter; and
- Auxiliary systems including electrical, controls, cooling water, fire protection, etc.

Table 1: Holyrood Operating Requirements 2017-2021

	Holyrood Production (GWh)	Total Unit Operating Hours	Annual Required Hydro Generation	Holyrood Production as Percentage of Total Load
2017	1,601	15,528	7,267	22%
2018	1,267	11,496	7,403	17%
2019	1,088	9,768	7,283	15%
2020	482	6,888	7,233	7%
2021	142	1,419	7,135	2%

4.0 Maintenance Strategy through the Operational Phases

Phase 1 requires no change in terms of maintenance strategy. Scheduled overhauls of plant equipment, such as auxiliary system pumps, will continue through this period to ensure plant reliability. The upgrade of equipment at or near the end of its useful service life and replacement of obsolete equipment that can no longer be maintained will also continue with serious consideration given to the short service life. While there may be efforts to reduce routine planned loading of the Holyrood units to reduce overall risk, it is necessary to be able to operate at maximum capacity in the event such operation is required.

Phase 2 starts the evolution of the plant maintenance strategy. While significant changes will not be made at this point, as unit reliability will continue to be important during the standby period, equipment maintenance intervals may change. As some intervals are based on annual operating hours, extension beyond more typical timeframes during the standby period may be achieved in some instances depending on the actual operating hours, allowing Hydro to reduce cost while maintaining reliability.

In Phase 3, assets with operational requirements beyond the post winter 2021 timeframe will continue to be optimally maintained with investment reflecting that continued requirement.

5.0 Holyrood 2018 Capital Plan Summary

The complexity of the thermal generating units, along with the age of the Holyrood plant and changing requirements for Holyrood, necessitates a review of the assets to ensure future generating requirements can be met. Condition assessments and inspections ensure that critical systems receive the appropriate level of refurbishment. Additionally, preparation has begun to operate in synchronous condenser mode as part of the Phase 3 operational requirements.

The 2018 Capital Plan (Tables 2, 3 and 4) was prepared considering asset condition, equipment obsolescence (both end of life and availability of support), and forecast production requirements, to identify the necessary rehabilitation and replacement projects to ensure customer needs can be met. In the event of unforeseen failure, or unexpected as-found condition, adjustments or additions may be required beyond the current plan.

Table 2 provides a summary description of all proposed Holyrood capital projects for 2018. All of the proposed projects are required to ensure that the Holyrood facility is available and ready to ensure reliable service for Hydro’s customers in advance of the full in-service of the Lower Churchill Project assets.

Hydro is managing several degrading pieces of infrastructure outside of the capital plan, notably the waste water basins building and the concrete exhaust stacks, with the intention of reaching end of generation life with minimal refurbishment costs. Condition assessments are completed annually and minor interventions are addressed as a means to mitigate safety and asset integrity risk. Should additional measures be required, Hydro will seek capital refurbishment at that time.

The Install Raw Water Line, Install Fire Detection in Outbuildings, Upgrade Cranes and Hoists, and Install Plant Heating System projects relate to plant common support systems and infrastructure, which are required to ensure the plant can continue to be operated safely, reliably, and with regulatory compliance through the normal operation and standby production phases to post winter 2021. All of these projects are also required for plant operation in Phase 3 as they support the synchronous condensing operation of Unit 3. The Install Raw Water Line and Install Fire Detection in Outbuildings also support operation of the Holyrood gas turbine.

The Overhaul Pumps, Overhaul Unit 1 Turbine Valves and Generator, and Condition Assessment and Miscellaneous Upgrades projects relate directly to the major components of the power generation process; the boiler, turbine, generator, and their supporting systems. The first of these projects is related to the boiler feedwater for Unit 2. The remaining projects relate to the steam turbines, generators, boilers, and their systems required for safe and reliable operation.

Table 3 provides a summary guide to all internal and external reports filed in support of the capital expenditure proposals summarizing the alternatives considered and recommendations made.

Table 4 provides an explanation of the necessity of all proposed capital expenditures in the context of the changes in operations at Holyrood.

Table 2: Holyrood Projects Included in the 2018 Capital Plan

Project	Scope Summary	Proposal Location
Overhaul Pumps	This proposed project involves overhauling the Unit 2 south vacuum pump and the Unit 2 east boiler feed pump.	>$200k and <$500k Projects
Overhaul Unit 1 Turbine Valves	This project proposes the completion of a scheduled overhaul of Unit 1 turbine valves. This overhaul consists of total dismantling of all turbine valves, inspection of the valves, lapping of the valve seats, and adjustment of valve clearances.	>$500k Projects Tab 7
Overhaul Unit 1 Generator	This project proposes the completion of a scheduled overhaul of Unit 1 generator. The generator will be disassembled and the rotor will be removed from the stator. Visual inspection as well as mechanical and electrical testing will be performed to verify the condition of the generator.	>$500k Projects Tab 11
Install Raw Water Line	This proposed project will mitigate a significant business continuity risk through the installation of a new raw water line from the Quarry Brook Dam that will supply raw water to the Holyrood Thermal Plant and the Holyrood Gas Turbine for operation, domestic use, and fire fighting.	>$500k Projects Tab 10

Upgrade Cranes and Hoists	This proposed project will convert the control of the overhead crane in the powerhouse to a handheld remote pendant. This eliminates safety hazards and also results in process improvements that will improve work efficiency.	>$200k and <$500k Projects
Install Fire Detection in Outbuildings	This proposed project will connect the automatic fire suppression systems in three outbuildings on the Holyrood site to the main fire alarm panel in the Thermal Plant Control Room. This will ensure rapid response to any activation of these systems.	>$50k and <$200k Projects
Condition Assessment and Miscellaneous Upgrades	The scope of this proposed project consists of three separate pieces of work. The primary piece of work is to perform condition assessment related to internal components of the main steam generators (boilers) and also associated external high energy piping. This work is part of a three-year program that will be completed in 2019. Additional Level 2 condition assessment work will be completed on other critical systems in the plant. Finally, miscellaneous upgrades will take place. These upgrades will include the Unit 3 cooling water travelling screen replacement and boiler component replacements, such as the replacement of expansion joints.	>$500k Projects Tab 5

Install Plant Heating System	This proposed project is a two year project that will install a heating system in the thermal plant powerhouse to be used in the standby and post steam phases (Phase 2 and Phase 3) when there is no heating steam available from the unit power boilers.	>$500k Projects Tab 4
Thermal In-Service Failures	The purpose of this program is to allow completion of capital work due to failure of equipment, or the recognition of an incipient failure that cannot wait for the next capital submission cycle. Previously, capital work of this nature required a supplemental submission for approval. This project also includes the purchase of critical capital spares that are required to be on hand to reduce downtime and increase availability should a failure of a key component occur.	>$500k Projects

Table 3: Reports Filed in Support of the 2018 Project Proposals

Project	Reports filed	Alternatives Considered	Recommendation
Condition Assessment and Miscellaneous Upgrades	- Holyrood Level II Condition Assessment Follow-Up Inspection - 2016	There are no alternatives	Perform condition assessment and upgrades.

Table 4: 2018 Project Necessity in the Context of Changing Role of Holyrood

Major System or Subsystem	Project	Necessity by Operational Phase		
		Phase 1[4]	Phase 2[5]	Phase 3[6]
Fuel Storage & Delivery	No Projects included			
Feedwater & Condensate	Overhaul Holyrood Pumps	Required	Required	Not required
	Install Raw Water Line	Required	Required	Required
Boiler	Condition Assessment and Miscellaneous Upgrades	Required	Required	Not required
Turbine Generator	Overhaul Unit 1 Turbine Valves and Generator	Required	Required	Not required
Cooling Water Systems	Condition Assessment and Miscellaneous Upgrades	Required	Required	Not required
Buildings & Grounds	Install Remote Fire Detection in Outbuildings	Required	Required	Required
Common Systems	Install Plant Heating System	Required	Required	Required
	Upgrade Cranes and Hoists	Required	Required	Required
	Install Raw Water Line	Required	Required	Required

[4] Phase 1 – 2016 to Q2 2018 – normal production
[5] Phase 2 – Q2 2018 to end of Winter 2021 – stand-by production
[6] Phase 3 – Post Winter 2021 – synchronous condenser operation

6.0 Holyrood 2018-2022 Capital Expenditures Outlook

To ensure continued security of supply, capital investment will be necessary throughout the period of 2018 to 2022 to ensure Holyrood can provide the level of service required in generation and synchronous condenser operations. Various types of investments and expenditures for the Holyrood facility are anticipated, including refurbishment, upgrade or replacement of failed or obsolete equipment, and general plant infrastructure work. In reviewing future capital projects for Holyrood going forward, Hydro has considered the three phases discussed previously and will submit for approval only those projects it deems necessary for the safe and reliable operation of the plant as a generator up to the time of decommissioning.

Capital projects proposed as part of this and upcoming future budget submissions have been, and will continue to be, reviewed in light of the future plant requirements and are considered essential to fulfill Hydro’s mandate to serve its customers and meet safety and environmental requirements.

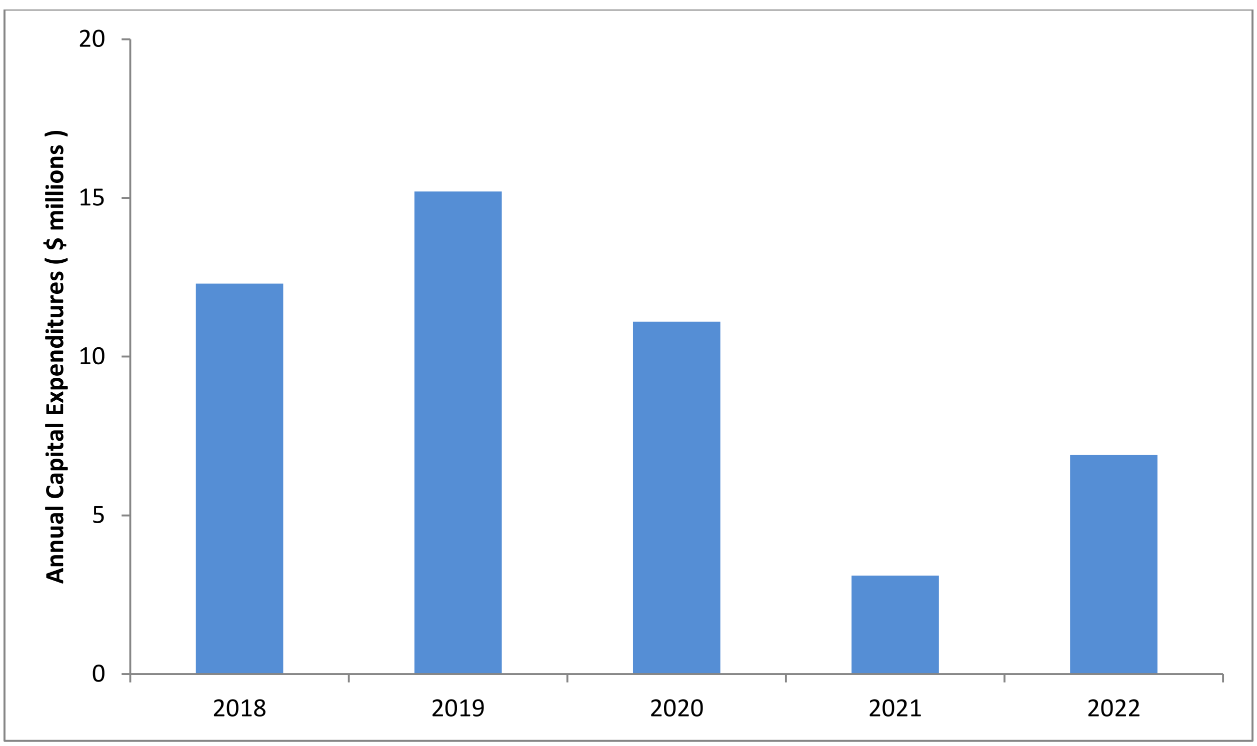
The maintenance strategy for Holyrood going forward to its end of life as a generating station is to extend the life of the existing assets at minimum cost through continued preventative maintenance, repair, and rehabilitation where critical, to provide safe and reliable energy at the forecast levels. In cases where repair and rehabilitation are not viable alternatives, and where the associated assets remain critical to operation, assets will be renewed in the least cost manner. For Phases 1 and 2 of Holyrood's future operations, few changes are expected in terms of maintenance strategy since the plant is generally expected to produce with a high level of reliability through to commissioning of the Muskrat Falls Project and must be fully available until winter 2021. Non-critical assets will receive minimal attention and may be allowed to degrade where such action does not significantly increase risk to safe and reliable production. Assets with operational requirements beyond 2021 will continue to be optimally maintained with investment reflecting that continued operation requirement. Data will be collected from inspections, on-line monitoring, and formal condition assessments, and then used to determine the right work, on the right assets, at the optimal time in light of the changing role of Holyrood.

Figure 3 provides the planned level of expenditure for Holyrood over the 2018 to 2022 period. The annual average expenditure is $9.7 million, ranging from a high of $15.2 million in 2019 to a low of $3.1 million in 2021. Projects planned for the pending five years include:

- $5.7 million for the installation of a plant heating system;
- $4.7 million to replace Stage II Electrical Distribution Equipment; and
- $7.1 million for the rewind of Unit 3 generator stator.

All of these projects are required for the Phase 3 operation. Planned expenditures for the five year period total $48.6 million.

Figure 3: Holyrood Capital Expenditures 2018 to 2022



5. Holyrood Projected Operating Maintenance Expenditures

Plan of Projected Operating

Maintenance Expenditures

2 0 1 8 - 2 0 2 7

For Holyrood Generating Station

July 2017

A Report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro

a nalcor energy company

Table of Contents

1.0 Introduction

In Decision and Order No. P. U. 14(2004), the Board of Commissioners of Public Utilities (the Board), directed Newfoundland and Labrador Hydro (Hydro) to "file a ten year plan of maintenance expenditures for the Holyrood Generating Station (Holyrood) with its annual capital budget application, until otherwise directed by the Board."[1] As this requirement is specifically related to system equipment maintenance (SEM) costs, non-maintenance SEM costs and capital expenditures have not been included in the following report. Capital expenditures for the Holyrood plant are submitted annually to the Board with other Hydro capital proposals as part of the annual capital budget application, as well as in the Holyrood Overview.

This report addresses the identified and expected maintenance expenditures for the years 2018 to 2027 inclusive. With respect to these expenditures, it should be noted that Units 1 and 2, as well as two of the main fuel storage tanks and other associated ancillary equipment, have been in service for 47 years and that Unit 3 and its associated equipment have been in service for 37 years. While many components of this equipment have been replaced and additional items added through the maintenance and capital program over the years, numerous pieces of equipment and components are original.

An accurate, uniform ten-year plan of SEM is difficult to complete. The harsh operating environment, evolving production requirements, and the age of units may trigger revision of the maintenance plan to address unforeseen events. Even though expenses for major overhauls are included in capital, some variability in the annual budget will remain as a result of the complexity of numerous components and integrated systems that form a fossil fuel fired thermal electric generating system. This report will endeavor to identify the regular variations in the annual operating costs for Holyrood.

[1] Order No. P. U. 14(2004), at page 166.

2.0 Maintenance Philosophy

In Order No. P. U. 14(2004), the Board stated that "The Board will require NLH's ten-year plan of maintenance expenditures for the Holyrood Generating Station to be updated annually to reflect changing operating circumstances."[2]

Maintenance efforts aim to prevent functional failure and extend the operational life of assets, helping to minimize total asset life cycle cost. The type and amount of maintenance applied is dependent on the criticality of the asset and the impact of failure on service delivery. Hydro seeks to balance the cost of maintenance against the cost of failure and the impact on safe, reliable service when applying maintenance strategies and tactics. There are three main types or categories of maintenance undertaken at Holyrood, including: preventive maintenance; corrective maintenance; boiler overhauls; and operating projects.

2.1 Preventive Maintenance

Holyrood continues to use, up-to-date maintenance techniques and practices to maintain plant efficiency, availability, and reliability. These include preventive, predictive, and condition-based maintenance techniques, which are usually referred to by the overall term of "Preventive Maintenance". The basic principle underlying this approach to maintenance is timely intervention to prevent imminent or catastrophic failure that may cause a substantial safety exposure, an extended unavailability of the unit or system, or an increase in cost.

Preventive maintenance comprises routine inspections, minor checks, and component replacement at specific time intervals to prevent failures that are known, or reasonably expected to occur, within a definable time or operating hour interval during the life of the equipment (e.g. generator brush wear, air and oil filter replacements). This also includes discarding equipment or components rather than repairing them when it is less costly to do so.

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[2] Order No. P. U. 14(2004), at page 64.

Predictive maintenance involves routine testing of equipment to determine deterioration rates and initiating and carrying out repairs in a timely manner before a failure occurs (e.g. ultrasonic thickness checks on fluid lines to monitor erosion wear rates and non-destructive testing of boiler and turbine components to determine fatigue, wear or corrosion rates, and remaining life). Predictive maintenance items include such things as boiler and auxiliary equipment annual overhauls, wherein an assessment is made of components or subsystems that are only accessible during these overhauls.

There is also regular or continual monitoring of equipment operating parameters with a comparison of the results with optimum conditions to determine the most economic time to intervene and perform remedial work that is intended to return the equipment to optimum performance levels (e.g. air heater washes, generator winding insulation condition, oil sampling and testing).

Since 2008, the Preventive Maintenance Program has been enhanced to include the extra costs associated with plant cleaning in areas where asbestos and heavy metals have been identified as potential health hazards.

2.2 Corrective Maintenance

In addition to the preventive maintenance techniques outlined above, there are also corrective maintenance requirements. This includes work performed to identify, isolate and restore equipment, machines or systems to a level in which it can be operated safely and used for its intended purpose. The requirement of corrective maintenance may arise for various reasons including failure, wear and tear, and harsh environments such as humid or salt laden air. Examples of corrective maintenance include wear and tear on pumps, pipes, and valves in the main and auxiliary systems.

2.3 Boiler Overhauls

Boiler overhauls consist of the maintenance and refurbishment work required to ensure reliable boiler operation for the upcoming season. Overhauls include packages of standard work, defined work, and as-found work. Standard work covers activities that are predictable and required on an annual basis due to normal operation, wear and tear. Defined work represents planned, specific activities that do not normally occur on an annual basis and addresses issues identified from prior condition inspections and trending. As-found work covers unforeseen issues identified during an ongoing overhaul. In some cases the nature of defined work meets criteria for capitalization, and in such cases is not included in SEM.

2.4 Operating Projects

Operating projects are low cost repairs and annual inspections that are required to return structures and equipment to their original or near original operability, to maintain structural integrity, improve efficiency, improve availability, and prevent or reduce environmental risks. Such projects include emissions monitoring and testing, and periodic basin cleaning in the Waste Water Treatment Plant.

3.0 Cost Variability

Preventive maintenance costs are generally incurred annually at a constant level and do not fluctuate significantly. This principle does not apply to corrective maintenance costs, which are unavoidable and unpredictable due to the changing energy production demands on the units from year to year. Due to accounting methodology changes approved in Order P.U. 13(2012), major overhauls and inspections with a frequency of greater than one year are capitalized, reducing the fluctuation in maintenance expenditures that were experienced in prior periods. Projects for Holyrood are planned on a five-year basis, but as with any plan, it is not fixed or definitive, as other events can cause a shift in the prioritization of such projects. The five-year maintenance plan is updated on a regular basis to reflect any shifts in priority.

4.0 Detailed Analysis

Appendices A thru D set out the ten-year maintenance plan for Holyrood. Appendix A is a summary that indicates the expected expenditures in each of the major equipment groupings containing SEM costs for the years 2018 to 2027. Appendices B thru D, inclusive, show the expected SEM costs categorized according to Preventive, Corrective, Annual Overhauls, and Operating Projects for each of the major equipment groupings containing SEM costs.

Appendix B lists the categories of SEM costs for generating units for the years 2018 to 2027 in each of the major equipment groupings. The categories listed are:

Preventive	Routine preventive maintenance activities carried out every year.
Corrective	Typical but unknown breakdown/emergency repairs carried out during the year.
Boiler	Boiler overhauls carried out annually with one unit per year overhauled on a reduced scope as a result of better fuel quality. For 2020 and 2021, all boiler overhauls are expected to be on a reduced scope. No boiler overhauls are expected beyond 2021.
Operating Projects	Non-capitalized projects justified on the basis of safety, environment, reliability, or cost benefit analysis.

Appendices C and D provide a listing of the remaining equipment groupings, including Common Equipment, Building and Grounds, Water Treatment Plant, Waste Water Treatment Plant and Environmental Monitoring and use only Preventive, Corrective, and Operating Projects.

It should be noted that this ten-year plan spans the period during which the role of Holyrood will change as a result of the interconnection between Labrador and the Island. These events significantly impact cost and activity levels for Holyrood for the standby period and for the synchronous condenser period, as reflected in this plan. Generation from the Holyrood Thermal Generation Plant will start to reduce once the Labrador Island Transmission Link and Maritime

Link are in service. The units at Holyrood will start to be placed in standby mode as these systems are proven to be ready for reliable service. The timing of the final shut down and repurposing of the Holyrood plant will be made once commissioning of the infrastructure related to the Muskrat Falls Project is complete in 2020 and reliable service has been demonstrated over the following winter period. This is anticipated to occur in the 2020/2021 timeframe. For the purposes of projecting operating costs in this report, a placeholder assumption has been made that the standby phase begins in 2018 and continues into 2021. In 2018, delivery of power and energy via the Labrador Island Transmission Link line could start, but will be limited as the Muskrat Falls powerhouse is not yet in service.

Hydro does not normally use any escalation in its five-year operating plan at the Plant or regional level as the five-year plan is primarily used for internal purposes and generation of work plans rather than detailed financial planning. However, in the attached ten-year plan, a single escalation factor of 2.5% per year has been used for 2018 to 2027 based on an average rate from Hydro’s current corporate assumptions.

It should be noted that the appendices do not itemize preventive and corrective items. The preventive maintenance program consists of approximately 1,200 preventive maintenance work orders performed on plant equipment annually. Corrective items include a large number of low cost projects, the majority of which are largely unknown until they happen; thus, it is not practical to provide a breakout of the costs.

5.0 Summary

This Plan is based on the 2018 and 2019 budgets for system equipment and adjusted for future years using the best available information including up to date maintenance tactics and known restoration and inspection work to establish a ten-year forecast of the maintenance projects for the Holyrood Plant. As with any forecast, it is subject to change depending on the operating demands of the plant, the results of inspections and assessments of changing equipment conditions.

APPENDIX A

APPENDIX A
TOTAL HOLYROOD 10 YEAR SEM EXPENDITURES
($000)

	Base Year 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Unit 1 Total SEM	$1,407	$1,871	$996	$258	$0	$0	$0	$0	$0	$0
Unit 2 Total SEM	$1,777	$1,420	$1,092	$258	$0	$0	$0	$0	$0	$0
Unit 3 Total SEM	$1,779	$1,880	$1,003	$262	$268	$275	$282	$289	$296	$303
Common Equipment Total SEM	$1,805	$1,820	$1,399	$673	$690	$707	$725	$743	$762	$781
Buildings & Grounds Total SEM	$282	$282	$217	$110	$113	$116	$119	$122	$125	$128
WT Plant Total SEM	$57	$57	$44	$20	$20	$21	$21	$22	$22	$23
WWT Plant Total SEM	$10	$10	$8	$8	$8	$8	$8	$9	$9	$9
Environmental Monitoring Total SEM	$112	$112	$86	$40	$41	$42	$43	$44	$45	$46
Total Operating Projects	$271	$211	$105	$49	$0	$0	$150	$0	$0	$0
Total Holyrood SEM	**$7,500**	**$7,664**	**$4,949**	**$1,679**	**$1,140**	**$1,169**	**$1,348**	**$1,228**	**$1,258**	**$1,290**

APPENDIX B

APPENDIX B

10 YEAR SEM EXPENDITURES FOR GENERATING UNITS

($000)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Unit No. 1										
Preventive	380	385	296	138	0	0	0	0	0	0
Corrective	327	335	258	120	0	0	0	0	0	0
Boiler O/H	700	1,151	442	0	0	0	0	0	0	0
Subtotal	$1,407	$1,871	$996	$258	$0	$0	$0	$0	$0	$0
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total - Unit No. 1	**$1,407**	**$1,871**	**$996**	**$258**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unit No. 2										
Preventive	380	385	296	138	0	0	0	0	0	0
Corrective	327	335	258	120	0	0	0	0	0	0
Boiler O/H	1,070	700	538	0	0	0	0	0	0	0
Subtotal	$1,777	$1,420	$1,092	$258	$0	$0	$0	$0	$0	$0
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total - Unit No. 2	**$1,777**	**$1,420**	**$1,092**	**$258**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Unit No. 3										
Preventive	380	390	300	140	143	147	150	154	158	162
Corrective	329	339	261	122	125	128	131	135	138	141
Boiler O/H	1,070	1,151	442	0	0	0	0	0	0	0
Subtotal	$1,779	$1,880	$1,003	$262	$268	$275	$282	$289	$296	$303
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total - Unit No. 3	**$1,779**	**$1,880**	**$1,003**	**$262**	**$268**	**$275**	**$282**	**$289**	**$296**	**$303**

APPENDIX C

APPENDIX C

10 YEAR SEM EXPENDITURES FOR ANCILLARY UNITS

($000)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Common Equipment										
Preventive	1,625	1,635	1,257	597	608	623	639	655	671	688
Corrective	180	185	142	76	82	84	86	88	91	93
Subtotal	$1,805	$1,820	$1,399	$673	$690	$707	$725	$743	$762	$781
Operating Projects										
Total Op Projects - Common	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total - Common Equipment	**$1,805**	**$1,820**	**$1,399**	**$673**	**$690**	**$707**	**$725**	**$743**	**$762**	**$781**
Buildings & Grounds										
Preventive	260	260	200	97	99	101	104	107	109	112
Corrective	22	22	17	13	14	14	15	15	15	16
Subtotal	$282	$282	$217	$110	$113	$116	$119	$122	$125	$128
Operating Projects										
Total Op Projects - Bldgs & Grounds	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total - Bldgs & Grounds	**$282**	**$282**	**$217**	**$110**	**$113**	**$116**	**$119**	**$122**	**$125**	**$128**
Water Treatment Plant										
Preventive	32	32	24	11	11	11	12	12	12	12
Corrective	25	25	19	9	9	9	9	10	10	10
Subtotal	$57	$57	$44	$20	$20	$21	$21	$22	$22	$23
Operating Projects										
Resin Replacement	80	82	63	29	0	0	0	0	0	0
Total Op Projects - WTP	$80	$82	$63	$29	$0	$0	$0	$0	$0	$0
Total - Water Treatment Plant	**$137**	**$139**	**$107**	**$50**	**$20**	**$21**	**$21**	**$22**	**$22**	**$23**

APPENDIX D

APPENDIX D

10 YEAR SEM EXPENDITURES FOR ANCILLARY UNITS

($000)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Environmental Monitoring										
Preventive	16	16	12	6	6	6	6	6	7	7
Corrective	96	96	74	35	35	36	37	38	39	40
Subtotal	$112	$112	$86	$40	$41	$42	$43	$44	$45	$46
Operating Projects										
Emmissions Monitoring	53	54	42	19	0	0	0	0	0	0
Stack Emmissions Testing										
Tube Bundle Replacement	38									
Total Op Projects - Environment	$91	$54	$42	$19	$0	$0	$0	$0	$0	$0
Total - Environmental Monitoring	**$203**	**$166**	**$128**	**$60**	**$41**	**$42**	**$43**	**$44**	**$45**	**$46**
Waste Water Treatment Plant										
Preventive	5	5	4	4	4	4	4	4	4	5
Corrective	5	5	4	4	4	4	4	4	4	5
Subtotal	$10	$10	$8	$8	$8	$8	$8	$9	$9	$9
Operating Projects										
WWTP Periodic Basin Cleaning							150			
WWTP Continuous Basin Clean-Out	100	75								
Total Op Projects - WWTP	$100	$75	$0	$0	$0	$0	$150	$0	$0	$0
Total - Waste Water Treatment	**$110**	**$85**	**$8**	**$8**	**$8**	**$8**	**$158**	**$9**	**$9**	**$9**

A. Capital Budget

	Expended to 2017	2018	Future Years	Total
GENERATION	16,917.0	58,397.7	22,651.7	97,966.4
TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	73,886.0	535,328.0
GENERAL PROPERTIES	3,349.7	7,565.8	4,613.4	15,528.9
ALLOWANCE FOR UNFORESEEN ITEMS		1,000.0		1,000.0
TOTAL CAPITAL BUDGET	342,499.6	206,172.6	101,151.1	649,823.3

	Expended to 2017	2018	Future Years	Total
		($000)		
GENERATION				
Hydraulic Plant	9,121.2	28,072.8	10,081.7	47,275.7
Thermal Plant	6,273.0	12,292.6	4,520.3	23,085.9
Gas Turbines	1,522.8	17,780.6	8,049.7	27,353.1
Tools and Equipment		251.7		251.7
TOTAL GENERATION	16,917.0	58,397.7	22,651.7	97,966.4
TRANSMISSION AND RURAL OPERATIONS				
Terminal Stations	29,603.4	47,763.3	55,909.6	133,276.3
Transmission	290,447.9	57,746.2	381.3	348,575.4
Distribution	111.3	10,672.0	3,046.2	13,829.5
Generation	1,569.7	15,953.3	12,320.4	29,843.4
Properties	422.0	3,598.4	241.2	4,261.6
Metering	78.6	2,165.3	1,001.0	3,244.9
Tools and Equipment		1,310.6	986.3	2,296.9
TOTAL TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	73,886.0	535,328.0
GENERAL PROPERTIES				
Information Systems	877.8	2,180.2		3,058.0
Telecontrol	470.5	2,675.0	3,303.2	6,448.7
Transportation	2,001.4	2,066.0	753.7	4,821.1
Administrative		644.6	556.5	1,201.1
TOTAL GENERAL PROPERTIES	3,349.7	7,565.8	4,613.4	15,528.9
ALLOWANCE FOR UNFORESEEN ITEMS		1,000.0		1,000.0
TOTAL CAPITAL BUDGET	342,499.6	206,172.6	101,151.1	649,823.3

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Page Ref
		($000)			
HYDRAULIC PLANT					
Hydraulic Generation Refurbishment and Modernization (2018-2019)		10,325.4	4,283.1	14,608.5	C-4
Replace Site Facilities - Bay d'Espoir	5,664.6	6,316.7		11,981.3	
Refurbish Powerhouse Station Services - Bay d'Espoir	413.2	2,473.3	1,460.6	4,347.1	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	119.2	921.2	2,306.6	3,347.0	
Water System Replacements - Bay d'Espoir and Cat Arm	265.5	2,288.3		2,553.8	
Install Remote Operation of Salmon River Spillway - Bay d'Espoir		645.9	1,862.5	2,508.4	C-18
Control Structure Refurbishments - Various	1,735.3	452.9		2,188.2	
Refurbish Backfill Penstock 1 - Bay d'Espoir		1,630.4		1,630.4	C-23
Hydraulic In-Service Failures		1,251.1		1,251.1	C-30
Upgrade Ventilation in Powerhouse 1 and 2 - Bay d'Espoir	134.1	863.8		997.9	
Install Asset Health Monitoring System - Upper Salmon	438.0	203.4		641.4	
Replace Slip Rings Units 1-6 - Bay d'Espoir	312.6	159.7		472.3	
Energy Efficiency Improvements - Various		276.2	168.9	445.1	D-2
Refurbish Sump Level System for Powerhouse 2 - Bay d'Espoir	38.7	264.5		303.2	
TOTAL HYDRAULIC PLANT	9,121.2	28,072.8	10,081.7	47,275.7	

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total
		($000)		
THERMAL PLANT				
Upgrade Powerhouse Building Envelope - Holyrood	5,693.7	784.1		6,477.8
Install Plant Heating System - Holyrood		1,465.0	4,220.0	5,685.0
Condition Assessment and Miscellaneous Upgrades - Holyrood		2,749.6		2,749.6
Overhaul Unit 1 Turbine Valves - Holyrood		2,485.7		2,485.7
Install Raw Water Line - Holyrood		1,252.6		1,252.6
Thermal In-Service Failures		1,250.0		1,250.0
Upgrade Holyrood Access Road - Holyrood	579.3	583.4		1,162.7
Overhaul Unit 1 Generator - Holyrood		1,005.0		1,005.0
Overhaul Pumps - Holyrood		438.3		438.3
Upgrade Cranes and Hoists - Holyrood		80.3	300.3	380.6
Install Fire Detection in Outbuildings - Holyrood		198.6		198.6
TOTAL THERMAL PLANT	6,273.0	12,292.6	4,520.3	23,085.9
GAS TURBINES				
Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine		8,829.9	3,012.7	11,842.6
Turbine Hot Gas Path Level 2 Inspection and Overhaul - Holyrood Gas Turbine		6,538.8	4,607.7	11,146.5
Gas Turbine Equipment Replacement and Refurbishment - Hardwoods and Stephenville		997.9	429.3	1,427.2
Gas Turbine Life Extension - Stephenville	847.5	505.7		1,353.2
Gas Turbine Life Extension - Hardwoods	675.3	281.4		956.7
Purchase Capital Spares - Gas Turbines		626.9		626.9
TOTAL GAS TURBINES	1,522.8	17,780.6	8,049.7	27,353.1
TOOLS AND EQUIPMENT				
Purchase Tools and Equipment less than $50,000 - Bay d'Espoir		235.2		235.2
Purchase Tools and Equipment less than $50,000 - Holyrood		16.5		16.5
TOTAL TOOLS AND EQUIPMENT	0.0	251.7	0.0	251.7
TOTAL GENERATION	16,917.0	58,397.7	22,651.7	97,966.4

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Page Ref
		($000)			
TERMINAL STATIONS					
Upgrade Circuit Breakers (2016-2020) - Various	17,777.8	15,408.6	28,274.1	61,460.5	
Terminal Station Refurbishment and Modernization (2018-2019)		8,170.6	22,625.1	30,795.7	C-41
Terminal Station Refurbishment and Modernization - Various	10,831.3	16,550.8		27,382.1	
Upgrade Frequency Converter - Corner Brook	194.6	2,749.2		2,943.8	
Replace Transformer T1 - Buchans		249.0	2,086.1	2,335.1	C-63
Install Breaker Bypass Switch - Howley		83.1	1,440.9	1,524.0	C-68
Replace 66 kV Station Service Feed - Holyrood	62.8	1,198.6		1,261.4	
Replace Substation - Holyrood	439.4	758.6		1,198.0	
Replace Power Transformers - Oxen Pond	297.5	850.1		1,147.6	
Terminal Station In-Service Failures		1,000.0		1,000.0	C-82
Implement Terminal Station Flood Mitigation - Springdale		186.2	787.8	974.0	C-85
Purchase Mobile DC Power Systems		270.9	695.6	966.5	C-88
Upgrade Aluminium Support Structures - Holyrood		287.6		287.6	D-32
TOTAL TERMINAL STATIONS	29,603.4	47,763.3	55,909.6	133,276.3	
TRANSMISSION					
Construct 230 kV Transmission Line - Bay d'Espoir to Western Avalon	274,239.7	17,418.3		291,658.0	
Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	14,684.4	11,876.5		26,560.9	
Muskrat Falls to Happy Valley Interconnection		23,513.9	381.3	23,895.2	C-44
Wood Pole Line Management Program - Various		3,532.9		3,532.9	C-54
Transmission Line Upgrades - TL212 and TL218	1,378.2	1,133.3		2,511.5	
Replace Insulators - TL227	145.6	271.3		416.9	
TOTAL TRANSMISSION	290,447.9	57,746.2	381.3	348,575.4	
DISTRIBUTION					
Provide Service Extensions - All Regions		4,520.0		4,520.0	C-48
Upgrade Distribution Systems - All Regions		3,650.0		3,650.0	C-50
Distribution System Upgrades (2018-2019) - Various		383.8	2,771.2	3,155.0	C-57
Distribution Upgrades (2017-2018) - Various	64.2	1,130.9		1,195.1	
Additions for Load Growth - Happy Valley		505.0		505.0	C-99
Install Recloser Remote Control - Bottom Waters	47.1	418.6		465.7	
Install Recloser Remote Control (2018-2019) - English Harbour West and Barachoix		63.7	275.0	338.7	D-28
TOTAL DISTRIBUTION	111.3	10,672.0	3,046.2	13,829.5	

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Page Ref
		($000)			
GENERATION					
Diesel Genset Replacements - Makkovik		604.1	8,296.1	8,900.2	C-46
Diesel Genset Replacements - Port Hope Simpson and Charlottetown	658.8	5,148.0		5,806.8	
Replace Secondary Containment System Liner - Nain		1,639.2	1,450.4	3,089.6	C-59
Overhaul Diesel Engines - Various		2,852.4		2,852.4	C-61
Replace Automation Equipment (2018-2019) - St. Anthony		307.4	1,565.9	1,873.3	C-65
Diesel Plant Engine Cooling System Upgrades - Various		638.4	671.6	1,310.0	C-70
Diesel Plant Engine Auxiliary Upgrades - Various	790.6	416.3		1,206.9	
Replace Automation Equipment - Mary's Harbour	120.3	1,021.7		1,142.0	
Diesel Plant Fire Protection - Postville		505.6	336.4	842.0	C-90
Inspect Fuel Storage Tanks - Black Tickle		818.7		818.7	C-92
Additions for Load Growth - Makkovik and Rigolet		730.1		730.1	C-95
Install Sub-Surface Drainage System - Paradise River		524.9		524.9	C-97
Upgrade Ventilation - Cartwright		465.7		465.7	D-16
Replace Human Machine Interface - St. Lewis		280.8		280.8	D-39
TOTAL GENERATION	1,569.7	15,953.3	12,320.4	29,843.4	
PROPERTIES					
Construct New Facilities - Various	422.0	1,034.1		1,456.1	
Line Depot Condition Assessment and Refurbishment - Various		1,233.0		1,233.0	C-72
Upgrade Office Facilities and Control Buildings - Various		1,180.6		1,180.6	C-77
Install Energy Efficiency Lighting in Diesel Plants - Various		104.0	241.2	345.2	D-25
Install Fall Protection Equipment - Various		46.7		46.7	
TOTAL PROPERTIES	422.0	3,598.4	241.2	4,261.6	
METERING					
Install Automated Meter Reading (2017-2018) - Happy Valley	78.6	1,891.6		1,970.2	
Install Automated Meter Reading (2018-2019) - Bottom Waters		75.2	1,001.0	1,076.2	C-80
Purchase Meters and Metering Equipment - Various		198.5		198.5	E-5
TOTAL METERING	78.6	2,165.3	1,001.0	3,244.9	
TOOLS AND EQUIPMENT					
Replace Off-Road Track Vehicles - Bishop Falls and Bay d'Espoir		213.7	986.3	1,200.0	C-75
Replace Light Duty Mobile Equipment - Various		429.0		429.0	D-20
Purchase Tools and Equipment less than $50,000 - Central		257.4		257.4	
Replace Front End Loader Unit No. 9628 - Bay d'Espoir		170.2		170.2	E-7
Purchase Tools and Equipment less than $50,000 - Labrador		146.4		146.4	
Purchase Tools and Equipment less than $50,000 - Northern		93.9		93.9	
TOTAL TOOLS AND EQUIPMENT	0.0	1,310.6	986.3	2,296.9	
TOTAL TRANSMISSION AND RURAL OPERATIONS	322,232.9	139,209.1	73,886.0	535,328.0	

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Page Ref
		($000)			
INFORMATION SYSTEMS					
SOFTWARE APPLICATIONS					
Upgrade Microsoft Office Products - Hydro Place	1,637.1	957.3		2,594.4	
Cost Recovery	(759.3)	(444.0)		(1,203.3)	
Upgrade Energy Management System - Hydro Place		336.8		336.8	D-68
Upgrade Software Applications - Hydro Place		114.7		114.7	E-19
Refresh Security Software - Hydro Place		62.2		62.2	E-23
Perform Minor Enhancements - Hydro Place		49.4		49.4	
TOTAL SOFTWARE APPLICATIONS	877.8	1,076.4	0.0	1,954.2	
COMPUTER OPERATIONS					
Replace Personal Computers - Hydro Place		493.0		493.0	D-43
Upgrade Core IT Infrastructure - Hydro Place		352.4		352.4	D-62
Replace Peripheral Infrastructure - Hydro Place		258.4		258.4	D-72
TOTAL COMPUTER OPERATIONS	0.0	1,103.8	0.0	1,103.8	
TOTAL INFORMATION SYSTEMS	877.8	2,180.2	0.0	3,058.0	

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Page Ref
		($000)			
TELECONTROL					
NETWORK SERVICES					
Replace PBX Phone Systems - Various		91.7	1,150.6	1,242.3	C-104
Replace MDR 6000 Microwave Radio - Various		64.0	1,137.0	1,201.0	C-106
Replace Battery Banks and Chargers (2017-2018) - Various	379.3	566.2		945.5	
Replace Battery Banks and Chargers - Various		382.1	555.8	937.9	C-108
Upgrade Telecontrol Facilities - Mary March Hill and Blue Grass Hill	91.2	665.9		757.1	
Replace Teleprotection - TL261		57.6	459.8	517.4	C-112
Replace Radomes - Various		360.3		360.3	D-48
Replace Network Communications Equipment - Various		199.5		199.5	E-10
Upgrade RTUs - Various		118.3		118.3	E-16
Replace Air Conditioners - Various		74.4		74.4	E-21
Upgrade Site Facilities - Various		49.0		49.0	
Purchase Tools and Equipment less than $50,000		46.0		46.0	
TOTAL TELECONTROL	470.5	2,675.0	3,303.2	6,448.7	
TRANSPORTATION					
Replace Vehicles and Aerial Devices (2018-2019) - Various		1,667.2	753.7	2,420.9	C-101
Replace Vehicles and Aerial Devices (2017-2018) - Various	2,001.4	398.8		2,400.2	
TOTAL TRANSPORTATION	2,001.4	2,066.0	753.7	4,821.1	
ADMINISTRATION					
Upgrade Exterior of Building - Hydro Place		260.2	405.7	665.9	C-110
Purchase Office Equipment		90.0	150.8	240.8	
Remove Safety Hazards - Various		199.4		199.4	E-12
Replace Washroom Fixtures - Hydro Place		49.5		49.5	
Security Improvements - Hydro Place		45.5		45.5	
TOTAL ADMINISTRATION	0.0	644.6	556.5	1,201.1	
TOTAL GENERAL PROPERTIES	3,349.7	7,565.8	4,613.4	15,528.9	

B. Capital Budget Summary With Multi-Year Projects Separated

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
($000)

		2018
GENERATION		13,123.4
TRANSMISSION AND RURAL OPERATIONS		22,877.1
GENERAL PROPERTIES		2,569.4
ALLOWANCE FOR UNFORESEEN EVENTS		1,000.0
TOTAL PROJECTS UNDER $50,000		302.6
MULTI-YEAR (2018 Expenditures):		
	Multi-year Projects Commencing in 2018	68,781.0
	Multi-year Projects Commencing in 2017	45,201.6
	Multi-year Projects Commencing Prior to 2017:	
	Construct 230 kV Transmission Line - Bay d'Espoir to Western Avalon	17,418.3
	Upgrade Circuit Breakers (2016-2020) - Various	15,408.6
	Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	11,876.5
	Replace Site Facilities - Bay d'Espoir	6,316.7
	Upgrade Powerhouse Building Envelope - Holyrood	784.1
	Upgrade Microsoft Office Products - Hydro Place	957.3
	Cost Recovery	(444.0)
TOTAL CAPITAL BUDGET		**206,172.6**

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
SINGLE YEAR PROJECTS OVER $50,000
($000)

PROJECT DESCRIPTION	
Generation	
HYDRAULIC PLANT	
Refurbish Backfill Penstock 1 - Bay d'Espoir	1,630.4
Hydraulic In-Service Failures	1,251.1
THERMAL PLANT	
Condition Assessment and Miscellaneous Upgrades - Holyrood	2,749.6
Overhaul Unit 1 Turbine Valves - Holyrood	2,485.7
Install Raw Water Line - Holyrood	1,252.6
Thermal In-Service Failures	1,250.0
Overhaul Unit 1 Generator - Holyrood	1,005.0
Overhaul Pumps - Holyrood	438.3
Install Fire Detection in Outbuildings - Holyrood	198.6
GAS TURBINES	
Purchase Capital Spares - Gas Turbines	626.9
TOOLS AND EQUIPMENT	
Purchase Tools and Equipment less than $50,000	235.2
TOTAL GENERATION	13,123.4

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
SINGLE YEAR PROJECTS OVER $50,000
($000)

PROJECT DESCRIPTION	
TRANSMISSION & RURAL OPERATIONS	
TERMINAL STATIONS	
Terminal Station In-Service Failures	1,000.0
Upgrade Aluminium Support Structures - Holyrood	287.6
TRANSMISSION	
Wood Pole Line Management Program - Various	3,532.9
DISTRIBUTION	
Provide Service Extensions - All Regions	4,520.0
Upgrade Distribution Systems - All Regions	3,650.0
Additions for Load Growth - Happy Valley	505.0
GENERATION	
Overhaul Diesel Engines - Various	2,852.4
Inspect Fuel Storage Tanks - Black Tickle	818.7
Additions for Load Growth - Makkovik and Rigolet	730.1
Install Sub-Surface Drainage System - Paradise River	524.9
Upgrade Ventilation - Cartwright	465.7
Replace Human Machine Interface - St. Lewis	280.8
PROPERTIES	
Line Depot Condition Assessment and Refurbishment - Various	1,233.0
Upgrade Office Facilities and Control Buildings - Various	1,180.6
METERING	
Purchase Meters and Metering Equipment - Various	198.5
TOOLS AND EQUIPMENT	
Replace Light Duty Mobile Equipment - Various	429.0
Purchase Tools and Equipment less than $50,000 - Central	257.4
Replace Front End Loader Unit No. 9628 - Bay d'Espoir	170.2
Purchase Tools and Equipment less than $50,000 - Labrador	146.4
Purchase Tools and Equipment less than $50,000 - Northern	93.9
TOTAL TRANSMISSION AND RURAL OPERATIONS	22,877.1

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
SINGLE YEAR PROJECTS OVER $50,000
($000)

PROJECT DESCRIPTION	
General Properties	
INFORMATION SYSTEMS	
SOFTWARE APPLICATIONS	
Upgrade Energy Management System - Hydro Place	336.8
Upgrade Software Applications - Hydro Place	114.7
Refresh Security Software - Hydro Place	62.2
COMPUTER OPERATIONS	
Replace Personal Computers - Hydro Place	493.0
Upgrade Core IT Infrastructure - Hydro Place	352.4
Replace Peripheral Infrastructure - Hydro Place	258.4
TELECONTROL	
NETWORK SERVICES	
Replace Radomes - Various	360.3
Replace Network Communications Equipment - Various	199.5
Upgrade RTUs - Various	118.3
Replace Air Conditioners - Various	74.4
ADMINISTRATION	
Remove Safety Hazards - Various	199.4
TOTAL GENERAL PROPERTIES	2,569.4
TOTAL SINGLE YEAR PROJECTS OVER $50,000	38,569.9

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
PROJECTS OVER $50,000
MULTI-YEAR PROJECTS
($000)

Multi-year Projects Commencing in 2018

PROJECT DESCRIPTION	2018	2019	2020	2021	2022	Total
Terminal Station Refurbishment and Modernization (2018-2019)	8,170.6	18,625.1				26,795.7
Hydraulic Generation Refurbishment and Modernization (2018-2019)	10,325.4	7,534.2				17,859.6
Muskrat Falls to Happy Valley Interconnection	23,513.9	381.3				23,895.2
Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine	8,829.9	3,012.7				11,842.6
Turbine Hot Gas Path Level 2 Inspection and Overhaul - Holyrood Gas Turbine	6,538.8	4,607.7				11,146.5
Diesel Genset Replacements - Makkovik	604.1	4,703.3	3,592.8			8,900.2
Install Plant Heating System - Holyrood	1,465.0	4,220.0				5,685.0
Distribution System Upgrades (2018-2019) - Various	383.8	2,771.2				3,155.0
Replace Secondary Containment System Liner - Nain	1,639.2	1,450.4				3,089.6
Install Remote Operation of Salmon River Spillway - Bay d'Espoir	645.9	1,862.5				2,508.4
Replace Vehicles and Aerial Devices (2018-2019) - Various	1,667.2	753.7				2,420.9
Replace Transformer T1 - Buchans	249.0	2,086.1				2,335.1
Replace Automation Equipment (2018-2019) - St. Anthony Diesel Plant	307.4	1,565.9				1,873.3
Install Breaker Bypass Switch - Howley	83.1	1,440.9				1,524.0
Gas Turbine Equipment and Refurbishment - Hardwoods and Stephenville	997.9	429.3				1,427.2
Diesel Plant Engine Cooling System Upgrades - Various	638.4	671.6				1,310.0
Replace PBX Phone Systems - Various	91.7	1,150.6				1,242.3
Replace MDR 6000 Microwave Radio - Various	64.0	1,137.0				1,201.0
Replace Off Road Track Vehicles - Bishop Falls and Bay d'Espoir	213.7	986.3				1,200.0
Install Automated Meter Reading (2018-2019) - Bottom Waters	75.2	1,001.0				1,076.2
Implement Terminal Station Flood Mitigation - Springdale	186.2	787.8				974.0
Purchase Mobile DC Power Systems	270.9	695.6				966.5
Replace Battery Banks and Chargers - Various	382.1	555.8				937.9
Diesel Plant Fire Protection - Postville	505.6	336.4				842.0
Upgrade Exterior of Building - Hydro Place	260.2	405.7				665.9
Replace Teleprotection - TL261	57.6	459.8				517.4
Energy Efficiency Improvements - Various	276.2	168.9				445.1
Upgrade Cranes and Hoists - Holyrood	80.3	300.3				380.6
Install Energy Efficiency Lighting in Diesel Plants - Various	104.0	119.0	122.2			345.2
Install Recloser Remote Control (2018-2019) - English Harbour West and Barachoix	63.7	275.0				338.7
Purchase Office Equipment	90.0	39.1	40.1	71.6		240.8
Total Multi-Year Projects over $50,000 commencing in 2018	68,781.0	64,534.2	3,755.1	71.6	0.0	137,141.9

NEWFOUNDLAND AND LABRADOR HYDRO
2018 CAPITAL BUDGET
PROJECTS OVER $50,000
MULTI-YEAR PROJECTS
($000)

Multi-year Projects Commencing in 2017

PROJECT DESCRIPTION	Expended to 2017	2018	2019	2020	2021	2022	Total
Terminal Station Refurbishment and Modernization - Various	10,831.3	16,550.8					27,382.1
Diesel Genset Replacements - Port Hope Simpson and Charlottetown	658.8	5,148.0					5,806.8
Refurbish Powerhouse Station Services - Bay d'Espoir	413.2	2,473.3	1,460.6				4,347.1
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	119.2	921.2	877.0	1,429.6			3,347.0
Upgrade Corner Brook Frequency Converter - Corner Brook	194.6	2,749.2					2,943.8
Water System Replacements - Bay d'Espoir and Cat Arm	265.5	2,288.3					2,553.8
Transmission Line Upgrades - TL212 and TL218	1,378.2	1,133.3					2,511.5
Replace Vehicles and Aerial Devices (2017-2018) - Various	2,001.4	398.8					2,400.2
Control Structure Refurbishments - Various	1,735.3	452.9					2,188.2
Install Automated Meter Reading (2017-2018) - Happy Valley	78.6	1,891.6					1,970.2
Construct Facilities - Various	422.0	1,034.1					1,456.1
Gas Turbine Life Extension - Stephenville	847.5	505.7					1,353.2
Replace 66 kV Station Service Feed - Holyrood	62.8	1,198.6					1,261.4
Diesel Plant Engine Auxiliary Upgrades - Various	790.6	416.3					1,206.9
Replace Substation - Holyrood	439.4	758.6					1,198.0
Distribution Upgrades (2017-2018) - Various	64.2	1,130.9					1,195.1
Upgrade Holyrood Access Road - Holyrood	579.3	583.4					1,162.7
Replace Power Transformers - Oxen Pond	297.5	850.1					1,147.6
Replace Automation Equipment - Mary's Harbour	120.3	1,021.7					1,142.0
Upgrade Ventilation in Powerhouse 1 and 2 - Bay d'Espoir	134.1	863.8					997.9
Gas Turbine Life Extension - Hardwoods	675.3	281.4					956.7
Replace Battery Banks and Chargers (2017-2018) - Various	379.3	566.2					945.5
Upgrade Telecontrol Facilities - Mary March Hill and Blue Grass Hill	91.2	665.9					757.1
Install Asset Health Monitoring System - Upper Salmon	438.0	203.4					641.4
Replace Slip Rings Units 1-6 - Bay d'Espoir	312.6	159.7					472.3
Install Recloser Remote Control - Bottom Waters	47.1	418.6					465.7
Replace Insulators - TL227	145.6	271.3					416.9
Refurbish Sump Level System for Powerhouse 2 - Bay d'Espoir	38.7	264.5					303.2
Total Multi-Year Projects over $50,000 commencing in 2017	23,561.6	45,201.6	2,337.6	1,429.6	0.0	0.0	72,530.4
Multi-year Projects Commencing before 2017							
Construct 230 kV Transmission Line - Bay d'Espoir to Western Avalon	274,239.7	17,418.3					291,658.0
Upgrade Circuit Breakers - Various	17,777.8	15,408.6	15,247.3	13,026.8			61,460.5
Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	14,684.4	11,876.5					26,560.9
Replace Site Facilities - Bay d'Espoir	5,664.6	6,316.7					11,981.3
Upgrade Powerhouse Building Envelope - Holyrood	5,693.7	784.1					6,477.8
Upgrade Microsoft Office Products - Hydro Place	1,637.1	957.3					2,594.4
Cost Recovery	(759.3)	(444.0)					(1,203.3)
Total Multi-Year Projects over $50,000 commencing before 2017	318,938.0	52,317.5	15,247.3	13,026.8	0.0	0.0	399,529.6

C. Projects $500,000 and Over

PROJECT DESCRIPTION	Expended to 2017	2018 ($000)	Future Years	Total	Definition	Classification	Page Ref
GENERATION							
Hydraulic Generation Refurbishment and Modernization (2018-2019)		10,325.4	4,283.1	14,608.5	Other	Normal	C-4
Replace Site Facilities - Bay d'Espoir	5,664.6	6,316.7		11,981.3	Other	Normal	
Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine		8,829.9	3,012.7	11,842.6	Other	Justifiable	C-8
Turbine Hot Gas Path Level 2 Inspection and Overhaul - Holyrood Gas Turbine		6,538.8	4,607.7	11,146.5	Other	Normal	C-11
Upgrade Powerhouse Building Envelope - Holyrood	5,693.7	784.1		6,477.8	Other	Normal	
Install Plant Heating System - Holyrood		1,465.0	4,220.0	5,685.0	Other	Normal	C-13
Refurbish Powerhouse Station Services - Bay d'Espoir	413.2	2,473.3	1,460.6	4,347.1	Other	Normal	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	119.2	921.2	2,306.6	3,347.0	Other	Normal	
Condition Assessment and Miscellaneous Upgrades - Holyrood		2,749.6		2,749.6	Other	Normal	C-15
Water System Replacements - Bay d'Espoir and Cat Arm	265.5	2,288.3		2,553.8	Other	Normal	
Install Remote Operation of Salmon River Spillway - Bay d'Espoir		645.9	1,862.5	2,508.4	Other	Normal	C-18
Overhaul Unit 1 Turbine Valves - Holyrood		2,485.7		2,485.7	Other	Normal	C-21
Control Structure Refurbishments - Various	1,735.3	452.9		2,188.2	Pooled	Normal	
Refurbish Backfill Penstock 1 - Bay d'Espoir		1,630.4		1,630.4	Other	Normal	C-23
Gas Turbine Equipment Replacement and Refurbishment - Hardwoods and Stephenvi		997.9	429.3	1,427.2	Other	Normal	C-25
Gas Turbine Life Extension - Stephenville	847.5	505.7		1,353.2	Other	Normal	
Install Raw Water Line - Holyrood		1,252.6		1,252.6	Other	Normal	C-27
Hydraulic In-Service Failures		1,251.1		1,251.1	Pooled	Normal	C-30
Thermal In-Service Failures		1,250.0		1,250.0	Pooled	Normal	C-33
Upgrade Holyrood Access Road - Holyrood	579.3	583.4		1,162.7	Other	Normal	
Overhaul Unit 1 Generator - Holyrood		1,005.0		1,005.0	Other	Normal	C-36
Upgrade Ventilation in Powerhouse 1 and 2 - Bay d'Espoir	134.1	863.8		997.9	Other	Normal	
Gas Turbine Life Extension - Hardwoods	675.3	281.4		956.7	Other	Normal	
Install Asset Health Monitoring System - Upper Salmon	438.0	203.4		641.4	Other	Normal	
Purchase Capital Spares - Gas Turbines		626.9		626.9	Other	Normal	C-38
TOTAL GENERATION	16,565.7	56,728.4	22,182.5	95,476.6			

PROJECT DESCRIPTION	Expended to 2017	2018 ($000)	Future Years	Total	Definition	Classification	Page Ref
TRANSMISSION AND RURAL OPERATIONS							
Construct 230 kV Transmission Line - Bay d'Espoir to Western Avalon	274,239.7	17,418.3		291,658.0	Other	Justifiable	
Upgrade Circuit Breakers (2016-2020) - Various	17,777.8	15,408.6	28,274.1	61,460.5	Other	Normal	
Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	14,684.4	11,876.5		26,560.9	Other	Normal	
Terminal Station Refurbishment and Modernization (2018-2019)		8,170.6	22,625.1	30,795.7	Other	Normal	C-41
Terminal Station Refurbishment and Modernization - Various	10,831.3	16,550.8		27,382.1	Other	Normal	
Muskrat Falls to Happy Valley Interconnection		23,513.9	381.3	23,895.2	Other	Normal	C-44
Diesel Genset Replacements - Makkovik		604.1	8,296.1	8,900.2	Other	Normal	C-46
Diesel Genset Replacements - Port Hope Simpson and Charlottetown	658.8	5,148.0		5,806.8	Pooled	Normal	
Provide Service Extensions - All Regions		4,520.0		4,520.0	Pooled	Normal	C-48
Upgrade Distribution Systems - All Regions		3,650.0		3,650.0	Pooled	Normal	C-50
Wood Pole Line Management Program - Various		3,532.9		3,532.9	Other	Normal	C-54
Distribution System Upgrades (2018-2019) - Various		383.8	2,771.2	3,155.0	Other	Normal	C-57
Replace Secondary Containment System Liner - Nain		1,639.2	1,450.4	3,089.6	Other	Mandatory	C-59
Upgrade Frequency Converter - Corner Brook	194.6	2,749.2		2,943.8	Other	Normal	
Overhaul Diesel Engines - Various		2,852.4		2,852.4	Pooled	Normal	C-61
Transmission Line Upgrades - TL212 and TL218	1,378.2	1,133.3		2,511.5	Other	Normal	
Replace Transformer T1 - Buchans		249.0	2,086.1	2,335.1	Other	Normal	C-63
Install Automated Meter Reading (2017-2018) - Happy Valley	78.6	1,891.6		1,970.2	Other	Justifiable	
Replace Automation Equipment (2018-2019) - St. Anthony		307.4	1,565.9	1,873.3	Other	Normal	C-65
Install Breaker Bypass Switch - Howley		83.1	1,440.9	1,524.0	Other	Normal	C-68
Construct New Facilities - Various	422.0	1,034.1		1,456.1	Other	Normal	
Diesel Plant Engine Cooling System Upgrades - Various		638.4	671.6	1,310.0	Other	Normal	C-70
Replace 66 kV Station Service Feed - Holyrood	62.8	1,198.6		1,261.4	Other	Normal	
Line Depot Condition Assessment and Refurbishment - Various		1,233.0		1,233.0	Other	Normal	C-72
Diesel Plant Engine Auxiliary Upgrades - Various	790.6	416.3		1,206.9	Other	Normal	
Replace Off-Road Track Vehicles - Bishop Falls and Bay d'Espoir		213.7	986.3	1,200.0	Other	Normal	C-75
Replace Substation - Holyrood	439.4	758.6		1,198.0	Other	Normal	
Distribution Upgrades (2017-2018) - Various	64.2	1,130.9		1,195.1	Other	Normal	
Upgrade Office Facilities and Control Buildings - Various		1,180.6		1,180.6	Other	Normal	C-77
Replace Power Transformers - Oxen Pond	297.5	850.1		1,147.6	Other	Normal	
Replace Automation Equipment - Mary's Harbour	120.3	1,021.7		1,142.0	Other	Normal	
Install Automated Meter Reading (2018-2019) - Bottom Waters		75.2	1,001.0	1,076.2	Other	Justifiable	C-80
Terminal Station In-Service Failures		1,000.0		1,000.0	Pooled	Normal	C-82
Implement Terminal Station Flood Mitigation - Springdale		186.2	787.8	974.0	Other	Normal	C-85
Purchase Mobile DC Power Systems		270.9	695.6	966.5	Other	Justifiable	C-88
Diesel Plant Fire Protection - Postville		505.6	336.4	842.0	Other	Normal	C-90
Inspect Fuel Storage Tanks - Black Tickle		818.7		818.7	Other	Normal	C-92
Additions for Load Growth - Makkovik and Rigolet		730.1		730.1	Other	Normal	C-95
Install Sub-Surface Drainage System - Paradise River		524.9		524.9	Other	Normal	C-97
Additions for Load Growth - Happy Valley		505.0		505.0	Other	Normal	C-99
TOTAL TRANSMISSION AND RURAL OPERATIONS	322,040.2	135,975.3	73,369.8	531,385.3			

GENERAL PROPERTIES							
Replace Vehicles and Aerial Devices (2018-2019) - Various		1,667.2	753.7	2,420.9	Other	Normal	C-101
Replace Vehicles and Aerial Devices (2017-2018) - Various	2,001.4	398.8		2,400.2	Other	Normal	
Upgrade Microsoft Office Products - Hydro Place	877.8	513.3		1,391.1	Other	Normal	
Replace PBX Phone Systems - Various		91.7	1,150.6	1,242.3	Other	Normal	C-104
Replace MDR 6000 Microwave Radio - Various		64.0	1,137.0	1,201.0	Other	Normal	C-106
Replace Battery Banks and Chargers (2017-2018) - Various	379.3	566.2		945.5	Other	Normal	
Replace Battery Banks and Chargers - Various		382.1	555.8	937.9	Other	Normal	C-108
Upgrade Telecontrol Facilities - Mary March Hill and Blue Grass Hill	91.2	665.9		757.1	Other	Normal	
Upgrade Exterior of Building - Hydro Place		260.2	405.7	665.9	Other	Normal	C-110
Replace Teleprotection - TL261		57.6	459.8	517.4	Other	Normal	C-112
TOTAL GENERAL PROPERTIES	3,349.7	4,667.0	4,462.6	12,479.3			
TOTAL PROJECTS $500,000 AND OVER	$341,956	$197,371	$100,015	$639,341			

Project Title: Hydraulic Generation Refurbishment and Modernization

Location: Various

Category: Generation - Hydraulic

Definition: Other

Classification: Normal

Project Description:

Newfoundland and Labrador Hydro (Hydro) has ten hydroelectric generating stations and over 3000 assets involved in the functioning of these ten stations.
Hydro executes a robust capital program to replace or refurbish failing or failed assets to ensure the delivery of safe, reliable, least-cost electricity in an environmentally responsible manner. Hydro's Capital Program includes the replacement and refurbishment of equipment based on Hydro's Long-term Asset Management Strategy.

In the 2018 Capital Budget Application, Hydro proposes the following activities under the *Hydraulic Generation Refurbishment and Modernization Project*:
Hydraulic Generating Units Program:

1. Turbine and Generator Six Year Overhauls;
2. Turbine Major Overhauls;
3. Replace/Improve Unit Metering, Monitoring, SCADA and Protection and Control Assets; and
4. Infrequent Refurbishment or Replacement - Hydraulic Generating Units
    a. Install Protective Guards in Turbine Pits;
        b. Replace Vent Chambers; and
        c. Replace Generator Bearing Coolers.

Hydraulic Structures Program:

1. Refurbish and Replace of Control Gates Infrastructure; and
2. Refurbish Surge Tanks and Towers Program.

Reservoirs Program:

1. Upgrade Public Safety Around Dams and Waterways.

Site Buildings and Services Program:

1. Refurbish Accommodation.

Common Auxiliary Equipment Program:

1. Replace/Improve Unit Metering, Monitoring, SCADA and Protection and Control Assets;
2. Ancillary AC/DC Electrical System Refurbishment and Replacement; and
3. Diesel Fuel Storage Refurbishment and Replacement.

The combined estimate for the project is provided in Table 1.

Table 1: Programs Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	812.2	221.0	0.0	1,033.2
Labour	2,862.0	514.8	0.0	3,376.9
Consultant	502.0	75.6	0.0	577.6
Contract Work	3,903.4	2,228.8	0.0	6,132.2
Other Direct Costs	253.8	112.9	0.0	366.6
Interest and Escalation	606.1	388.1	0.0	994.2
Contingency	1,385.9	741.9	0.0	2,127.8
TOTAL	**10,325.4**	**4,283.1**	**0.0**	**14,608.5**

In the 2018 Capital Budget Application, Hydro has consolidated program, pooled, and stand-alone type hydraulic generation projects into a single project, *Hydraulic Generation Refurbishment and Modernization Project*, and will respond to hydraulic generation in-service infrastructure failures using the *Hydraulic Generation In-Service Failures Project,* where applicable. Moving forward, these projects are proposed for work to address the required refurbishment or replacement of assets and have similar justifications and other information presented each year.

In alignment with this consolidation, Hydro is changing its presentation for this Project. The *Hydraulic Generation Asset Management Overview* (See Volume II, Tab 1), submitted with the 2018 Capital Budget Application, outlines Hydro's philosophies for the assessment of equipment plus the selection of projects. In addition, this summary document and supporting proposal report have been altered to eliminate repetitive information. Additionally, as the requirement for the work is founded on condition assessment practices or previously approved long term programs, data such as individual equipment operating experience and future plans has been removed.

The Hydraulic Generation Refurbishment and Modernization Project will not include projects related to growth, or projects related to an isolated issue in a particular generating station. These projects will continue to be proposed separately.

Hydro will continue to maintain individual records with regards to the asset capital, maintenance and retirement expenditures, assessments, and performance.

Project Justification:

Hydro replaces or refurbishes assets that have deteriorated, or pose a safety or environmental risk, such as those assets containing PCBs. The replacement of such assets is required to ensure Hydro continues to deliver safe, reliable, least-cost electricity in an environmentally responsible manner. Further details on Hydro's philosophies for the assessment of equipment condition and selection and justification of projects can be found in the *Hydraulic Generation Asset Management Overview*.

Future Plans:

Hydro will submit a proposal for the *Hydraulic Generation Refurbishment and Modernization* Project on an annual basis.

Attachment:

See reports entitled "Hydraulic Generation Refurbishment and Modernization" and "*Hydraulic Generation Asset Management Overview*" located in Volume II, Tab 1 for further details.

Project Title: Increase Fuel and Water Treatment System Capacity

Location: Holyrood Gas Turbine

Category: Generation - Gas Turbines

Definition: Other

Classification: Justifiable

Project Description:

The project proposes the installation of two 1.25 million litre tanks to expand the fuel storage system and the installation of additional water treatment equipment to increase demineralized water capacity for nitrogen oxide (NO_x) from 380 litres per minute to 570 litres per minute. The equipment will be placed in-service in 2018 and the final exterior painting of the tanks will be completed in 2019.

The cost estimate for this project is listed in Table 1.

Table 1: Overall Project Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	0.0	0.0	0.0
Labour	1,059.6	157.9	0.0	1,217.5
Consultant	269.2	0.0	0.0	269.2
Contract Work	5,696.7	2,200.0	0.0	7,896.7
Other Direct Costs	32.2	6.6	0.0	38.8
Interest and Escalation	360.7	175.3	0.0	536.0
Contingency	1,411.5	472.9	0.0	1,884.4
TOTAL	**8,829.9**	**3,012.7**	**0.0**	**11,842.6**

Operating Experience:

Since being placed in service, the Holyrood Gas Turbine generating unit has been operated more frequently and for longer durations than was forecasted during the engineering for its installation. Table 2 provides the forecasted and actual operating hours for the gas turbine from February 2015 to April 2017.

Table 2: Forecasted and Actual Operating Hours – HRD GT from 2015-2017

Year	Forecasted Running Hours	Actual Running Hours
2015	184	823
2016	294	1818
2017	444	237 (to April 30)

In some increased generation situations, sustained higher daily fuel deliveries are required. To date, those deliveries have been achieved but fuel production problems, delays resulting from poor road condition due to weather, truck and driver unavailability, and blocked access to the unloading station are all risks which could impact future sustained deliveries resulting in impacts to the gas turbines ability to meet generation requirements. In addition, the demineralized water requirement for NO_x control has at times exceeded the capacity of the water treatment system and when this occurs, generation is not compliant with the Certificate of Approval. The gas turbine is operated under Certificate of Approval No. AA14-125602. As per Section 38 of this approval, Hydro shall not operate the 123 MW gas turbine unless the NOx control system associated with the unit is in full operation.

Project Justification:

Increasing the on-site fuel storage to 5 million litres will allow, when the tanks are full and without any deliveries, the gas turbine to generate at 100% capacity for 5 days. With normal daily fuel deliveries of 400,000 litres (assuming the expanded storage facility is full at the start of the period) the GT can generate at 100% capacity for 10 days.

To ensure compliance with Section 38 of the Certificate of Approval for the gas turbine, the water treatment capacity must be expanded from 380 litres per minute to 570 litres per minute.

Cumulative Present Worth analysis shows that the installations to be completed as part of this proposal are the lowest cost alternatives for increasing fuel storage and water treatment capacity for the gas turbine, which are required to ensure its reliable and compliant generation.

Attachments:

Please see report entitled "*Increase Fuel and Water Treatment System*" located in Volume II, Tab 2 for further project details.

Project Title: Turbine Hot Gas Path Level 2 Inspection and Overhaul

Location: Holyrood Gas Turbine

Category: Generation - Gas Turbines

Definition: Other

Classification: Normal

Project Description:

This is a two year project to complete a hot gas path inspection and overhaul on the gas turbine unit located at the Holyrood Gas Turbine Plant. This work includes:

- Replacement of specific components identified by the manufacturer in this overhaul;
- Level 2 inspection and assessment; and
- If required by the assessment, additional refurbishment or replacement of deteriorated components.

The installation of an access hatch in the powerhouse roof to allow for lifting major components out of the building to a laydown area by the powerhouse during the inspection and overhaul is also included in the scope of work.

The project budget estimate is provided in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	5.0	0.0	5.0
Labour	95.8	374.3	0.0	470.1
Consultant	81.1	0.0	0.0	81.1
Contract Work	5,997.6	1,756.4	0.0	7,754.1
Other Direct Costs	4.7	34.7	0.0	39.4
Interest and Escalation	359.6	767.4	0.0	1,127.0
Contingency	0.0	1,669.9	0.0	1,669.9
TOTAL	**6,538.8**	**4,607.7**	**0.0**	**11,146.5**

Operating Experience:
The Holyrood Gas Turbine has been in service since March, 2015. A Combustion Overhaul was completed in 2016 when the unit total equivalent starts approached 400. The manufacturer recommends that a hot gas path level 2 inspection and overhaul be completed when the unit total equivalent starts reaches 800. The on-going requirement for hot gas path level 2 inspection and overhaul has been incorporated into the Holyrood Combustion Turbine asset management practices and Hydro expects the unit to reach its first 800 total equivalent starts in 2019.

Project Justification:
This project is required to execute asset management activity which will contribute to the future reliable operation of the Holyrood Combustion Turbine.

Attachments:
See report entitled "*Turbine Hot Gas Path Level 2 Inspection and Overhaul*" located in Volume II, Tab 3, for further project details.

Project Title: Install Plant Heating System

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

This proposed project includes the design, supply, and installation of a new heating system for the powerhouse and pumphouse at the Holyrood Thermal Generating Station. This heating system will consist of light oil fired heating and ventilation units, including associated electrical and control systems. Some electrical heating units will be installed for localized heating and freeze protection in areas of the powerhouse, including the air compressors, water treatment plant, and maintenance areas.

This project will undertake detailed design and procurement in 2018 and installation and commissioning in 2019.

The project budget estimate is provided in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	1,000.0	500.0	0.0	1,500.0
Labour	117.3	654.7	0.0	772.0
Consultant	265.4	31.0	0.0	296.4
Contract Work	0.0	1,716.6	0.0	1,716.6
Other Direct Costs	0.0	2.3	0.0	2.3
Interest and Escalation	82.3	457.9	0.0	540.2
Contingency	0.0	857.5	0.0	857.5
TOTAL	**1,465.0**	**4,220.0**	**0.0**	**5,685.0**

Operating Experience:

The auxiliary steam for plant heating is extracted from the high pressure steam produced by one or more of the three power boilers when one or more of the generating units are used for power generation. Holyrood was also originally equipped with two auxiliary boilers. Steam was provided for the plant heating from the auxiliary boilers when all three power boilers were not operating. In 1992, an assessment of the auxiliary boilers concluded that their condition had deteriorated and it was decided to remove the auxiliary boilers, largely based on the assumption that it would be unlikely that all the three power boilers would experience a shut down at the same time. This assumption will no longer be valid after the Muskrat Falls assets come into service and the steam generation comes to an end.

Project Justification:

An alternative continuous source of heating will be required for Holyrood plant heating and freeze protection of equipment because Holyrood will remain in stand-by generation mode for a period of time after the Lower Churchill Project is brought into service to ensure that Holyrood is available and ready to provide generation in the event that it is required. In addition, the facility will also operate as a synchronous condensing station after the stand-by period and will require a heating source.

Attachments:

See report entitled “*Install Plant Heating System*” located in Volume 2, Tab 4, for further project details.

Project Title: Condition Assessment and Miscellaneous Upgrades

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

This project proposes the completion of a Level 2 condition assessment on the internal components of the main steam generators (boilers) and the associated external high energy piping to catalogue a list of refurbishment or replacement work required to be completed in succeeding years. Additionally, the following activities will be completed:

- In-service Level 2 inspection of heavy oil storage tank no. 4;
- Level 2 inspection and refurbishment of boilers stacks;
- Replacement of boiler expansion joints;
- Replacement of Unit 3 generator brush holders;
- Replacement of condenser cooling water piping in Unit 2;
- Replacement of steam heat tracing piping in the tank farm;
- Replacement of domestic water piping (control room, shops and contractor washrooms);
- Refurbishment of Unit 3 traveling screen; and
- Refurbishment of marine terminal arm.

The project budget estimate is provided in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	258.0	0.0	0.0	258.0
Labour	443.4	0.0	0.0	443.4
Consultant	358.8	0.0	0.0	358.8
Contract Work	1,096.0	0.0	0.0	1,096.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	162.2	0.0	0.0	162.2
Contingency	431.2	0.0	0.0	431.2
TOTAL	**2,749.6**	**0.0**	**0.0**	**2,749.6**

Operating Experience:

The activities listed in the project description are required as a result of deteriorated infrastructure and equipment, and require refurbishment to ensure reliable operation of the Holyrood Thermal Generating Station (Holyrood).

These activities can be classified into the following:

1. Level 2 inspections and condition assessments are required to determine an appropriate course of action (e.g. boiler stack inspections and work resulting from those assessments, and boiler stack refurbishment).
2. Work resulting from deterioration that was previously identified during operation of the plant (e.g. failed boiler expansion joints which cause combustion gas to leak into the plant during operation of the boilers must be replaced). In addition, recommended interventions based on the previous year's condition assessment project would also be included (e.g. 2017 condition assessment projects currently being executed were guided by the results of the 2016 results).
3. Work resulting from asset management practices for infrastructure and equipment that have to be refurbished on a regular basis, e.g. the marine terminal loading arm is refurbished under direction of an industry expert every three years.

Project Justification:

Holyrood has exceeded the normal life expectancy for a thermal generating station. Units 1 and 2 at Holyrood are 47 years old and Unit 3 is 37 years old. Considering the age, there is infrastructure and equipment that must undergo Level 2 condition assessments, refurbishment and/or replacement to maintain safe and reliable operation of Holyrood.

Future Plans:

The 2019 condition assessment project will be the last year of this program.

Attachments:

See report entitled, "*Condition Assessment and Miscellaneous Upgrades*" located in Volume II, Tab 5, for further project details.

Project Title: Install Remote Operation of Salmon River Spillway

Location: Bay d'Espoir

Category: Generation - Hydraulic

Definition: Other

Classification: Normal

Project Description:

This proposed project is to install remote operation of the Salmon River Spillway.

The scope of work includes:

- Installation of a communication control network to interface with the corporate communications network;
- Installation of instrumentation and controls to transmit pertinent data to a remote operator and enable the operator to operate the gates and notify personnel in the area through an alarm system of the pending gate operation;
- Installation of back-up generation in the event that the normal electrical supply is lost due to a storm event;
- Construction of additional building space required to house new equipment;
- Modification of the downstream road crossing to reduce the need to remove existing culverts prior to spilling operations; and
- Installation of required signage to warn of spilling hazards.

The project is scheduled to start in 2018 with engineering, procurement of equipment, and the commencement of civil works. Completion of civil works, equipment installation, and commissioning will be completed in 2019.

The project estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	20.0	255.7	0.0	275.7
Labour	245.9	465.5	0.0	711.4
Consultant	100.6	53.4	0.0	154.0
Contract Work	224.9	440.6	0.0	665.5
Other Direct Costs	14.4	70.0	0.0	84.4
Interest and Escalation	40.1	199.1	0.0	239.2
Contingency	0.0	378.2	0.0	378.2
TOTAL	**645.9**	**1,862.5**	**0.0**	**2,508.4**

Operating Experience:

The Salmon River Spillway provides protection for the Long Pond Reservoir. This spillway is used to release water in a controlled manner to prevent the failure of the Long Pond Reservoir during periods of high water inflows. Currently, the Salmon River Spillway gates are manually operated in order to release water from the reservoir.

In recent years there has been an increase in the number of times the Bay d'Espoir Salmon River Spillway control gates have to be opened to spill water. In October 2016, during Hurricane Matthew, the volume of water added to the reservoir and the upstream drainage basin caused an increase in the reservoir level, putting the structure at risk. During the storm, travel to the spillway structure to open the spill way gates was not possible as the storm had caused 11 wash-outs making the road impassible and high wind conditions during the storm eliminated the use of helicopters. Events like this increase the risk that access is not available, via helicopter or road, and flood waters could compromise the reservoir containment system.

Project Justification:

The remote control of the Salmon River Spillway control gates will enable remote operation of the gates during conditions when personnel cannot travel to the site to operate the gates to ensure safe and reliable operation of the spillway. In flooding situations, if timely water release is not done, water in the Long Pond Reservoir could raise to a level which could cause a dam failure; flooding the downstream communities in Bay d'Espoir and resulting in an extended loss of Bay d'Espoir power generation. This project is justified to ensure safe operation of the spillway.

Attachments:

Please see report entitled "*Install Remote Operation of Salmon River Spillway*" located in Volume II, Tab 6 for further project details.

Project Title: Overhaul Unit 1 Turbine Valves

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

This project is required to perform a scheduled overhaul of the Generating Unit 1 Turbine Valves located at the Holyrood Thermal Generating Station.

The valve overhaul consists of:

- Total dismantle of all turbine valves;
- Inspection of the valves;
- Blue checks (check the contact area between two sealing surfaces);
- Lapping of the valve seats;
- Adjustment of valve clearances;
- Refurbishment as required; and
- Re-assembly of all turbine valves.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	655.0	0.0	0.0	655.0
Labour	135.9	0.0	0.0	135.9
Consultant	355.0	0.0	0.0	355.0
Contract Work	804.0	0.0	0.0	804.0
Other Direct Costs	4.0	0.0	0.0	4.0
Interest and Escalation	141.0	0.0	0.0	141.0
Contingency	390.8	0.0	0.0	390.8
TOTAL	**2485.7**	**0.0**	**0.0**	**2485.7**

Operating Experience:

The Unit 1 operating hours up to December 2016 are 200,800 hours. The generator operates for approximately 5,000 hours per year. Unit 1 has undergone scheduled valve overhauls on a three year rotation since 1971.

Project Justification:

The valves of a turbine control the steam flow to the steam turbine generator and hence the electricity production. The purpose of the valve overhaul is to return the turbine and auxiliary systems to design or near design specifications such that they can perform safely, efficiently, and reliably to meet system demands until the next overhaul. It will also identify any unusual findings (internal or external) that, if not corrected or controlled, could lead to premature failure of the equipment. The three year overhaul frequency is supported by industry practice, consultants, and original equipment manufacturers.

Future Plans:

A turbine valve overhaul for Unit 3 is scheduled to be completed in 2019.

Attachments:

See report entitled “*Overhaul Unit 1 Turbine Valves*” located in Volume II, Tab 7, for further project details

Project Title: Refurbish Backfill on Penstock No. 1

Location: Bay d'Espoir

Category: Generation - Hydraulic

Definition: Other

Classification: Normal

Project Description:

This project includes the following scope of work at the Bay d'Espoir Generating Station:

- The removal of existing backfill on Penstock 1 from 75 meters to 425 meters downstream from the intake; and
- Supply, install, and compact backfill material between these points (350 meters long) on Penstock 1 to reinstate the original design condition.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	195.3	0.0	0.0	195.3
Consultant	0.0	0.0	0.0	0.0
Contract Work	1,081.6	0.0	0.0	1,081.6
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	98.1	0.0	0.0	98.1
Contingency	255.4	0.0	0.0	255.4
TOTAL	**1,630.4**	**0.0**	**0.0**	**1,630.4**

Operating Experience:

In 2016, there were two weld failures in Penstock 1. A root cause analysis indicated that the existing backfill around Penstock 1 did not provide adequate lateral support to the penstock. A finite element stress analysis confirmed that the stresses in the penstock metal exceeded acceptable industry levels for this type and size of penstock given the existing backfill condition. The finite element stress analysis report also indicated that the depth and width of the backfill support around the penstock be increased to prevent overstressing of the penstock welds and eliminate the risk of weld cracks developing under normal operating conditions.

Project Justification:

The refurbishment of backfill on penstock 1 at Bay D’Espoir is justified on the requirement to prevent failure of critical infrastructure that is essential to reliable operation of Units 1 and 2. The backfill is necessary for the structural integrity of Penstock 1; it is part of the conduit construction and serves to keep the penstock in shape when it is unwatered. It also prevents collapse due to pressure in the pipe falling below atmospheric pressures and insulates the pipe to prevent excessive thermal stresses.

Attachment:

See report entitled “*Refurbish Backfill on Penstock 1*” located in Volume II, Tab 8, for further project details.

Project Title: Gas Turbine Equipment Replacement and Refurbishment

Location: Hardwoods and Stephenville

Category: Generation - Gas Turbines

Definition: Other

Classification: Normal

Project Description:

The scope of work for this proposed project includes:

- Replace existing demisters at Hardwoods and Stephenville gas turbine plants with larger size demisters, including any modifications to associated piping and lube oil enclosures required to support new demisters; and
- Refurbish air intake and exhaust stack structures at Hardwoods.

The refurbishment of the air intake and exhaust stack structures at Hardwoods will be completed in 2018. The procurement of both demisters for Hardwoods and Stephenville will be completed in 2018 with installation scheduled for 2019.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	64.0	0.0	0.0	64.0
Labour	172.0	74.3	0.0	246.3
Consultant	150.0	0.0	0.0	150.0
Contract Work	550.0	100.0	0.0	650.0
Other Direct Costs	1.2	11.7	0.0	12.9
Interest and Escalation	60.7	94.3	0.0	155.0
Contingency	0.0	149.0	0.0	149.0
TOTAL	**997.9**	**429.3**	**0.0**	**1,427.2**

Operating Experience:

*Demister (Hardwoods and Stephenville)***:**

Newfoundland and Labrador Hydro (Hydro) has gas turbine generating plants at Hardwoods and Stephenville. Each gas turbine has main lube oil system, which contains a demister. The demister separates oil mist from the lube oil exhaust gases for either disposal or recirculation. The existing demister at both Hardwoods and Stephenville gas turbine plants are undersized, which causes the filters to become saturated with lube oil in two to four weeks. This results in oil leaking into the enclosure of the main lube oil system and releasing oil mist into the atmosphere, which creates health and environmental concerns.

Air Intakes and Exhaust Stacks (Hardwoods):

The air intakes and exhaust stacks at Hardwoods are more than 40 years old. Structural deficiencies were noted in condition assessments conducted in 2015, 2016 and 2017 for the air intakes and exhaust stacks at Hardwoods. In 2017, it was found that the extent of the cracking had increased and if not arrested, will continue to propagate to an extent that the stacks no longer have structural integrity and the gas turbine will have to be removed from service. There are also items which need to be addressed to increase safety, including handrails with low height and damaged mesh on the air intake structures.

Project Justification:

The demisters at Hardwoods and Stephenville need to be replaced to ensure a healthy and environmentally responsible workplace.

The air intakes and exhaust stacks at Hardwoods need to be refurbished to ensure reliable operation of the gas turbine.

Attachments:

See report entitled "*Gas Turbine Equipment Replacement and Refurbishment*" located in Volume II, Tab 9, for further project details.

Project Title: Install Raw Water Line

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

This project proposes to install a 400 mm diameter PVC (polyvinyl chloride) underground pipe, which will be approximately 1,000 m in length extending from the Quarry Brook Dam to Pump House 1 at the Holyrood Thermal Generating Station. Existing spur piping to the Holyrood Combustion turbine and other facilities on the Holyrood Site will be connected to the piping. The raw water line will provide equal flow capacity as the existing gravity fed asbestos cement (AC) pipe.

The budget estimate for this project is shown in Table 1.

Table 1: Project Cost

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	0.0	0.0	0.0
Labour	195.1	0.0	0.0	195.1
Consultant	140.4	0.0	0.0	140.4
Contract Work	645.5	0.0	0.0	645.5
Other Direct Costs	5.9	0.0	0.0	5.9
Interest and Escalation	68.3	0.0	0.0	68.3
Contingency	197.4	0.0	0.0	197.4
TOTAL	**1,252.6**	**0.0**	**0.0**	**1,252.6**

Operating Experience:

The raw water line is a 1,000 m length 400 mm diameter gravity fed pipe used to carry water from the nearby Quarry Brook Dam to Holyrood Pump House 1. The existing water line is an asbestos cement, 400 mm diameter, pipe installed to supply water from Quarry Brook Dam to the Holyrood Pump House 1 to provide water to the entire Holyrood site for steam generation, firefighting, and domestic water needs. At the thermal plant, there is water storage capacity that will provide enough water to sustain full thermal power production for 1 day and the combustion turbine has storage capacity which will provide enough water to sustain full thermal power production for 10 hours.

As asbestos cement pipes age, they gradually corrode and deteriorate, which leads to a reduction in the effective cross-section, resulting in pipe softening and loss of strength. Inspections completed in 2014 and 2015 found areas of deterioration which indicates that the water line, which has already failed once, is at risk of future failures.

In 2012, a backup water supply system was obtained consisting of a diesel pump and a 200 mm diameter fire hose, which would be deployed in case of a pipe failure. This system can supply water to the thermal generating station for power generation requirements with minimal water available for fire protection and domestic use. This system would also be susceptible to freeze-up in the winter months.

In 2014, during installation of the Holyrood Combustion Turbine, the Quarry Brook Dam water line was tapped to provide water for generation of electricity, for firefighting, and domestic water use. The backup water supply system was obtained prior to the installation of the Holyrood Combustion Turbine and is not capable of supplying the combustion turbine, which means there is no backup to maintain water supply to the combustion turbine in case of a cement pipe failure.

Project Justification:

This project is to ensure an adequate and reliable supply of water to the Holyrood Thermal Generating Units and the Holyrood Combustion Turbine for generation, firefighting and domestic water needs.

Attachment:

See report entitled "*Install Raw Water Line*" located in Volume 2, Tab 10, for further project details.

Project Title: Hydraulic Generation In-Service Failures

Location: Hydro Generation

Category: Generation - Hydraulic

Definition: Pooled

Classification: Normal

Project Description:

Hydro conducts asset management activities to proactively identify, replace, repair, or refurbish equipment to minimize the disruption of service and to avoid unsafe working conditions due to equipment failure. An objective of Hydro's Asset Management Program is to identify refurbishment and replacement activities that require Board approval in time to be included in its annual Capital Budget Application. The identification is done through the Hydraulic Generation Preventative Maintenance Program using various condition-based assessment testing procedures. Hydro has had success in projecting the deterioration rate of equipment for submission of refurbishment or replacement work into capital budget applications. However, there are situations where immediate refurbishment or replacement must be completed due to actual failures, the identification of an incipient failure, or faster than anticipated equipment deterioration. These situations can be caused by events such as vandalism, storm damage, lightning, accidental damage, abnormal electrical system operations, cavitation, etc.

Similar to Hydro's Terminal Station In-Service Failures Project, Hydro will use a standby pool of equipment (formerly referred to as Capital Spares) and undertake the timely refurbishment and replacement work required to maintain the integrity and reliability of the electrical system. These activities will be undertaken in accordance with the philosophies outlined throughout the *Hydraulic Generation Asset Management Overview* (see Volume II, Tab 1) document.

Actual annual purchases from the standby pool will be undertaken to allow responsive action to failures. It is expected that many of these purchases will be usable in various Hydro plants over time, but Hydro anticipates purchasing the following in in 2018:

- Hinds Lake Circuit Breaker;
- Cat Arm excitation transformer; and
- Hinds Lake station service transformer.

The Hydraulic Generation In-Service Failures Project will support hydraulic generation operations in case of an unforeseen event. Once identified, materials will be procured or obtained from Hydro's stocked inventory and the refurbishment and/or replacement work required to maintain the integrity and reliability of the Hydraulic Generation asset will be completed. Hydro uses historical data and engineering judgement to predict the magnitude of in-service failures.

Examples of possible in-service failure work that could be completed under this project include:

- Generating unit bearing cooler failure;
- Hydraulic structure jammed gates;
- Replacement of rollers;
- Erosion of dam reservoir;
- Building damage from weather; and
- Replacement of pumps or compressors due to accelerated wear or premature failure.

Hydro's estimated project cost of the *Hydraulic Generation In-Service Failures* project is presented in Table 1.

Table 1: Project Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	686.5	0.0	0.0	686.5
Labour	344.3	0.0	0.0	344.3
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	65.0	0.0	0.0	65.0
Interest and Escalation	76.9	0.0	0.0	76.9
Contingency	78.4	0.0	0.0	78.4
TOTAL	**1,251.1**	**0.0**	**0.0**	**1,251.1**

Operating Experience:

Electrical systems, like that of Hydro's, are prone to in-service failures. This program will allow Hydro to address such failures without impacting planned sustaining projects on hydraulic generation assets shown in the *2018 Hydraulic Generation Refurbishment and Modernization Project* in this Capital Budget Application.

Project Justification:

The failure of hydraulic generation equipment, if not addressed in a timely manner, can impact the robustness of the electrical system. This project provides the resources to address such failures promptly and minimize impacts to Hydro's electrical system.

Future Plans:

This project will be proposed annually. With each annual submission, Hydro will include a concise summary of activities completed under the Hydraulic Generation In-Service Failures Project for the previous year.

Project Title: Thermal Generation In-Service Failures

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Pooled

Classification: Normal

Project Description:

Hydro conducts its asset management activities to proactively identify, replace, repair, or refurbish equipment to minimize the disruption of service and to avoid unsafe working conditions due to equipment failure. An objective of Hydro's Asset Management Program is to identify refurbishment and replacement activities that require Board approval early enough to include in its annual Capital Budget Application. The identification is done through the preventative maintenance program using various condition based assessments testing procedures. Hydro has had success in projecting the deterioration rate of equipment so as to submit refurbishment or replacement work in capital budget applications. However, there are situations where immediate refurbishment or replacement has to be undertaken due to actual failures or the recognition of an incipient failure or faster than anticipated equipment deterioration.

Some examples of this work include:

- Replacement or refurbishment of auxiliary equipment (such as pumps, compressors, motors) due to accelerated deterioration or premature failure;
- Replacement or refurbishment of boiler or steam system components due to accelerated deterioration or premature failure;
- Level 2 condition assessment of aging equipment suspected of failure; and
- Damages caused by abnormal weather events, vandalism, etc.

The probability of in-service failures at the Holyrood Thermal Generating Station has increased, given the age of the facility and its stage of operating life. This project will allow

Hydro to promptly address minor failures/sustaining projects not already included in the 2018 Capital Budget Application.

Similar to Hydro's Terminal Station In-Service Failures Project, Hydro will include purchases of items for a standby pool of equipment.[1] Under this project, stand-by pool purchases for 2018 will include, but not be limited to:

- 1400 kVA Excitation transformer;
- 1500 kVA Auxiliary board transformer; and
- DC Lube Oil Motor (250 VDC).

The estimated cost of the Thermal In-Service Failures project is presented in Table 1.

Table 1: Project Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	490.0	0.0	0.0	490.0
Labour	507.6	0.0	0.0	507.6
Consultant	0.0	0.0	0.0	0.0
Contract Work	130.0	0.0	0.0	130.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	83.6	0.0	0.0	83.6
Contingency	38.8	0.0	0.0	38.8
TOTAL	**1,250.0**	**0.0**	**0.0**	**1,250.0**

Operating Experience:

Table 2 shows a list of supplemental capital budget applications for the previous ten years where portions or the entire project could have been executed within the Thermal In-Service Failures Project's budget.

For example, some common high temperature and pressure components that are prone to failure include expansion joints, seals, piping, fittings, and valves. Replacement of these

[1] These types of equipment were obtained in previous years under the Capital Spares Project.

components was undertaken in the 2017 Reliability Improvements supplemental project, which also included inspection and testing to predict the potential source of failures as accurately as possible. The Thermal In-Service Failures Project can be utilized to inspect, test, evaluate weak points, and perform smaller replacements thereby eliminating the need file for a supplemental project.

Table 2: Historical Supplemental Projects

Year	Description	Cost ($x1,000)
2017	Reliability Improvements	2,660.0
2016	Tank 1 Inspection and Condition Assessment	39.0
2015	Inspect and Repair Transformer UST-3	82.0
2015	Replace Unit 1 and 2 Rectifying Transformers	756.0
2014	Replace Air Compressor	308.0
2013	Installation of Blackstart Capability	1,263.0
2011	Stack Breeching Upgrades	1,754.0
2011	Upgrade Fuel oil Storage Facility	2,694.0

Future Plans:

This project will be proposed annually. With each annual submission, Hydro will include a concise summary of activities completed under the Thermal In-Service Failures Project in the previous year. Work executed under this project in 2018 will be reported in 2019 as part of the 2020 Capital Budget Application.

Project Title: Overhaul Unit 1 Generator

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

This project is required to perform a scheduled six-year overhaul of the Unit 1 Generator located at the Holyrood Thermal Generating Station (Holyrood). This overhaul consists of the removal of the generator rotor and subsequent internal inspection of its components.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2016	2017	Beyond	Total
Material Supply	100.0	0.0	0.0	100.0
Labour	95.0	0.0	0.0	95.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	592.1	0.0	0.0	592.1
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	60.5	0.0	0.0	60.5
Contingency	157.4	0.0	0.0	157.4
TOTAL	**1,005.0**	**0.0**	**0.0**	**1,005.0**

Operating Experience:

Unit 1 has undergone scheduled generator overhauls since 1971.

Project Justification:

This project is justified as it completes Unit 1 generator’s six-year overhaul and corrects deficiencies found during the project work to ensure reliable operation of the generator.

Future Plans:

No additional generator overhauls are planned for the foreseeable future.

Attachments:

See report entitled "*Overhaul Unit 1 Generator*" located in Volume II, Tab 11 for further project details.

Project Title: Purchase Capital Spares – Gas Turbines

Location: Various

Category: Generation - Gas Turbines

Type: Other

Classification: Normal

Project Description:

The capital spares proposed to be purchased in this project include:

- New steel bellows, which can be used in either the Hardwoods or Stephenville Gas Turbines; and
- One high pressure and one low pressure compressor bleed valve with a rebuild kit for each. The high pressure and low pressure bleed valves are used for the Holyrood Combustion Turbine.

In addition to the equipment being purchased by this proposed project is the refurbishment of existing combustion cans and steel bellows, which can be used in either Hardwoods or Stephenville Gas Turbines.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	467.7	0.0	0.0	467.7
Labour	20.0	0.0	0.0	20.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	41.7	0.0	0.0	41.7
Contingency	97.5	0.0	0.0	97.5
TOTAL	**626.9**	**0.0**	**0.0**	**626.9**

Justification

Hydro has assessed its combustion turbines and identified critical equipment for each unit. A stock of spare replacement units, components, and parts has been established for the identified equipment. This stock facilitates an expedited return to service of combustion turbines in the event of failure that requires the replacement of one of the stock items. Critical spare inventory evaluations are conducted annually with the objective of improving reliability.

Equipment Background

Combustion Cans

The combustion cans are the section of the turbine where high pressure air from the compressor is mixed with fuel and ignited to produce hot gasses for turbine rotation and in turn, power generation. Hardwoods or Stephenville gas turbine generators cannot operate without all eight cans functioning properly.

Bellows

The bellows are flexible expansion joints between the gas turbine and the power turbine that accommodate thermal expansion due to the high operating temperatures. Between the new and refurbished units, one can be stored at each site.

Bleed Valves

High pressure and low pressure compressor bleed valves and rebuild kits are used to limit airflow and control pressures inside the compressor.

Conclusion

Hydro maintains a critical spares stock to facilitate an expedited return to reliable service of a turbine by allowing prompt replacement of failed components.

Project Schedule

The anticipated project schedule is provided in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Open Project	January 2018	January 2018
Design	Prepare specifications, tender documentation	February 2018	March 2018
Procurement	Procure components	March 2018	November 2018
Closeout	Prepare closeout documents	November 2018	December 2018

Project Title: Terminal Station Refurbishment and Modernization (2018-2019)

Location: Various

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Normal

Project Description:

Terminal stations play a critical role in the transmission and distribution of power across the Province. Terminal stations contain electrical equipment, such as transformers, circuit breakers, instrument transformers, disconnect switches, and all associated protection and control relays and equipment required to protect, control, and operate the province's electrical grid. Terminal stations act as transition points in the transmission system and interface points with the lower voltage distribution and generation systems. Hydro owns and operates 69 terminal stations across the Island and Labrador interconnected systems.

Hydro aims to replace or refurbish failing or failed terminal station assets to ensure the delivery of safe, reliable, least-cost electricity in an environmentally responsible manner.

In the 2018 Budget Application, Hydro proposes the following activities under the Terminal Station Refurbishment and Modernization Project:

- Replacement of Instrument Transformers;
- Replacement of Disconnect Switches;
- Replacement of Surge Arrestors;
- Refurbishment and Modernization of Power Transformers;
- Replacement of Insulators;
- Refurbishment and Upgrade of Station Grounding;
- Refurbishment of Equipment Foundations;
- Installation of Fire Suppression Systems in Control Buildings;
- Protection, Control, and Monitoring replacements and modernization; and

- Refurbishment and modernization of the Wabush Terminal Station.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	2,379.0	1,231.8	0.0	3,610.8
Labour	2,188.8	4,078.7	0.0	6,267.5
Consultant	620.6	1,155.6	0.0	1,776.2
Contract Work	1,850.2	5,860.3	0.0	7,710.5
Other Direct Costs	312.8	878.0	0.0	1,190.8
Interest and Escalation	426.0	1,702.6	0.0	2,128.6
Contingency	393.2	3,718.1	0.0	4,111.3
TOTAL	**8,170.6**	**18,625.1**	**0.0**	**26,795.7**

In the 2017 Capital Budget Application, Hydro consolidated program-type terminal station projects into a single project, *Terminal Station Refurbishment and Modernization*. The *Terminal Station Asset Management Overview* (Asset Overview), which was also submitted with the 2017 Capital Budget Application, outlines Hydro's philosophies for the assessment of equipment plus the selection and justification of projects.

The Terminal Station Refurbishment and Modernization project does not include projects related to growth, or projects related to an isolated issue for a particular terminal station. These projects are proposed separately. In the 2018 Terminal Station Refurbishment and Modernization project, Hydro has added work related to the refurbishment of the recently acquired Wabush Terminal Station and associated equipment in the Churchill Falls Switchyard, as well as the installation of breaker bypass switches. The scope of work within this station is presented separately, as this provides a better overview of the total costs of proposed work on these newly acquired assets.

Hydro will continue to maintain individual records with regards to the asset capital, maintenance and retirement expenditures, assessments, and performance.

Project Justification:

Hydro replaces or refurbishes assets that have deteriorated, or pose a safety or environmental risk, such as those assets containing PCBs. The replacement of such assets is required to ensure Hydro continues to deliver safe, reliable, least-cost electricity in an environmentally responsible manner. Further details on Hydro's philosophies for the assessment of equipment condition and selection and justification of projects can be found in the *Terminal Station Asset Management Overview*.

Future Plans:

Hydro will submit a proposal for the *Terminal Station Refurbishment and Modernization* project on an annual basis.

Attachments:

See Reports entitled "*Terminal Station Refurbishment and Modernization (2018-2019)*" and "*Terminal Station Asset Management Overview"* located in Volume II, Tab 12, for further details.

Project Title: Muskrat Falls to Happy Valley Interconnection

Location: Eastern Labrador

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Normal

Project Description:

This project proposes splitting TL240, [1] the 138 kV transmission line from the Churchill Falls Terminal Station to the Happy Valley Terminal Station, and terminating the ends of the split on a Hydro-constructed ring bus in the Muskrat Falls 315 kV Terminal Station. The ring bus will also accept two 138 kV supplies from Muskrat Falls. As this proposed project will increase the maximum fault level in Happy Valley Terminal Station, five reclosers and one circuit breaker will also be replaced. To house the new Happy Valley protection and control infrastructure being installed, a new control building will be constructed.

The budget estimate for the project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	2,546.3	0.0	0.0	2,546.3
Labour	3,827.5	300.0	0.0	4,127.5
Consultant	144.6	0.0	0.0	144.6
Contract Work	12,040.2	0.0	0.0	12,040.2
Other Direct Costs	399.4	0.0	0.0	399.4
Interest and Escalation	764.3	21.3	0.0	785.6
Contingency	3,791.6	60.0	0.0	3,851.6
TOTAL	**23,513.9**	**381.3**	**0.0**	**23,895.2**

[1] TL240 is also known in the Labrador Interconnected System as L1301 and L1302. L1301 is from Churchill Falls Terminal Station to the Muskrat Falls Tap Station, and L1302 is from the Muskrat Falls Tap Station to Happy Valley Terminal Station.

Operating Experience:

When the electrical demand in the Upper lake Melville area of Hydro's Interconnected Labrador System exceeds 77 MW, the system will suffer voltage degradation and ultimately voltage collapse, which will result in outages. The projected peak load for the area is expected to increase from 79.8 MW in 2017 to 88 MW in 2042.

Project Justification:

To support load levels beyond 77 MW in the Upper Lake Melville area reliably, the capacity of transmission system supplying the area must be increased.

Attachments:

See report entitled "Muskrat Falls to Happy Valley Interconnection" located in Volume II, Tab 13, for further project details.

Project Title: Diesel Genset Replacement

Location: Makkovik

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Normal

Project Description:

This project proposes the replacement of Unit 2059 in Makkovik's Diesel Generation Station with a higher capacity diesel generator (genset). To achieve the replacement of Unit 2059 the powerhouse building will be extended.

The new genset will require a new exhaust stack, radiator, fuel cooler, aftercooler, switchgear with breaker, and all other necessary mechanical equipment to facilitate a new unit. The new physical location of the genset will be in the building extension, resulting in the need for new power cables to the new unit. Upgrades to the protection and control equipment will be required because the current plant automation equipment is not compatible with the new equipment. A fire suppression system will also be included in this project for the entire generating station including the new extension.

The estimate for the full project is listed in Table 1.

Table 1: Project Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**2020**	**Total**
Material Supply	0.0	1,010.6	65.0	1,075.6
Labour	180.0	625.3	626.2	1,431.5
Consultant	270.4	260.0	726.9	1,257.3
Contract Work	0.0	1,625.2	966.2	2,591.4
Other Direct Costs	21.2	57.7	264.0	342.9
Interest and Escalation	38.2	408.8	414.8	861.8
Contingency	94.3	715.7	529.7	1,339.7
TOTAL	**604.1**	**4,703.3**	**3,592.8**	**8,900.2**

Operating Experience:

The replacement of Unit 2059 at Makkovik is required by the year 2020 because the genset is projected to reach the end of its service live in the fourth quarter of 2019. Hydro has established the service life of a diesel genset to be an accumulated 100,000 operating hours.

Project Justification:

The project proposal is justified on the requirement to satisfy Hydro's current asset management strategy to replace gensets when they approach 100,000 operating hours and on improving overall plant efficiency. A larger unit will reduce the overall usage of the other diesel units in the plant, thereby decreasing the individual annual operating hours per diesel engine, which will ultimately reduce fuel and maintenance costs.

Hydro has a program to install automatic fire protection systems in all diesel generating plants, including the Makkovik Plant. Details of this program were presented in the 2016 Capital Budget Application in *Install Fire Protection System*, Volume III, Tab 13. Hydro will avail of this project's building expansion construction efforts to install fire prevention throughout the expanded building in accordance with that document.

Attachments:

See report entitled "*Diesel Genset Replacement*" located in Volume II, Tab 15, for further project details.

Project Title: Provide Service Extensions

Location: All Service Areas

Category: Transmission and Rural Operations – Distribution

Definition: Pooled

Classification: Normal

Project Description:

This project is an annual allotment based on past expenditures to provide for service connections, including street lights to new customers.

Table 1 identifies the total budget for the Central, Northern, and Labrador operating regions.

Table 1: Budget Estimate

Project Cost: ($ x 1,000)	2018	2019	Beyond	Total
Material Supply	2,000.0	0.0	0.0	2,000.0
Labour	1,690.0	0.0	0.0	1,690.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	145.0	0.0	0.0	145.0
Other Direct Costs	115.0	0.0	0.0	115.0
Interest and Escalation	190.0	0.0	0.0	190.0
Contingency	380.0	0.0	0.0	380.0
Sub-Total	4,520.0	0.0	0.0	4,520.0
Cost Recoveries	(200.0)	0.0	0.0	(200.0)
TOTAL	**4,320.0**	**0.0**	**0.0**	**4,320.0**

Operating Experience:

In recent years, rural areas of the Island have generally experienced increased expenditures for service extensions due to customer growth and economic activity. Expenditures in Labrador for service extensions had increased dramatically for similar reasons as the Island but, expenditures have been declining since 2012.

The five year actual expenditures for service extensions by region are shown in Table 2.

Table 2: Five Year Expenditures

Region	Expenditures ($000) 2012		2013		2014		2015		2016	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
Central	1,437	1,231	1,437	1,751	1,490	1,660	1,600	1,842	1,750	1,531
Northern	1,371	1,728	1,371	1,218	1,460	1,366	1,460	1,498	1,470	1,623
Labrador	2,198	3,073	2,198	2,720	3,220	1,848	3,020	1,242	1,930	1,522
Total	**5,006**	**6,032**	**5,006**	**5,689**	**6,170**	**4,814**	**6,080**	**4,582**	**5,150**	**4,675**

Project Justification:

The forecast budget estimate for 2018 is based on an analysis of the historical expenditures within the past five years on new customer connections by region supplemented with regional planning input with respect to future activity expenditure levels.

The service extension budget for Labrador is forecast for 2018 on the basis of the two-year historical average expenditures from 2015 and 2016 to reflect the expected decline in activity from the historically high levels experienced in 2012 and 2013. A five-year historical average was used for the Central Region and a five year historical average was used for the Northern Region respectively. The 2018 budget was developed assuming distribution line cost escalation of 2.1% over 2017. The budget by region is shown in Table 3.

Table 3: Budget for 2017 Service Extensions

Region	Budget ($000)
Central	1,750
Northern	1,290
Labrador	1,290
Total	**4,330**

Future Plans:

This is an annual allotment that is adjusted from year to year depending on historical expenditures. Please see the five-year capital plan (2018-2022 Capital Plan Tab, Appendix A).

Project Title: Upgrade Distribution Systems

Location: All Service Areas

Category: Transmission and Rural Operations - Distribution

Definition: Pooled

Classification: Normal

Project Description:

This project is an annual allotment based on historical expenditures, which provide for the replacement of deteriorated poles, substandard structures, corroded and damaged conductors, transformers/street lights/reclosers, and other associated equipment. Upgrading requirements for distribution systems are identified through preventive maintenance inspections, or when there is damage caused to equipment by adverse weather conditions, such as storms, or salt contaminations.

The budget estimate for this project is shown in Table 1 below.

Table 1: Budget Estimate

Project Cost: ($ x 1,000)	2018	Beyond	Total
Material Supply	1,978.0	0.0	1,978.0
Labour	1,145.0	0.0	1,145.0
Consultant	0.0	0.0	0.0
Contract Work	144.0	0.0	144.0
Other Direct Costs	3.0	0.0	3.0
Interest and Escalation	158.0	0.0	158.0
Contingency	317.0	0.0	317.0
Sub-Total	3,744.0	0.0	3,744.0
Cost Recoveries	(94.0)	0.0	(94.0)
TOTAL	**3,650.0**	**0.0**	**3,650.0**

Operating Experience:

Expenditures for upgrading distribution systems in rural areas were higher in 2016 than 2013 and 2015, but lower than the expenditures for 2014, on an inflation-adjusted basis.

The five-year expenditures for distribution upgrades by region are shown in Table 2.

Table 2: Five Year Expenditures

Expenditures ($000)										
Region	2012		2013		2014		2015		2016	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
Central	993	1,854	1,095	1,692	1,700	1,861	1,720	1,887	1,870	1,671
Northern	1,089	1,010	1,237	678	1,270	854	1,210	730	1,120	924
Labrador	426	270	458	604	400	859	410	370	900	610
Total	**2,508**	**3,134**	**2,790**	**2,974**	**3,370**	**3,574**	**3,340**	**2,987**	**3,890**	**3,205**

Other specifically approved projects for 2012 – 2016 are listed in Table 4.

Project Justification:

The forecast budget estimate for 2018 is based on an analysis of the historical expenditures for distribution upgrading by region supplemented with regional planning input with respect to future activity expenditure levels. The 2018 budgets for the Central, Northern, and Labrador regions are based on the five-year average for distribution system upgrades for the period 2012 – 2016. Inflation adjusted budgets for 2018 were developed assuming distribution upgrading cost escalation of approximately 2.1% over 2017.

Table 3: Budget for 2018 Distribution System

Region	Budget ($000)
Central	1,870
Northern	880
Labrador	900
Total	**3,650**

Future Plans:

This is an annual allotment, which is adjusted from year to year depending on historical expenditures. See the five-year capital plan (2018-2022 Capital Plan Tab, Appendix A).

Table 4 shows the history of other specific distribution system upgrades that have been completed over the past five years as well as the budget for 2017.

Table 4: Historical Information

Year	Project Description	Budget ($000)	Actuals ($000)
2017B	Farewell Head Pole Replacements (Year 2 of 2)	856.4	
	King's Point Pole Replacement (Year 2 of 2)	737.9	
	Replace Recloser CA1-R2 – Cat Arm (Year 2 of 2)	345.0	
	Replace Recloser GB1-R1 – Grandy Brook (Year 2 of 2)	278.4	
	Bay d'Espoir Underground Upgrade (Year 2 of 2)	906.8	
	Happy Valley Upgrade Distribution (L16) (Year 2 of 2)	738.8	
	Paradise River Pole Replacements (Year 2 of 2)	621.1	
	L'Anse au Loop Distribution Upgrade (Year 2 of 2)	1,666.0	
	Sally's Cove Upgrade Distribution System (Year 2 of 2)	199.9	
	Grandy Brook Distribution Upgrade 2017 (Year 1 of 2)	32.1	
	Ramea Distribution Upgrade System 2017 (Year 1 of 2)	32.1	
2016	Farewell Head Pole Replacements (Year 1 of 2)	31.9	336.2
	King's Point Pole Replacement (Year 1 of 2)	32.0	16.1
	Replace Recloser CA1-R2 – Cat Arm (Year 1 of 2)	20.6	0
	Replace Recloser GB1-R1 – Grandy Brook (Year 1 of 2)	15.4	0.6
	Bay d'Espoir Underground Upgrade (Year 1 of 2)	32.0	0
	Happy Valley Upgrade Distribution (L16) (Year 1 of 2)	32.0	0
	Paradise River Pole Replacements (Year 1 of 2)	32.1	8.9
	L'Anse au Loop Distribution Upgrade (Year 1 of 2)	74.2	0
	Sally's Cove Upgrade Distribution System (Year 1 of 2)	15.4	0
	Upgrade Distribution Feeder – Line 1, 3, 4, 6 and 7 Bottom Waters (Year 2 of 2)	818.8	710.8
2015	Upgrade Distribution Feeder – Line 1, 3, 4, 6 and 7 Bottom Waters (Year 1 of 2)	42.7	163.2
	Upgrade Distribution Feeder – Line 7 North West River (Year 2 of 2)	700.1	806.5
	Pole Replacements – Pinsent's Arm and Labrador City	593.4	754.6
	Insulator Replacements – Farewell Head	500.0	461.3
	Relocate Voltage Regulators – Hawke's Bay	166.4	116.6
	Install Second Distribution Feeder – Nain	1,050.3	1,139.4
	Upgrade Distribution Feeder – Line 1 Nain (Year 2 of 2)	261.0	339.0
	Upgrade Distribution Feeder – Line 1 Daniel's Hr. (Year 2 of 2)	877.8	980.5
	Upgrade Distribution Feeder – Line 1 and 2 Main Brook (Year 2 of 2)	837.1	811.9
	Upgrade Distribution Feeder – Line 1 Plum Point (Year 2 of 2)	1,440.9	1,342.9
	Upgrade Distribution Feeder – Line 1 Hampden (Year 2 of 2)	733.2	728.8
2014	Upgrade Distribution Feeder – Line 7 North West River (Year 1 of 2)	64.3	26.6
	Upgrade Distribution Feeder – Line 1 Nain (Year 1 of 2)	43.0	10.0
	Upgrade Distribution Feeder – Happy Valley (Year 1 of 2)	64.3	26.6
	Upgrade Distribution Feeder – Line 1 Daniel's Hr. (Year 1 of 2)	69.7	14.9
	Upgrade Distribution Feeder – Line 1 and 2 Main Brook (Year 1 of 2)	64.3	104.7
	Upgrade Distribution Feeder – Line 1 Plum Point (Year 1 of 2)	75.3	6.4
	Upgrade Distribution Feeder – Line 1 Hampden (Year 1 of 2)	53.6	10.5

Year	Project Description	Budget ($000)	Actuals ($000)
	Upgrade Distribution Feeder – Line 1 MacCallum	359.1	320.1
	Upgrade Distribution Feeder – Line 1, 2, 4 and 5 Barachoix	583.7	553.8
	Upgrade Distribution Feeder – Line 1 Bay d'Espoir	692.6	632.3
	Upgrade Distribution Feeder – Line 1 Conne River	494.2	443.2
	Upgrade Distribution Feeder – Line 1 St. Lewis (Year 2 of 2)	908.1	740.5
	Upgrade Distribution Feeder – Line 1 and 3 Roddickton (Year 2 of 2)	1,259.5	1,366.7
	Upgrade Distribution System – Charlottetown (Year 2 of 2)	365.0	269.2
	Upgrade Distribution System – South Brook (Year 2 of 2)	975.8	846.2
	Upgrade Distribution Feeder – Line 1 Grey River (Year 2 of 2)	487.1	410.8
2013	Upgrade Distribution Feeder – Line 1 St. Lewis (Year 1 of 2)	76.9	23.3
	Upgrade Distribution Feeder – Line 1 and 3 Roddickton (Year 1 of 2)	98.4	106.5
	Upgrade Distribution System – Charlottetown (Year 1 of 2)	27.8	22.8
	Upgrade Distribution System – South Brook (Year 1 of 2)	76.3	108.5
	Upgrade Distribution Feeder – Line 1 Grey River (Year 1 of 2)	32.5	111.9
	Upgrade Distribution Feeder – Line 1 Cow Head	665.6	658.4
	Upgrade Distribution Feeder – Line 1 St. Brendan's	330.2	310.7
	Upgrade Distribution Feeder – Line 1 Holyrood	632.4	372.1
	Upgrade Distribution Feeder – Line 11 Wabush	400.8	513.2
	Upgrade Distribution Voltage – Line 6 St. Anthony	641.9	648.6
	Upgrade Distribution Feeder – Line 6 Farewell Head	961.9	980.0
	Upgrade Distribution Feeder – Line 5 Farewell Head	1,110.1	1,184.9
	Upgrade Distribution Feeder – Line 2 Plum Point (Year 2 of 2)	1,110.5	1,276.2
2012	Upgrade Distribution Feeder – Line 1 Bay d'Espoir	856.6	896.9
	Upgrade Distribution Feeder – Line 2 Bay d'Espoir	952.9	811.2
	Upgrade Distribution Feeder – Line 1 Francois	440.9	650.4
	Upgrade Distribution Feeder – Line 1 Parson's Pond	381.9	344.7
	Upgrade Distribution Feeder – Line 2 Plum Point (Year 1 of 2)	50.4	33.2
	Upgrade Distribution Feeder – Line 7 Happy Valley	1,260.1	1,163.6
	Upgrade Distribution Feeder – Line 2 Glenburnie (Year 3 of 4	2,114.6	1,895.0
	Reconfigure Feeders – Wabush	55.4	55.4
	Upgrade Distribution Feeder – Line 1 Rigolet (Year 2 of 2)	725.7	658.5
	Upgrade Distribution Feeder – Line 1 Makkovik (Year 2 of 2) (Materials ordered in 2011)	799.5	612.6

Project Title: Wood Pole Line Management Program (2018)

Location: Various

Category: Transmission and Rural Operations - Transmission

Definition: Other

Classification: Normal

Project Description:

The objective of the Wood Pole Line Management (WPLM) program is to maintain a comprehensive pole inspection and testing program using the conventional sound and bore methods supplemented by Non Destructive Evaluation (NDE), periodic full scale tests of poles removed from service, and remedial treatment application. Structural analysis to assess the line reliability is applied against all inspection information. Any replacement and/or refurbishment will be based on the assessment of quantitative risk with respect to in-service pole strength.

Under the program, transmission line inspection data in each year is analyzed and appropriate recommendations made for necessary refurbishment and/or replacement of line components such as poles/structures, hardware, and conductors in the subsequent year. The inspection data and any refurbishment and/or replacement of assets are recorded in a centralized database for future access and tracking.

The budget estimate for the project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	597.4	0.0	0.0	597.4
Labour	1,976.0	0.0	0.0	1,976.0
Consultant	100.0	0.0	0.0	100.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	98.8	0.0	0.0	98.8
Interest and Escalation	206.3	0.0	0.0	206.3
Contingency	554.4	0.0	0.0	554.4
TOTAL	**3,532.9**	**0.0**	**0.0**	**3,532.9**

Operating Experience:

Hydro operates approximately 2,500 kilometers of wood pole transmission lines, including approximately 26,000 poles. Hydro inspects and treats approximately 10 percent of these poles each year and these inspections indicate decreasing preservative levels and increasing decay in aging poles.

Project Justification:

As wood poles age, their preservative retention levels decrease and the poles become increasingly subjected to deterioration by different agents including fungi and insects. Wood poles must be regularly inspected and treated in-situ to proactively identify and assess any deterioration. The WPLM program detects deteriorated poles and other line components early to avoid safety hazards and to identify poles that are at early stages of decay to ensure that corrective measures can be taken to extend the average life of these poles. Money is saved through the deferring of rebuilding lines and avoiding forced outages.

In addition to proactively managing wood poles, the project detects deteriorated line components before the integrity of a structure is jeopardized. If the deterioration of the components are not detected early enough then the reduced integrity of the structure will result in component failures. This would cause a customer outage, thus affecting the reliability of the line and the system as a whole and could lead to increased failure costs.

Future Plans:

The program is based on two ten-year inspection cycles that began in 2003. It provides annual data to identify problem areas for the regional asset managers and develop recommendations for appropriate pole replacements, as well as other components in the following years. Please see the anticipated five-year capital schedule in Appendix A of the report entitled “Wood Pole Line Management Program.”

Attachments:

See report entitled “*Wood Pole Line Management Program (2018)*” located in Volume II, Tab 14, for further project details.

Project Title: Distribution System Upgrades (2018-2019)

Location: Various

Category: Transmission and Rural Operations - Distribution Central

Definition: Other

Classification: Normal

Project Description:

Hydro provides service to residents in select rural communities within the province through the use of distribution systems. Distribution systems typically consist of a substation, coupled with a wood pole distribution line that supplies power from the station to service drops throughout the community. This project proposal includes distribution lines located in the distribution systems of Farewell Head, English Harbour West, Rocky Harbour, and Cartwright that have been identified as requiring upgrades to existing infrastructure. The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	50.0	740.0	0.0	790.0
Labour	230.2	410.0	0.0	640.2
Consultant	0.0	0.0	0.0	0.0
Contract Work	80.0	900.0	0.0	980.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	23.6	239.2	0.0	262.8
Contingency	0.0	482.0	0.0	482.0
TOTAL	**383.8**	**2,771.2**	**0.0**	**3,155.0**

Operating Experience:

The distribution lines were originally constructed over 40 years ago. Most of the line components were installed at the time of original construction and have exceeded the expected service life of 30 years. In addition, standardized inspection and testing procedures indicate that some of the line components are deteriorated and have remaining life spans of only one to five years before failures occur.

Project Justification:

This project is justified based on reliability. The condition of the components could result in distribution line failures and have a negative effect on the reliability performance of the line. The failure of a line may also result in unplanned power outages to customers at a time when required repairs may be hampered by severe weather conditions.

Furthermore, deteriorated distribution lines create safety concerns for Hydro employees and local citizens who are near the line when a deteriorated pole fails. Failing poles can cause energized electrical conductors to fall to the ground and a risk of electrical shock or electrocution exists. Due to these safety hazards, Hydro does not allow distribution line components to remain in service until failure.

Future Plans:

Future distribution line upgrades will be proposed in future capital budget applications. See five-year capital plan (Capital Plan 2018 Tab, Appendix A).

Attachments:

See report entitled "*Distribution System Upgrades (2018-2019)*" located in Volume II, Tab 16, for further project details.

Project Title: Replace Secondary Containment System Liner

Location: Nain

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Mandatory

Project Description:

This is a two year project for the replacement of the dyke liner in the secondary fuel containment system at Hydro's diesel plant in Nain. The scope of work includes: lifting and temporary support of tank shell; removal of organic material within the dyke; removal of the granular liner topping material; reshaping of the dyke; replacement of the dyke liner; and reinstatement of the tanks. The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	100.6	54.4	0.0	155.0
Consultant	155.8	76.8	0.0	232.6
Contract Work	1,275.6	644.0	0.0	1,919.6
Other Direct Costs	14.2	8.5	0.0	22.7
Interest and Escalation	93.0	200.7	0.0	293.7
Contingency	0.0	466.0	0.0	466.0
TOTAL	**1,639.2**	**1,450.4**	**0.0**	**3,089.6**

Operating Experience:

Testing and assessment of the secondary containment system found that the system no longer conforms to its design specification and the dyke does not comply with the present regulatory requirements for permeability. While the root cause of the permeability noncompliance is not known, it is believed that the permeability issue is indicative of the age (43 years) of the liner.

In its present state the containment dyke presents an environmental risk, as spilled/leaked fuel can escape the dyke, contaminate groundwater, and migrate to adjacent properties and water bodies.

Project Justification:

The proposed liner replacement is required to restore the integrity of the secondary containment system to avoid the escape of spilled fuel from the containment system and address the regulatory non-compliance.

Attachments:

See report entitled "*Replace Secondary Containment System Liner*" located in Volume II, Tab 17, for further project details.

Project Title: Overhaul Diesel Engines

Location: Various

Category: Transmission and Rural Operations - Generation Northern

Definition: Pooled

Classification: Normal

Project Description:

This proposed project is required to overhaul the diesel engines at various diesel generating plants. The project consists of 12 overhauls of diesel engine that are projected to reach the required overhaul criteria in 2018. This projection is based on the engines being overhauled every 20,000 hours of operation (with the exception of the 100,000 hours milestone, at which point the engine is replaced instead of being overhauled).

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	1,223.0	0.0	0.0	1,223.0
Labour	643.9	0.0	0.0	643.9
Consultant	0.0	0.0	0.0	0.0
Contract Work	249.8	0.0	0.0	249.8
Other Direct Costs	126.9	0.0	0.0	126.9
Interest and Escalation	160.1	0.0	0.0	160.1
Contingency	448.7	0.0	0.0	448.7
TOTAL	**2,852.4**	**0.0**	**0.0**	**2,852.4**

Operating Experience:

Hydro's existing system of diesel generating stations consists of 25 diesel generating stations, 21 of which are prime power generating stations and four of which are emergency backup generating stations. Isolated diesel generation plants operate continuously since they provide the primary source of electricity to communities isolated from the Province's electrical grid. A given unit is not in service continually since the number of units in service varies based on the demand. Emergency backup diesel generation plants operate only in emergency situations, which are rare but critical. In automated plants the engine mix is automatically controlled by a control system to maximize fuel efficiency while in a manual plant this control is completed by the operator. In all of the plants, the operator has the flexibility to shut down engines for maintenance provided there is another engine available to take the load for that time. As a result, outages to engines occur without outages to customers.

Project Justification:

Hydro's current maintenance philosophy is to complete an engine overhaul on all diesel engines every 20,000 hours. This philosophy was established as a result of a 2003 review of the maintenance tactics and failure history. Performing overhauls too frequently results in additional expenditure for negligible improvements in reliability. An overhaul interval of 20,000 hours is considered to be the optimum interval for providing least-cost, reliable electrical service.

Future Plans:

The overhaul of diesel engines is a continuous program that will need to continue as long as there are prime power diesel generating plants. The long term plan for diesel engine overhauls forecasts 49 overhauls over the next five years (i.e. 2018 - 2022), which is an average of approximately 10 overhauls annually and is based on an overhaul interval of 20,000 operating hours. The long term plan is based on the present-day operating conditions, which are subject to change as the loading on a plant or other factors changes with time. Changes to the operating conditions can change the average number of annual overhauls.

Attachments:

See report entitled "*Overhaul Diesel Engines*" located in Volume II, Tab 18, for further project details.

Project Title: Replace Transformer T1

Location: Buchans

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Normal

Project Description:

This proposed project will take two years to complete and is required to replace the 230:66 kV, 40/53.3/66.6 MVA power transformer T1 (Buchans T1) at the Buchans Terminal Station.

Buchans T1 will be replaced with a spare transformer relocated from the Hardwoods Terminal Station. Necessary refurbishment of the spare transformer will be completed prior to commissioning including the neutral bushing, radiators, and leak repair. This project will also include replacement of the concrete foundation, installation of a new oil containment system, and upgrades to protection and control. Temporary generation will be required for approximately eight weeks to continue service to customers during the replacement.

The budget estimate for this project is shown in Table 1.

Table 1: Project Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	55.0	339.1	0.0	394.1
Labour	166.0	271.8	0.0	437.8
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	622.1	0.0	622.1
Other Direct Costs	14.0	325.9	0.0	339.9
Interest and Escalation	14.0	168.5	0.0	182.5
Contingency	0.0	358.7	0.0	358.7
TOTAL	**249.0**	**2,086.1**	**0.0**	**2,335.1**

Operating Experience:

Buchans T1 power transformer is 50 years old. A forced outage to the unit would result in customer outages to Buchans and nearby communities, as well as the Duck Pond Mine and the loss of Star Lake Generating Facility to the Island Interconnected System.

Based on the existing deteriorated state of the transformer, there is a high risk of an in-service failure. Intervention is required to maintain reliable power supply at Buchans. Therefore the existing transformer, Buchans T1, will be replaced. Replacement with a spare 230/66 kV, 40/53.3/66.6 MVA transformer located at the Hardwoods Terminal Station has been determined to be the least cost alternative.

Rebuilding Buchans T1 to restore reliable operation of the transformer for continued use in the transformer fleet as a spare is not a viable course of action. Therefore, the unit will be retired.

Project Justification:

This project is justified on the basis of reliability and least cost. A cost benefit analysis has determined that replacement with a spare transformer located at the Hardwoods Terminal Station is the least cost alternative.

Attachments:

See report entitled "*Replace Transformer T1*" located in Volume II, Tab 19, for further project details.

Project Title: Replace Automation Equipment (2018-2019)

Location: St. Anthony Diesel Plant

Category: Transmission and Rural Operations - Generation Northern

Definition: Other

Classification: Normal

Project Description:

This project proposes the replacement of obsolete automation equipment at the St. Anthony Diesel Plant, including:

- Replacement of 9 existing Programmable Logic Controllers (PLCs) with modern controller and required input/output drops for the diesel units. New PLCs will be Schneider Electric M580 complete with UnityPro software;
- Installation of a new PLC for the second mobile generating unit to integrate into plant automation system;
- Replacement of existing HMI, software and server with new HMI and Trihedral VTScada software;
- Installation and commission new load management automation program; and
- Replacement of existing combination motor starters with a new Motor Control Center (MCC).

The project will start in 2018 with the procurement of the equipment, and engineering design and drawings. The installation and commissioning of the system will be completed in 2019.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	134.0	95.7	**0.0**	229.7
Labour	113.5	426.6	0.0	540.1
Consultant	36.6	100.0	0.0	136.6
Contract Work	0.0	473.5	0.0	473.5
Other Direct Costs	6.5	50.2	0.0	56.7
Interest and Escalation	16.8	132.6	0.0	149.4
Contingency	0.0	287.3	0.0	287.3
TOTAL	**307.4**	**1,565.9**	**0.0**	**1,873.3**

Operating Experience:

There are six generating units inside the plant and two mobile generating units located outside. Presently, six of the plant's units as well as one of the mobile units are included in the plant's automation program. There are nine Programmable Logic Controllers (PLCs) presently installed in the Plant (six for the monitoring/control of units inside the plant, one for the automated mobile diesel, one for plant auxiliary systems and one for the main processor, which gathers data from the others). A Human Machine Interface (HMI) is used by the Operator to control/monitor the units and plant systems.

The existing HMI and PLC hardware were installed in 1990 and the software and server were upgraded in 2006. As per the product life cycle, Schneider Electric support for the HMI software (Schneider Electric Monitor Pro 7.2) will end December 31, 2017. The installed PLCs are Schneider Electric Compact 984. According to Schneider Electric, the commercial life for this product ended in 2006 and service life ended in 2014.

There are 24 combination motor starters that allow the automation system to control the operation of radiator fans, exhaust and ventilation fans, and fuel and lube oil pumps. The starters are original equipment for which spare/replacement parts are no longer available. The starters are in poor condition and as a result may not be dependable. The failure of a starter would prevent the automated control of the particular unit or entire system. Due to the lack of available spare parts, the replacement of the starter would be required. This involves equipment specification, procurement, and installation, during which time the automation function would be limited or potentially disabled.

Project Justification:

This project is required to replace equipment no longer supported by the manufacturer for the reliable operation of the diesel plant in St. Anthony.

Attachments:

See report entitled "*Replace Automation Equipment (2018-2019)*" located in Volume II, Tab 20, for further project details.

Project Title: Install Breaker Bypass Switch

Location: Howley Terminal Station

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Normal

Project Description:

This project proposes the installation of a bypass switch for circuit breaker B1T2 in the Howley Terminal Station. This requires the relocation of Howley T2 power transformer, TL251 take off structure, circuit breaker L51T2, and associated disconnects to accommodate the addition of two new high voltage switches.

The budget estimate for this project is provided in Table 1.

Table 1: Project Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	15.6	147.0	0.0	162.6
Labour	60.0	311.0	0.0	371.0
Consultant	0.0	62.4	0.0	62.4
Contract Work	0.0	535.0	0.0	535.0
Other Direct Costs	3.0	37.4	0.0	40.4
Interest and Escalation	4.5	113.8	0.0	118.3
Contingency	0.0	234.3	0.0	234.3
TOTAL	**83.1**	**1,440.9**	**0.0**	**1,524.0**

Operating Experience:

It is Hydro's practice is to install a high voltage breaker bypass switch on radial transmission systems to reduce outages to customers that result from breaker maintenance, troubleshooting, failure, refurbishment, and replacement. Presently, there are six locations within Hydro's System where circuit breakers for radial systems are installed without a bypass switch. In these locations, planned customer outages must be incurred, or backup generation operated, to eliminate outages in order to perform work on the breakers.

Project Justification:

This project is justified on its ability to increase reliability. The installation of by-pass switches will eliminate planned outages required for circuit breaker maintenance and provide prompt restoration of service in the event of circuit breaker failure.

Future Plans:

Hydro is proposing to include the installation of circuit breaker bypass switches at five other locations in future annual *Terminal Station Refurbishment and Modernization* projects as part of the *Breaker Bypass Switch Installation Program*. The completion of the program is expected in 2023 with a total cost of $5,094,400.

Attachments:

See report entitled "*Install Breaker Bypass Switches*" located in Volume II, Tab 21, for further project details.

Project Title: Diesel Plant Engine Cooling System Upgrades

Location: Various

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Normal

Project Description:

This two year project proposes the replacement of radiators, piping, valves, and heat exchangers at five diesel generating plants located in Black Tickle, Rigolet, Port Hope Simpson, St. Anthony, and St. Brendan's.

In all five diesel plants, the cooling components were installed at the time of plant construction and need replacing because of deterioration due to corrosion. In addition, Port Hope Simpson's heat exchangers have deteriorated to the point where leaks have developed and the units need to be replaced.

The cost of this project is an estimated $1,310,000. Engineering design and procurement will be completed in 2018 for all five plants, and installation and commissioning will take place in 2018 and 2019.

The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate.

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	182.5	110.5	0.0	293.0
Labour	242.4	186.2	0.0	428.6
Consultant	110.4	30.0	0.0	140.4
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	64.0	55.4	0.0	119.4
Interest and Escalation	39.1	93.2	0.0	132.3
Contingency	0.0	196.3	0.0	196.3
TOTAL	**638.4**	**671.6**	**0.0**	**1,310.0**

Operating Experience:

The cooling system components in each of these diesel plants were installed between 1973 and 1980 and are now approaching the end of service life due to corrosion and other deterioration. There have been no major upgrades to any of these systems since the time of installation.

Project Justification:

The diesel generators in each of these five diesel plants are designed with cooling systems that help ensure reliable operation. This project is required to address deterioration issues with these cooling systems that will help ensure reliable operation of the diesel generating units in each of the five communities.

Attachments:

See report entitled "*Diesel Plant Engine Cooling System Upgrades*" located in Volume II, Tab 22, for further project details.

Project Title: Line Depot Condition Assessment and Refurbishment Program

Location: Various

Category: Transmission and Rural Operations - Distribution

Definition: Other

Classification: Normal

Project Description:

This report outlines the 2018 year of a multi year program to refurbish Hydro's aging line depot infrastructure, planned to continue for the next nine years. This program includes continuing detailed assessments, engineering and construction of line depot upgrades and replacements as well as replacements of specific line depot storage ramps and storage sheds, which have been identified previously as needing replacement.

2018 Line Depot Project:

The 2018 project includes level 2 condition assessments for Bay D'Espoir and Baie Verte Line depots; detailed engineering for Fogo and Burgeo Line Depots; refurbishment of Flowers Cove Line Depot building; refurbishment of Wabush Line Depot roof; and replacement of Ramea Line Depot.

A condition assessment was completed for Flowers Cove and Ramea Line Depots in 2016 and the Wabush Line Depot in 2014. Recommendations from the condition assessments include refurbishment of the Flowers Cove and Wabush Line Depot and replacement of the Ramea Line Depot.

The project budget estimate is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	159.6	0.0	0.0	159.6
Consultant	151.8	0.0	0.0	151.8
Contract Work	635.0	0.0	0.0	635.0
Other Direct Costs	22.7	0.0	0.0	22.7
Interest and Escalation	70.1	0.0	0.0	70.1
Contingency	193.8	0.0	0.0	193.8
TOTAL	**1,233.0**	**0.0**	**0.0**	**1,233.0**

Operating Experience:

As outlined in the Line Depot Condition Assessment and Refurbishment Strategy Report filed in the 2015 Capital Budget Application, the purpose of these buildings and ramps is to provide line workers with a safe and protected area to store, load, and prepare materials and equipment used to maintain the integrity of Hydro's transmission lines. During emergency repairs in winter, under adverse weather conditions and difficulties working with frozen transmission line materials, the weather conditions can be too adverse to assemble materials on site. As such, the line depots provide a sheltered location to repair equipment and keep materials protected from the weather so components don't freeze together. These depots also provide a safe reprieve from the adverse weather condition that workers are required to be in during emergencies, sometimes for abnormally long hours.

Project Justification:

As outlined in the Line Depot Condition assessment and Refurbishment Strategy Report filed with the 2015 Capital Budget Application, these depots buildings are in the range of 25-40 years old. Many of the windows and doors, as well as heating and cooling units are at the end of their expected life cycle and need replacement. Many of the Heat Recovery Ventilation (HRV) systems do not meet code requirements for ventilation and require new HRV systems installed at each depot office. There have been a number of items identified as safety issues relating to the electrical system including incorrectly wired exterior plugs, code deficient panel barriers, overloaded circuits for identified use, and lack of ground fault interrupt circuits in wet areas. There have also been a number of fire safety deficiencies identified including missing fire detectors, illuminated exits signs, and emergency light wall packs. These condition assessments also identified the replacement of storage ramps that are dilapidated and unsafe for workers to use.

Future Plans:

A schedule has been developed prioritizing line depot detailed assessments and upgrades. It is anticipated this program will continue until 2026. In general, the detailed assessments will be completed in the first year of the identified schedule, detailed engineering completed in the second year, and construction completed in the third or fourth year.

Attachments:

See report entitled "*Upgrade Line Depots (2018)*" located in Volume II, Tab 23, for further project details.

Project Title: Replace Off Road Track Vehicles

Location: Bishop's Falls and Bay d'Espoir

Category: General Properties - Transportation

Definition: Other

Classification: Normal

Project Description:

This project is required to replace two off road track vehicles with similarly configured vehicles:

- Vehicle V7239, is a 2010 Powertrax model heavy-duty off road track vehicle; and
- Vehicle V7954, is a 1997 Bombardier Muskeg heavy-duty off road track vehicle

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	190.0	886.0	0.0	1,076.0
Labour	1.0	0.5	0.0	1.5
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	5.0	0.0	0.0	5.0
Interest and Escalation	8.5	54.8	0.0	63.3
Contingency	9.2	45.0	0.0	54.2
TOTAL	**213.7**	**986.3**	**0.0**	**1,200.0**

Operating Experience:

Unit V7239 in Bishop's Falls was extensively damaged as a result of a major accident in 2015. The unit was inspected by the both manufacturer of the chassis and the manufacturer of boom to determine if the unit was repairable. The inspection found that the chassis of the unit and sub-frame for the boom were twisted and stretched to the point that it was unrepairable. Unit V7239 was five years old when it was accidentally damaged.

Unit V7954 in Bay d'Espoir is used to transport personnel and material to remote worksites. V7954 is fitted with a medium duty crane, which is used to load material on the cargo deck of the unit. This type of equipment is used in extremely rugged terrain, which affects the life expectancy of the equipment. Unit V7954 is 20 years old.

Project Justification:

This project provides for the unscheduled replacement of a heavy-duty off road track vehicle, V7239 which was written off due to an accident.

This project also provides for the normal replacement of heavy-duty off road track vehicle, V7954 due to its age and condition. A cost benefit analysis between rebuilding the existing unit and purchasing a new unit was not performed given that the rebuild cost was determined to be 30% higher than the cost of a new unit.

Future Plans:

Replacement of off road track vehicles will be proposed in future Capital Budget Applications.

Attachments:

See report entitled *"Replace Off Road Track Vehicles*", located in Volume II, Tab 26, for further project details.

Project Title: Upgrade Office Facilities and Control Buildings (2018)

Location: Various Sites

Category: Transmission and Rural Operations - Properties

Definition: Other

Classification: Normal

Project Description:

This project is being proposed under the Upgrade Office Facilities and Control Buildings Asset Management Program submitted with the 2016 Capital Budget Application. Projects under this program include detailed assessments, engineering, and refurbishment of the aging facilities including the regional offices, area offices, and control buildings at terminal stations within Hydro's Transmission and Rural Operations (TRO) regions.

The projects being proposed in this year's capital budget application include:

- 2018 - Office Facilities Upgrades:
  Level 2 condition assessments will be completed for the Deer Lake and Baie Verte office buildings. Detailed engineering will be completed based on capital work identified in the condition assessments for the Bishop's Falls Main Building and the Whitbourne Site Office.
- 2018 - Control Building Upgrades:
  Detailed engineering will be completed based on the capital work identified in the condition assessments for the Holyrood and Come By Chance control buildings.

  The Oxen Pond, Massey Drive, and Stephenville Terminal Station control buildings will undergo refurbishment of each building's siding, roof, windows, and doors and replacement of heaters, exhaust fans, and miscellaneous electrical equipment.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	0.0	0.0	0.0
Labour	168.0	0.0	0.0	168.0
Consultant	282.0	0.0	0.0	282.0
Contract Work	445.0	0.0	0.0	445.0
Other Direct Costs	33.5	0.9	0.0	33.5
Interest and Escalation	66.4	0.0	0.0	66.4
Contingency	185.7	0.0	0.0	185.7
TOTAL	**1,180.6**	**0.0**	**0.0**	**1,180.6**

Operating Experience:

The TRO regional offices, area offices, and terminal station facilities are used by personnel for office space, storage space, workshops, and control buildings. These offices and workshops are essential in Hydro's daily planning and operations. The control buildings ensure that reliable electricity is distributed to customers. All Hydro's facilities need to be in good operating condition, structurally sound, secure, and weather tight to ensure a safe and healthy environment for all employees.

Project Justification:

As outlined in the Upgrade Office Facilities and Control Building Report, filed with the 2016 Capital Budget Application, these structures are in the range of 25-40 years old. Having facilities that are sound, well-maintained, and functional is essential in allowing employees to perform their work safely and efficiently. Many of the building's overhead doors, entry doors, windows, and exterior envelope require replacement/repair. There have also been a number of building code and fire safety deficiencies identified.

Future Plans:

A schedule has been developed that prioritizes the office and control building condition assessments and upgrades. It is anticipated that this program will continue until 2025. Condition assessments will be completed in the first year of the identified schedule, the assessments will be reviewed and work prioritized in the second year, detailed engineering completed in the third year, and construction will be completed in either the third and/or fourth year, depending on the upgrades required.

Attachments:

See report entitled "*Upgrade Office Facilities and Control Buildings (2018)*" located in Volume II, Tab 24, for further project details.

Project Title: Install Automated Meter Reading (2018-2019)

Location: Bottom Waters

Category: Transmission and Rural Operations - Metering

Definition: Other

Classification: Justifiable

Project Description:

This proposed project is required to install Automatic Meter Reader (AMR) equipment in the Bottom Waters Service Area. The AMR head end equipment shall be installed in the Bottom Waters substation. Customers shall include both residential as well as demand customers who will have their current meters replaced with new AMR units. The use of AMR equipment allows for customer usage (billing) data to be retrieved without requiring meter reader personnel to physically travel to a customer's property and read the meter. This new system will allow for accurate billing throughout the year, regardless of the weather conditions, which will in most cases eliminate the need for estimated billings.

The budget estimate for this project is shown in Table 1.

Table 1: Project Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	418.4	0.0	418.4
Labour	64.4	131.6	0.0	196.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	181.2	0.0	181.2
Other Direct Costs	6.0	16.9	0.0	22.9
Interest and Escalation	4.8	89.2	0.0	94.0
Contingency	0.0	163.7	0.0	163.7
TOTAL	**75.2**	**1001.0**	**0.0**	**1076.2**

Operating Experience:

The AMR system will replace:

(i) manual handheld devices used to collect meter readings at each customer site;

(ii) supporting infrastructure (computers and modems) used to retrieve the data; and
(iii) the requirement for personnel to travel to each customer location to read meters.

Previous AMR projects have been completed by Hydro in a number of other the service areas. The AMR system being implemented has proven to be reliable and accurate.

Project Justification:

This project is primarily justified on the results of a cost-benefit analysis that shows that the new AMR system has economic benefits over the existing system through a reduction in controllable costs. The new system also provides benefits in customer service through improvements in accuracy, frequency, and detail of reporting. Implementation of AMR will also enhance safety by reducing employee risk exposure and will provide a benefit to the environment as a result of less vehicle usage.

Future Plans:

This proposed project is part of an ongoing program to implement AMR in Hydro's service areas.

Attachments:

See report entitled "*Automated Meter Reading (2018-2019)*" located in Volume II, Tab 25, for further project details.

Project Title: Terminal Station In-Service Failures

Location: Various

Category: Transmission and Rural Operations - Terminal Stations

Definition: Pooled

Classification: Normal

Project Description:

Hydro conducts its asset management activities to proactively identify, replace, repair, or refurbish equipment to minimize the disruption of service and to avoid unsafe working conditions that result from equipment failure. An objective of Hydro's Asset Management Program is to identify refurbishment and replacement activities that require the Board's approval in time to include replacement or refurbishment requirements in the Capital Budget Application. The identification is done through the Terminal Station Preventative Maintenance Program using various condition based assessments and testing procedures. Hydro has had success in projecting the deterioration rate of equipment so as to submit refurbishment or replacement work in capital budget applications. However, there are situations where immediate refurbishment or replacement has to be undertaken due to actual failure or the recognition of an incipient failure, as well as faster than anticipated equipment deterioration. These situations can be caused by events such as vandalism, storm damage, lightning, accidental damage, abnormal electrical system operations, corrosion, etc. In this project, Hydro will continue to develop its equipment stand-by pool and undertake the timely refurbishment and replacement work required to maintain the integrity and reliability of the electrical system. These activities will be undertaken in accordance with the philosophies outlined throughout the *Terminal Station Asset Management Overview* document, as submitted in the Hydro 2017 Capital Budget Application (CBA) and as revised in the 2018 CBA (see Volume II, Tab 12). Hydro uses historical data and engineering judgement to predict the magnitude of in-service failure expenditures.

Hydro is undergoing a review of standby pool requirements for a number of asset types, including:

- Disconnect Switches;
- Protection and Control Equipment; and
- Synchronous Condensers.
-

Based on these reviews and equipment failures, Hydro will procure equipment for the standby pool to mitigate risks to restoration of system robustness from equipment failure. Hydro's estimated project cost of the terminal stations in-service failure project is listed in Table 1.

Table 1: Project Cost

Project Cost: *($ x1,000)*	**2017**	**2018**	**Beyond**	**Total**
Material Supply	634.8	0.0	0.0	634.8
Labour	258.9	0.0	0.0	258.9
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	46.9	0.0	0.0	46.9
Interest and Escalation	59.4	0.0	0.0	59.4
Contingency	0.0	0.0	0.0	0.0
TOTAL	**1,000.0**	**0.0**	**0.0**	**1,000.0**

Operating Experience:

On an electrical system, unexpected in-service failures occur. The Terminal Station Asset Management Program enables Hydro to address failures without impacting planned sustaining projects in terminal stations. Work executed under this project in 2018 will be reported in 2019 as part of the 2020 Capital Budget Application.

Project Justification:

The failure of terminal station equipment, if not addressed in a timely manner, affects the robustness of the electrical system. This project provides the resources to address such failures promptly and minimize its impacts to Hydro's electrical system.

Future Plans:

This project will be proposed annually. Hydro will include a concise summary of activities completed under the *Terminal Station In-Service Failures* Project in the previous year with its annual capital budget application. Work executed under this project in 2018 will be reported in 2019 as part of the 2020 Capital Budget Application.

Project Title: Implement Terminal Station Flood Mitigation

Location: Springdale

Category: Transmission and Rural Operations - Properties Central

Definition: Other

Classification: Normal

Project Description:

This is a two year project to implement flood mitigation measures at the Springdale Terminal Station. The proposed flood mitigation involves the installation of three earth retention berms, constructed to the north of Route 392 and along the eastern edge of the terminal station property boundary, see Figure 1.

Figure 1: Site Location Plan

The first year of the project will complete the detailed engineering design and the installation of the retention berms will follow in 2019. The installation will be designed to prevent flooding of the terminal station during a 1 in 100 year rainfall event. The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	0.0	0.0	0.0
Labour	67.1	86.7	0.0	153.8
Consultant	105.0	30.0	0.0	135.0
Contract Work	0.0	440.0	0.0	440.0
Other Direct Costs	1.3	10.6	0.0	11.9
Interest and Escalation	12.8	72.3	0.0	85.1
Contingency	0.0	148.2	0.0	148.2
TOTAL	**186.2**	**787.8**	**0.0**	**974.0**

Operating Experience:

The Springdale Terminal Station is located in Hydro's 138 kV system between Stony Brook and Howley and supplies Newfoundland Power customers in the Springdale area. Rainfall events in April 2006 and April 2015 resulted in the flooding of the station. On both occasions, the water level exceeded the door threshold elevation and entered the control building. During the 2015 flood event, water levels were high enough to infiltrate a control cabinet and damage a protective relay. This damage caused a trip of TL 223, resulting in an outage to Newfoundland Power customers.

Project Justification:

The proposed upgrades are required to prevent the flooding of the terminal station, ensuring its reliable operation. A repeat flood event could damage the protection and control equipment and result in a power disruption for customers.

Future Plans:

None.

Attachments:

See report entitled “Implement Terminal Station Flood Mitigation” located in Volume II, Tab 27, for further project details.

Project Title: Purchase Mobile DC Power Systems

Location: Various

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Justifiable

Project Description:

This project proposes the procurement of three mobile direct current (DC) electrical systems to be placed at strategic locations across Hydro's system. These power systems will be mounted on a mobile platform and contain a 130V battery bank, charger, cabling, heating, ventilation, and all other auxiliary equipment required to service DC systems in each area.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	20.4	13.0	0.0	33.4
Consultant	0.0	0.0	0.0	0.0
Contract Work	233.1	466.2	0.0	699.3
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	17.4	69.9	0.0	87.3
Contingency	0.0	146.5	0.0	146.5
TOTAL	**270.9**	**695.6**	**0.0**	**966.5**

Operating Experience:

Temporary battery banks are installed to maintain reliable operation of the DC systems when the stationary battery banks are removed from service for maintenance, testing, or replacement. The existing method for placing a temporary battery bank into service is labor intensive. Utilizing mobile DC power systems is less labor intensive.

Project Justification:

This project is justified on its cost effectiveness. Economic analysis shows the utilization of three mobile DC power systems will reduce the costs incurred during battery bank removals.

An economic analysis was completed using a 20-year study period, which is the anticipated life of mobile DC power systems. The chosen alternative has a projected cumulative net present value savings of $63,003.

Attachments:

See report entitled "*Purchase Mobile DC Power Systems*" located in Volume II, Tab 28, for further project details.

Project Title: Diesel Plant Fire Protection

Location: Postville

Category: Transmission and Rural Operations - Distribution Labrador

Definition: Other

Classification: Normal

Project Description:

This project proposes the installation of an automatic fire protection system at the Postville diesel plant. The work includes:

- Design, procurement, installation, and commissioning of the new equipment; and
- Installation of a new storage shelter for nitrogen cylinders, water cylinders, and associated equipment outside the powerhouse, including required foundations, electrical work, and ventilation.

The budget estimate for this project is provided in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	15.0	0.0	15.0
Labour	39.7	54.4	0.0	94.1
Consultant	33.9	67.5	0.0	101.4
Contract Work	390.0	0.0	0.0	390.0
Other Direct Costs	8.9	15.3	0.0	24.2
Interest and Escalation	33.1	59.3	0.0	92.4
Contingency	0.0	124.9	0.0	124.9
TOTAL	**505.6**	**336.4**	**0.0**	**842.0**

Operating Experience:

Hydro has experienced six fires at its diesel plants that have resulted in extensive damage or total loss of a plant. Postville is not equipped with an automated fire protection system.

Project Justification:

This project is justified by the requirement to minimize the damage that could result if a fire were to occur in the Postville Diesel Plant. It has been Hydro's experience that fire related damage may be extensive without an automated fire protection system. This damage could result in the community being left without power for an extended period of time.

Future Plans:
Hydro owns and operates 25 diesel plants and it is anticipated that Hydro will submit proposals in subsequent years to have automatic fire protection systems installed at additional remote diesel plants.

Attachments:

See report titled "*Diesel Plant Fire Protection*" located in Volume II, Tab 29, for further project details.

Project Title: Inspect Fuel Storage Tanks

Location: Black Tickle

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Normal

Project Description:

The purpose of this project is to complete detailed inspections of the above ground fuel storage tanks and associated fuel supply systems owned and operated by Hydro. Results from these inspections will be used to determine the work required to ensure that the tanks meet operational standards and to plan for the replacement of tanks that are nearing the end of their service life.

The scope of work for this project involves the completion of internal tank inspections and the completion of routine upgrades identified during the inspection while the tanks are empty. The tanks to be inspected in 2018 include two 257,000 litre, vertical fuel storage tanks located at the Black Tickle diesel plant. Hydro may inspect a higher priority tanks should conditions change and defer inspections on lower priority tanks.

Upgrade costs have been included, based on expected condition outcomes from similar tank inspections completed in the past. Where applicable, Hydro will complete the work necessary to enable the tanks to continue to perform as designed, ensuring that they are structurally sound, suitable for operation, and not at risk of releasing fuel into the environment.

The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate

Project Cost: ($ x1,000)	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	78.8	0.0	0.0	78.8
Consultant	30.0	0.0	0.0	30.0
Contract Work	588.1	0.0	0.0	588.1
Other Direct Costs	11.6	0.0	0.0	11.6
Interest and Escalation	39.3	0.0	0.0	39.3
Contingency	70.9	0.0	0.0	70.9
TOTAL	**818.7**	**0.0**	**0.0**	**818.7**

Operating Experience:

The fuel storage tanks serve as a fuel supply for the Black Tickle plant's diesel generation units. These tanks are critical to ensuring the continued supply of reliable power to the community of Black Tickle.

Project Justification:

To maximize the service life of its assets and adhering to its Environmental Policy and Guiding Principles, Hydro has formalized its tank inspections into a coordinated program.

Hydro must ensure that its fuel storage tanks are maintained in a safe and reliable operating condition. Tank inspections serve to identify necessary maintenance and repair items and forecast their remaining service life. These inspections are necessary to ensure that the tanks are structurally sound, suitable for operation, and not at risk of releasing fuel into the environment.

Future Plans:

Future plans will see the continuation of the multi-year tank inspection program.

Attachments:

See report entitled "*Inspect Fuel Storage Tanks (2018)"* located in Volume II, Tab 30, for further project details.

Project Title: Additions for Load Growth

Location: Makkovik and Rigolet

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Normal

Project Description:

This proposed project involves the replacement of equipment at the Makkovik and Rigolet Diesel Plants to address generation planning criteria violations caused by growing load.

The scope of the work includes:

1. Replacement of the main substation transformer bank that consists of 3x333 kVA transformers with 3x500 kVA transformers at Makkovik and purchase of a spare transformer for reliability;
2. Replacement of the 450 kW generator on Unit 2029 in Makkovik with a 565 kW generator; and
3. Replacement the plant's two 500 MCM service conductors with two 646 MCM copper conductors and replacement the 500 MCM overhead conductor between the plant and the substation with a 750 MCM copper conductor at Rigolet.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	210.9	0.0	0.0	210.9
Labour	299.9	0.0	0.0	299.9
Consultant	7.8	0.0	0.0	7.8
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	52.4	0.0	0.0	52.4
Interest and Escalation	44.9	0.0	0.0	44.9
Contingency	114.2	0.0	0.0	114.2
TOTAL	**730.1**	**0.0**	**0.0**	**730.1**

Operating Experience:

The diesel plants at Makkovik and Rigolet are the sole source of power for these two isolated communities. Both systems have historically experienced steady growth in peak load and energy sales. Load growth in both communities is forecasted to continue.

Project Justification:

The justification for this project is that it is required to address forecasted violations in Hydro's planning criteria for Makkovik and Rigolet. The load on the conductors at the Rigolet Diesel Plant is forecasted to exceed their rated capacity in 2018 and the load on the transformers at the Makkovik Diesel Plant is forecasted to exceed their rated capacity in 2019. Based on the same forecasts, the Makkovik Diesel Plant will violate the Firm Generation Criteria in 2019.

Future Plans:

None

Attachments:

See report entitled "*Additions for Load Growth*" located in Volume II, Tab 31, for further project details.

Project Title: Install Sub-Surface Drainage System

Location: Paradise River

Category: Transmission and Rural Operations - Generation Labrador

Definition: Other

Classification: Normal

Project Description:

This project is for the installation of a sub-surface drainage system at Hydro's Paradise River diesel plant. The scope of work consists of:

- the excavation for trench drains;
- implementation of a mobile filtration unit for trench dewatering;
- supply and installation of perforated drain pipe;
- import of trench backfill material; and
- the disposal of contaminated excavation material at an approved disposal facility.

The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	88.4	0.0	0.0	88.4
Consultant	85.0	0.0	0.0	85.0
Contract Work	239.4	0.0	0.0	239.4
Other Direct Costs	14.5	0.0	0.0	14.5
Interest and Escalation	27.0	0.0	0.0	27.0
Contingency	70.6	0.0	0.0	70.6
TOTAL	**524.9**	**0.0**	**0.0**	**524.9**

Operating Experience:

The concrete foundation, supporting the west wall of the Paradise River Diesel Plant's powerhouse, has developed significant cracks and has shifted away from the building.

In 2016, Hydro completed an investigation into the root cause of the powerhouse foundation movement. The investigation determined that the foundation movement is a direct result of frost heave, the impacts of which are exacerbated by the shallow foundation depth and poor drainage characteristics of the in-situ soil.

Project Justification:

To prevent the continued deterioration of the powerhouse building foundation in Paradise River, a drainage system must be implemented. This system will ensure that groundwater does not collect around the powerhouse foundation, thus reducing the effects of frost heave.

Future Plans:

Following the installation of the drainage system, Hydro will establish a monitoring program to determine whether or not the foundation movement persists. If the movement continues, Hydro will seek additional funding to replace the foundation.

Attachments:

See report entitled "*Install Sub-Surface Drainage System*" located in Volume II, Tab 32, for further project details.

Project Title: Additions for Load Growth

Location: Happy Valley

Category: Transmission and Rural Operations - Distribution Labrador

Definition: Other

Classification: Normal

Project Description:

This proposed project involves the replacement of the regulator bank, HV7-VR2, on Line 7 between Happy Valley-Goose Bay, North West River and Sheshatshui. The work will consist of replacing three 200 A voltage regulators with three 400 A voltage regulators, replacing the supporting structure, and purchasing a spare regulator for reliability.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	200.0	0.0	0.0	200.0
Labour	110.0	0.0	0.0	110.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	85.0	0.0	0.0	85.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	31.0	0.0	0.0	31.0
Contingency	79.0	0.0	0.0	79.0
TOTAL	**505.0**	**0.0**	**0.0**	**505.0**

Operating Experience:

Line 7 supplies power to commercial customers in the North Side Industrial Park in Happy Valley, as well as the communities of Sheshatshiu and North West River. Voltage regulation for Line 7 is provided at the Happy Valley Terminal Station by three voltage regulators HV7-VR2, HV7-VR3 and HV7-VR1 that are placed along the length of the feeder.

Project Justification:

A load study on the Happy Valley Distribution System was completed in February 2017 and indicated a peak current of 232 A, 228 A, and 240 A on phases A, B, and C respectively of the regulator bank, HV7-VR2. The study showed that the regulators are loaded above the nameplate rating of 200 A and therefore must be replaced. Due to the design of the regulators and the cold temperatures experienced in Happy Valley during peak load times, the voltage regulators can be safely loaded above nameplate rating for the period of time that the loading will exceed the nameplate rating during this coming winter.

Future Plans:

None

Attachments:

See report entitled "*Additions for Load*" located in Volume II, Tab 33, for further project details.

Project Title: Replace Vehicles and Aerial Devices (2018-2019)

Location: Various

Category: General Properties - Transportation

Definition: Other

Classification: Normal

Project Description:

This project proposes the replacement of 27 light-duty vehicles (cars, pick-ups and vans) and seven heavy-duty vehicles (aerial devices[1], material handlers and boom trucks) in accordance with Hydro's established replacement criteria for vehicle age and kilometers (km) as follows in Table 1. Table 2 shows the replacement criteria of three other electric utilities Hydro surveyed in 2014.

Table 1: Replacement Criteria - Hydro

Hydro	
Light-duty vehicles	5-7 years or > 150,000 km and Condition/Maintenance Cost
Heavy-duty vehicles:	
- Class 4, 5 and 6	6-8 years or > 200,000 km and Condition/Maintenance Cost
- Class 7 and 8	7-9 years or > 200,000 km and Condition/Maintenance Cost

[1] An aerial device or elevated work platform, also known as a 'cherry picker' or 'bucket truck', is a mechanical device used to provide temporary access for people or equipment to inaccessible areas, usually at height.

Table 2: Replacement Criteria - Other Utilities

Utility #1	
Light-duty vehicles	5 years or 200,000 km
Heavy-duty vehicles:	8 years or 300,000 km
Utility #2	
Light-duty vehicles	5-6 years or 200,000 km
Heavy-duty vehicles:	
- Class 3, 4, 5 and 6	8 years or 300,000 km
- Class 7 and 8	10 years or 300,000 km
Utility #3	
Light-duty vehicles	5 years or 150,000 km
Heavy-duty vehicles	10 years or 250,000 km

The budget estimate for this project is shown in Table 3.

Table 3: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	1,602.0	602.0	0.0	2,204.0
Labour	6.0	2.0	0.0	8.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	3.0	3.0	0.0	6.0
Interest and Escalation	56.2	35.8	0.0	92.0
Contingency	0.0	110.9	0.0	110.9
TOTAL	**1,667.2**	**753.7**	**0.0**	**2,420.9**

Operating Experience:

Hydro’s transportation section maintains a close liaison with other utilities across Canada and has established the replacement criteria based on industry standards and Hydro's operating experience. Extension of the service life of a vehicle beyond the replacement criteria result in increased operating and maintenance costs.

Project Justification:

Hydro operates in many diverse locations across the Province and it is critical to the provision of economical and reliable electricity that employees are provided with safe and reliable vehicles.

Future Plans:

Future replacement of vehicles and aerial devices will be proposed in future Capital Budget Applications.

Attachments:

See report entitled "*Replace Vehicles and Aerial Devices (2018-2019)*" located in Volume II, Tab 34 for further project details.

Project Title: Replace PBX Phone Systems

Location: Various

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

This project proposes the replacement of the existing Avaya CS1K PBX telephony network with a Cisco Unified Communications Manager solution for the following locations:

- Hydro Place;
- Holyrood;
- Bishop's Falls; and
- Bay d'Espoir.

The first year of this two year project will be focused on high level design and planning for deployment. At the end of year one, Hydro will release a Request for Proposals (RFP) for a third party to install and commission the new PBX phone system.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	701.1	0.0	701.1
Labour	85.1	90.3	0.0	175.4
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	65.0	0.0	65.0
Other Direct Costs	1.1	6.6	0.0	7.7
Interest and Escalation	5.5	97.8	0.0	103.3
Contingency	0.0	189.8	0.0	189.8
TOTAL	**91.7**	**1,150.6**	**0.0**	**1,242.3**

Operating Experience:

Hydro currently maintains four Private Branch eXchanges (PBXs) to provide telephony services to its main offices. The current PBXs maintained by Hydro are Avaya Communications Server 1000s (CS1Ks) located at Hydro Place, Holyrood, Bishop's Falls, and Bay d'Espoir.

Since installation, the systems have performed well. Other than the major upgrades, the success of this system can be attributed to its vendor support, which is no longer available since the product has entered End-of-Service-Support (EoSS) stage of its lifecycle as of late 2016.

As part of Avaya's Product Lifecycle Policy, Avaya defines the EoSS date as the date after which Avaya will cease to provide any type of support for a Product. In the EoSS stage of its lifecycle, Hydro also is not be able to buy new replacement parts should there be a hardware failure.

Project Justification:

This project is justified on the requirement to maintain the reliability of Hydro's telephone services at the four listed sites.

A hardware failure of any individual PBX could result in that entire site losing all telephone service, excluding cellular. Since these PBXs currently provide telephony service in Hydro's terminal and generating stations, hill top microwave sites and other locations, it is important that the reliability of the phone system be maintained.

Attachments:

See report entitled "*Replace PBX Phone Systems*" located at Volume II, Tab 35, for further project details.

Project Title: Replace MDR 6000 Microwave Radios

Location: Various

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

This project will replace the MDR-6000 microwave radio equipment for six radio links:

- Petty Harbor Hill to Hardwoods and Oxen Pond;
- Four Mile Hill to Holyrood Plant/Terminal Station;
- Chapel Arm Hill to Western Avalon; and
- Bull Arm Hill to Come By Chance and Sunnyside.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	630.2	0.0	630.2
Labour	59.2	212.8	0.0	272.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	1.2	22.3	0.0	23.5
Interest and Escalation	3.6	86.6	0.0	90.2
Contingency	0.0	185.1	0.0	185.1
TOTAL	**64.0**	**1,137.0**	**0.0**	**1,201.0**

Operating Experience:

The original Alcatel MDR-6000 radio equipment was installed in 2001. This equipment is used for the transmission of line protection signaling, Supervisory Control and Data Acquisition (SCADA) information, which is used for remote control and monitoring of the provincial power system, and administrative voice and data services. In 2002, Alcatel manufactured discontinued the MDR-6000, meaning that they will not guarantee that failed modules can be repaired or replaced due to the obsolescence of the electronic components within the modules. Hydro has obtained some components from the used market; however, this supply is unreliable. Should this equipment fail and repair not be possible, Hydro would be vulnerable to SCADA network and transmission line outages.

Project Justification:

The project is required for the reliable operation of Hydro's SCADA and transmission network.

Future Plans:

None

Attachments:

See report entitled "*Replace MDR 6000 Microwave Radio*", located in Volume II, Tab 36, for further project details

Project Title: Replace Battery Banks and Chargers (2018-2019)

Location: Various

Category: Transmission and Rural Operations - Transmission

Definition: Other

Classification: Normal

Project Description:

This proposed project is part of Hydro's ongoing program to replace stationary batteries and chargers at generating sites, terminal stations, and telecommunications microwave sites. These batteries are the source of power for telecommunications and protection and control equipment during the loss of station service. The batteries are a direct current (DC) power source and thus require a charging system that converts alternating current (AC) to direct current, or Uninterruptible Power Supply (UPS) batteries that also convert back to AC.

The budget estimate for this project is provided in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1, 000)*	2018	2019	Beyond	Total
Material Supply	194.9	191.9	0.0	386.8
Labour	121.0	112.0	0.0	233.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	44.8	46.3	0.0	91.1
Interest and Escalation	21.4	63.4	0.0	84.8
Contingency	0.0	142.2	0.0	142.2
TOTAL	**382.1**	**555.8**	**0.0**	**937.9**

Operating Experience:

Hydro generally inspects its batteries semi-annually or more often as needed, depending on age and condition. From these inspections and testing, Hydro determines which battery banks need to be replaced. The rate of battery deterioration increases with age and reaches a point where batteries are unable to provide the required power level to operate equipment in the event of an outage.

Hydro's ongoing Circuit Breaker Replacement Program has increased demand on terminal station battery banks involved in that program. In the Holyrood and Sunnyside Terminal Stations, the 125 VDC battery banks have to be replaced with banks of an increased capacity to accommodate the new breakers.

Project Justification:
When the capacity of a battery falls to 80 percent of its rated capacity it has to be replaced, as recommended by IEEE standard's 450 and 1188. The batteries to be replaced in this project are near the end of their useful lives when they have deteriorated to the 80 percent capacity level and must be replaced before total failure occurs to ensure continued reliable operation.

In the Holyrood and Sunnyside Terminal Stations, battery banks need to be replaced with larger capacity battery banks to ensure that equipment can operate as required.

Future Plans:
Replacement of battery banks and chargers will be proposed in future capital budget applications.

Attachments:
See report entitled "*Replace Battery Banks and Chargers (2018-2019)*" in Volume II, Tab 37, for further project details.

Project Title: Upgrade Exterior of Building

Location: Hydro Place

Category: General Properties - Administrative

Definition: Other

Classification: Normal

Project Description:

This is a two year project for the refurbishment of the sealant for the exterior precast panel cladding system at Hydro Place. Work includes replacement of deteriorated sealant and foam backing, and the application of grout over exposed anchor/lift devices and reinforcing steel. The budget estimate for this project is shown in Table 1.

Table 1: Project Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	0.0	0.0	0.0
Labour	46.3	26.5	0.0	72.8
Consultant	52.5	10.0	0.0	62.5
Contract Work	145.0	225.0	0.0	370.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	16.4	43.2	0.0	59.6
Contingency	0.0	101.0	0.0	101.0
TOTAL	**260.2**	**405.7**	**0.0**	**665.9**

Operating Experience:

The exterior of the building has been exposed to the ambient atmospheric conditions for nearly 30 years without undergoing any major upgrades.

A condition assessment of the precast concrete panels that form the outside cladding system for Hydro Place was completed in 2015. The assessment found that the joint sealant between the individual panels has failed allowing the infiltration of moisture into the wall cavity.

Project Justification:

If left unattended, there is a concern that this moisture will eventually result in the corrosion of the panel's framing and anchorage system, which could jeopardize its structural integrity.

The proposed refurbishment is required to refurbish the joint sealant, stop the infiltration of moisture, and extend the service life of the building's cladding system.

Attachments:

See report entitled "*Upgrade Exterior of Building*" located in Volume II, Tab 38, for further project details.

Project Title: Replace Teleprotection - TL261

Location: St. Anthony Airport to St. Anthony Diesel Plant

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

This proposed project is required to design, supply, install, and commission communications equipment to replace the existing Powerline Carrier (PLC) and associated coupling equipment on TL261, between the St. Anthony Airport and the St. Anthony Terminal Stations. The powerline carrier system transports power system protection circuits as well as operational voice and data in support of the Energy Control Centre.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	0.0	231.0	0.0	231.0
Labour	49.1	91.0	0.0	140.1
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	5.3	18.9	0.0	24.2
Interest and Escalation	3.2	39.8	0.0	43.0
Contingency	0.0	79.1	0.0	79.1
TOTAL	**57.6**	**459.8**	**0.0**	**517.4**

Operating Experience:

The Power Line Carrier (PLC) on TL261 transmits transmission line protection signaling between the St. Anthony Airport and St. Anthony Diesel Plant Terminal Stations and is an integral part of the Supervisory Control and Data Acquisition (SCADA) network, which is used for remote control and monitoring of the provincial power system. This equipment has been in service for over 22 years during which there have been no recorded failures of the equipment. In the fourth quarter of 1998, ABB discontinued the manufacture and sale of the model ETL40 PLC that is used on TL261. Then in 2008, ABB informed customers that the repair of faulty ETL40 PLC modules would cease, primarily due to the unavailability of electronic components. There are a number of critical components for which spares are unavailable.

This communications equipment is critical to the operation of the power grid and must operate continuously on a 24 hour basis, 365 days a year.

Project Justification:

Replacement of the PLC is required to provide uninterrupted SCADA and protection of the TL261 transmission line.

As the PLC is required for continued reliability for teleprotection and SCADA system, the unavailability of replacement parts and the lack of support from the manufacturer for repairs warrants replacement of this equipment before outages occur. Continued utilization of this equipment increases the risk of failure.

Future Plans:

Hydro plans to replace PLC systems on TL202 and TL206 (Bay d'Espoir to Sunnyside) in 2019-2020.

Attachments:

See report entitled "*Replace Teleprotection –TL261*" located in Volume II, Tab 39, for further project details

D. Projects Over $200,000 and Less Than $500,000

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Definition	Classification	Page Ref
GENERATION							
Replace Slip Rings Units 1-6 - Bay d'Espoir	312.6	159.7		472.3	Other	Normal	
Energy Efficiency Improvements - Various		276.2	168.9	445.1	Other	Justifiable	D-2
Overhaul Pumps - Holyrood		438.3		438.3	Pooled	Normal	D-8
Upgrade Cranes and Hoists - Holyrood		80.3	300.3	380.6	Other	Normal	D-12
Refurbish Sump Level System for Powerhouse 2 - Bay d'Espoir	38.7	264.5		303.2	Other	Normal	
Purchase Tools and Equipment less than $50,000 - Bay d'Espoir		235.2		235.2	Other	Normal	
TOTAL GENERATION	351.3	1,454.2	469.2	2,274.7			
TRANSMISSION AND RURAL OPERATIONS							
Install Recloser Remote Control - Bottom Waters	47.1	418.6		465.7	Other	Normal	
Upgrade Ventilation - Cartwright		465.7		465.7	Other	Normal	D-16
Replace Light Duty Mobile Equipment - Various		429.0		429.0	Other	Normal	D-20
Replace Insulators - TL227	145.6	271.3		416.9	Other	Normal	
Install Energy Efficiency Lighting in Diesel Plants - Various		104.0	241.2	345.2	Other	Justifiable	D-25
Install Recloser Remote Control (2018-2019) - English Harbour West and Barachoi		63.7	275.0	338.7	Other	Normal	D-28
Upgrade Aluminium Support Structures - Holyrood		287.6		287.6	Other	Normal	D-32
Replace Human Machine Interface - St. Lewis		280.8		280.8	Other	Normal	D-39
Purchase Tools and Equipment less than $50,000 - Central		257.4		257.4	Other	Normal	
TOTAL TRANSMISSION AND RURAL OPERATIONS	192.7	2,578.1	516.2	3,287.0			
GENERAL PROPERTIES							
Replace Personal Computers - Hydro Place		493.0		493.0	Other	Normal	D-43
Replace Radomes - Various		360.3		360.3	Pooled	Normal	D-48
Upgrade Core IT Infrastructure - Hydro Place		352.4		352.4	Other	Normal	D-62
Upgrade Energy Management System - Hydro Place		336.8		336.8	Other	Normal	D-68
Replace Peripheral Infrastructure - Hydro Place		258.4		258.4	Other	Normal	D-72
Purchase Office Equipment		90.0	150.8	240.8	Other	Normal	
TOTAL GENERAL PROPERTIES	0.0	1,890.9	150.8	2,041.7			
TOTAL PROJECTS OVER $200,000 AND UNDER $500,000	544.0	5,923.2	1,136.2	7,603.4			

Project Title: Energy Efficiency Improvements

Location: Various

Category: Generation - Hydraulic

Type: Other

Classification: Justifiable

Project Description:
The scope of this proposed project is to make energy efficiency improvements at the Bay d'Espoir Powerhouse and Intake buildings, Salmon River Spillway building, and Upper Salmon, Hinds Lake and Cat Arm Generating Station buildings. The improvements will consist of the following for each location:

- Bay d'Espoir Powerhouse
  - Installation of light emitting diode (LED) high bay Lighting;
- Hind's Lake, Upper Salmon and Cat Arm Generating Stations
  - Installation of LED high bay lighting;
  - Installation of LED interior and exterior fixtures;
  - Installation of heating controls;
  - Installation of lighting controls;
- Bay d'Espoir Intake buildings and Salmon River Spillway building
  - Installation of LED interior and exterior fixtures;
  - Installation of heating controls; and
  - Installation of lighting controls.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	87.9	45.0	0.0	132.9
Labour	148.5	80.5	0.0	229.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	10.5	22.0	0.0	32.5
Interest and Escalation	9.3	9.5	0.0	18.8
Contingency	20.0	11.9	0.0	31.9
TOTAL	**276.2**	**168.9**	**0.0**	**445.1**

Justification:

This project is justified because the cost benefit analysis shows economic benefit to execute the upgrades at each location (see Economic Analysis).

Economic Analysis

A cost benefit analysis was conducted for each location comparing the energy efficiency improvements alternative outlined in the project scope to the status quo alternative for each location. In all cases, a twenty-year study was conducted as that is the anticipated life of the equipment to be installed.

Operating costs for each alternative, at each location, is the energy consumption for each alternative's heating and lighting loads. For the status quo alternatives, maintenance costs were included at each location as lamps are replaced approximately every four years in existing lighting fixtures. The energy efficiency improvement option has no maintenance costs, since LED fixtures do not require re-lamping. Future replacement of the existing lighting fixtures was not included in the status quo alternative. This was judged to not be detrimental to the analysis as inclusion of replacement would have further increased the cumulative net present worth (CPW) of the status quo alternatives and further increased the viability of the energy improvement alternatives.

Bay d'Espoir Powerhouse

The analysis of the status quo alternative includes operating and maintenance costs. The operating costs include the energy consumption for the existing high bay, metal halide lighting and supplemental lighting systems in the powerhouse. Supplemental systems are used to provide adequate illumination during the warm up time required by metal halide lamps to reach acceptable lighting output. Supplemental lighting systems will not be required for the energy efficiency improvement alternative as LED fixtures do not have a warm up period.

The energy efficiency improvement alternative includes the cost of replacement and operation of high bay lighting fixtures with LED units.

The results of cumulative net present value analysis are shown in Table 2. The analysis indicates, that over a 20 year period, there is a $157,654 saving obtained by implementing the energy efficiency improvements alternative for the Bay d'Espoir Powerhouse high bay lighting.

Table 2: CPW of Alternatives – Bay d'Espoir Powerhouse

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	180,729	0
Status Quo	338,383	157,654

Hinds Lake, Upper Salmon and Cat Arm Generating Station

The analysis of the status quo alternative includes operating and maintenance costs. The operating costs includes the energy consumption for existing interior, exterior, high bay, high pressure sodium or metal halide lighting, and electric space heating.

The analysis of the energy efficiency improvement alternative includes the cost of replacement of high bay and exterior lighting with LED fixtures and the installation of more accurate heating and lighting controllers. The analysis also includes the lighting and heating operating costs with the new controllers, which allow heating and lighting loads to be running for fewer hours per year when compared to the status quo option.

The results of the cumulative net present value analysis are shown in Table 3, 4 and 5 for Hind's Lake, Upper Salmon and Cat Arm, respectively. The analysis indicates that over a 20 year period, there is a $296,517, $251,167 and $473,591 savings obtained by implementing the energy efficiency improvements alternatives.

Table 3: CPW of Alternatives –Hind's Lake

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	490,586	0
Status Quo	787,103	296,517

Table 4: CPW of Alternatives – Upper Salmon

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	510,284	0
Status Quo	761,451	251,167

Table 5: CPW of Alternatives – Cat Arm

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	798,186	0
Status Quo	1,271,777	473,591

<u>Bay d'Espoir Intake and Salmon River Spillway</u>

The analysis of the status quo alternative includes operating and maintenance costs. The operating costs include the energy consumption for existing interior, exterior and high bay, high pressure sodium or metal halide lighting as well as electric space heating.

The analysis of the energy efficiency improvement alternative includes the cost of replacement of interior and exterior lighting with LED fixtures, and the installation of more accurate heating and lighting controllers. The analysis also includes the lighting and heating operating costs with the new controllers, which allow heating and lighting loads to be running for fewer hours per year when compared to the status quo option.

The results of cumulative net present value analysis are shown in Table 6 and 7 for the Bay d'Espoir Intake and the Salmon River Spillway, respectively. The analysis indicates that over a 20 year period there is a $293,615 and $172,794 saving obtained by implementing the energy efficiency improvements alternatives for the Bay d'Espoir Intake and the Salmon River Spillway, respectively

Table 6: CPW of Alternatives – Bay d'Espoir Intake

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	542,989	0
Status Quo	836,604	293,615

Table 7: CPW of Alternatives – Salmon River Spillway

Alternatives	Cumulative Net Present Value (CPW)	CPW Difference between Alternative and the Least Cost Alternative
Energy Efficiency Improvements	304,911	0
Status Quo	477,704	172,794

The economic analysis shows the least cost alternative for all locations is to implement the energy efficiency improvements. The projected combined savings is $1,645,338.

CONCLUSION

The economic analysis shows the least cost alternative for all locations is to implement the energy efficiency improvements outlined in this project. The projected combined savings is $1,645,338.

Project Schedule

The anticipated project schedule is shown in Table 8:

Table 8: Project Schedule

Activity		Start Date	End Date
Planning	Open project	January 2018	February 2018
Design	Engineering design	March 2018	March 2018
Procurement	Order fixtures, clocks and thermostats	April 2018	April 2018
Construction	Installation of controls and fixtures	May 2018	September 2019
Closeout	Close the project	October 2019	October 2019

Project Title: Overhaul Pumps

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Pooled

Classification: Normal

Project Description:

This project will involve overhauling the Unit 2 East Boiler Feed Pump and the Unit 2 South Vacuum Pump at the Holyrood Thermal Generating Station (Holyrood).

Boiler feed water pumps supply water at high pressure to boilers for steam production. Unit 2 has two boiler feed water pumps, with each pump capable of supplying feed water for 50 percent of the capacity of the boiler.

The vacuum pump maintains a vacuum pressure inside the turbine casing and is critical for startup and normal operation of Unit 2.

The budget estimate for the pump overhauls is shown in Table 1.

Table 1: Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	79.5	0.0	0.0	79.5
Labour	85.2	0.0	0.0	85.2
Consultant	49.9	0.0	0.0	49.9
Contract Work	128.0	0.0	0.0	128.0
Other Direct Costs	1.0	0.0	0.0	1.0
Interest and Escalation	26.0	0.0	0.0	26.0
Contingency	68.7	0.0	0.0	67.8
TOTAL	**438.3**	**0.0**	**0.0**	**438.3**

Figure 1: Unit 2 Boiler Feed Pump

Figure 2: Unit 2 Vacuum Pump

Operating Experience

The Unit 2 East Boiler Feed Pump is one of two pumps which provide 50 percent of the high pressure feed water required for steam production in the Unit 2 Boiler. The pumps are vital components of the High Pressure (HP) Feed Water System. The pumps draw water from the deaerator, pump it through HP heaters to gain efficiency, and then send water on to the Unit 2 Boiler. The water is converted to steam in the boiler and used for power generation in the turbine. Both pumps operate in parallel to feed the boiler at full load.

The Unit 2 South Vacuum Pump is one of two pumps that are critical to reliable power generation because failure of both would result in complete shutdown of the Unit 2 generating unit. A negative pressure of 75 kPa vacuum must be present in the system to allow unit startup and normal operation; otherwise, the turbine will not accept steam. During normal power generation, one vacuum pump will operate and the second will remain in standby mode. A failure or trip affecting the operating pump will result in the startup of the standby pump, ensuring no loss of vacuum pressure and allowing continued power generation.

Justification

The pumps are required to be operational in order for the generating units at Holyrood to produce 100 percent power. Routine overhauls are done to inspect and check internal components for wear or damage. Pump specialist, Flowserve, was consulted for optimization of the overhaul schedule for pumps at Holyrood. This activity is directly related to the overall reliability of the facility by maintaining equipment operation and enabling consistent supply of power to the Island Interconnected System. The overhaul schedules for the pumps include 6-year overhauls for Boiler Feed Pumps and 12-year overhauls for Cooling Water, Vacuum and Extraction Pumps.

Future Plans

As previously noted, the overhaul schedules for the pumps include 6-year overhauls for Boiler Feed Pumps and 12-year overhauls for Cooling Water, Vacuum and Extraction Pumps. Under this schedule, additional pump overhaul projects will be proposed in future Capital Budget Applications.

Project Schedule

The anticipated project schedule is shown in the table 2 below. The schedule may be adjusted based on finalization of the maintenance outages.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Open project	January 2018	January 2018
Design	Prepare tender/contract documents	February 2018	March 2018
Procurement	Order replacement components	March 2018	June 2018
Construction	Mobilize consultants, isolate pumps, remove and disassemble	July 2018	July 2018
Construction	Repair and replace components, install pumps, remove isolations, demobilize consultants	July 2018	October 2018
Closeout	Prepare closeout documentation	October 2018	December 2018

Project Title: Upgrade Cranes and Hoists

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

The project proposes the replacement of the existing controls on the overhead crane (Figure 1) located in the Powerhouse Turbine Hall of the Holyrood Thermal Generating Station (Holyrood) with a wireless radio frequency type handheld control base station (Figure 2). This project includes the replacement of the existing hydraulic brake system in the crane cab with an electric brake system, which will be operated through the handheld control station. The overhead crane will also be recertified under this project by a certified crane inspector before being placed back in service.

Figure 1: Overhead Crane[1] in Holyrood Powerhouse Turbine Hall

[1] Note operator cab to the left

Figure 2: Typical Wireless Remote Control Station for Overhead Crane

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	2.0	0.0	2.0
Labour	74.8	38.2	0.0	113.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	170.0	0.0	170.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	5.5	33.1	0.0	38.6
Contingency	0.0	57.0	0.0	57.0
TOTAL	**80.3**	**300.3**	**0.0**	**380.6**

Justification

This project is justified to eliminate the exposure of Hydro staff to unsafe temperatures while operating the overhead crane.

Existing System

The overhead crane is located close to the ceiling of the powerhouse, above the thermal generating units. The generating units produce a significant amount of heat that accumulates near the ceiling.

The crane is used for maneuvering large objects, such as generator rotors during overhauls, and also assists in miscellaneous preventative and corrective maintenance work.

The overhead crane controls are electromechanical in nature, consisting of pushbuttons and joysticks. The braking system in the cab is hydraulic and is operated by a footswitch.

Operating Experience

When the overhead crane is involved in a critical lift of a piece of the generating unit equipment, the operator must stay in the crane from the time the rigging of the load is started until it is moved and unhooked. This process can take in excess of two hours when moving the generator rotor. Depending on the time of the year and the generating schedule of the plant, the crane may have to be operated when the temperature around the cab of the crane exceeds 40°C. In those situations, the operator may be exposed to excessive temperatures for periods that are above those recommended for work/rest cycles by the Association Advancing Occupational and Environmental Health standard (ACGIH ISBN: 978-1-607260-84-4), 2016 Threshold Limit Values. Based on this standard, temperatures should not exceed 38°C to prevent heat stress exposure.

In addition, any time this crane is operated, emergency rescue personnel are required to stand by and monitor crane operating staff and provide rescue if the operators experience a medical incident, such as becoming overcome from heat exposure, or other reasons. High angle rescue from the crane cab is hazardous and puts the rescue crew, as well as the crane operators, at risk if a rescue of the crane operator has to be conducted.

Historical Information

A similar project to upgrade the overhead crane in the Bay d'Espoir Hydroelectric Generating Facility Powerhouse 1 was approved by the Board in 2015.

Conclusion

The overhead crane in Holyrood is located above the generating units, which can experience temperatures in excess of 40°C. Operating the overhead crane from the cab of the crane exposes the operator to unsafe temperatures. This project will eliminate that exposure by allowing the operator to control the crane from an area where temperatures are acceptable, and will also reduce the need for standby rescue crew when the crane is operational.

Project Schedule

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Kickoff meeting, safety plan, communication plan, open project in JDE, complete WBS	February 2018	March 2018
Procurement	Prepare Technical Conditions for Tender, develop contract documents and issue for tender, award tender	April 2018	May 2018
Design	Site visit with crane technician, detailed requirements for replacements, procurement.	June 2018	November 2018
Construction	Site Work Assessment / Site Safety Tour, On site orientation, installation of new equipment.	January 2019	February 2019
Commissioning	Commissioning of new equipment by crane technician.	February 2019	February 2019
Closeout	Asset Assignment Forms, PIR Form, Lessons Learned Meeting, Contract Close Out Certificate	March 2019	March 2019

Project Title: Upgrade Ventilation

Location: Cartwright

Category: Transmission and Rural Operations - Generation Labrador

Type: Other

Classification: Normal

Project Description:

This proposed project is for the procurement of equipment and required construction to correct the deficiencies in the Cartwright Diesel Plant's ventilation system in order to maintain the reliable operation of the diesel generators in this plant.

Engineering design was completed in 2016 as part of the Upgrade Ventilation Systems project outlined in the 2015 Capital Budget Application, Volume 1, Pages D-189 to D-214. Material procurement and installations will be completed in 2018.

A summary of the scope of work for Cartwright Diesel Plant includes:

- Demolition and removal of existing ventilation system;
- Supply and installation of new supply fans, louvers, dampers, exhaust fans, motor starters, thermostats, and other associated equipment; and
- Addition of thermal insulation to the exhaust piping on the diesel engines.

The budget estimate is shown in Table1.

Table: 1 Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	15.0	0.0	0.0	15.0
Labour	56.7	0.0	0.0	56.7
Consultant	15.0	0.0	0.0	15.0
Contract Work	263.3	0.0	0.0	263.3
Other Direct Costs	16.2	0.0	0.0	16.2
Interest and Escalation	26.3	0.0	0.0	26.3
Contingency	73.2	0.0	0.0	73.2
TOTAL	**465.7**	**0.0**	**0.0**	**465.7**

Justification

In Hydro's 2015 Capital Budget Application, Volume 1, Upgrade Ventilation Systems, Pages D-189 to D-214, a course of action was justified to assess ventilation deficiencies at the Cartwright Diesel Plant and to undertake engineering design in 2016, which, when implemented, would correct those deficiencies. This project will procure the equipment and undertake required construction to correct the identified deficiencies so as to maintain the reliable operation of the diesel generators.

Existing System

The diesel plant in Cartwright is located on the eastern side of the Southern Coast of Labrador. The generator building is a two-storey engine hall containing four diesel generators. The engine hall ventilation system consists of two roof mounted exhaust fans and two supply louvres, as seen in Figures 1 and 2.

Figure 1: Cartwright Diesel Generating Station

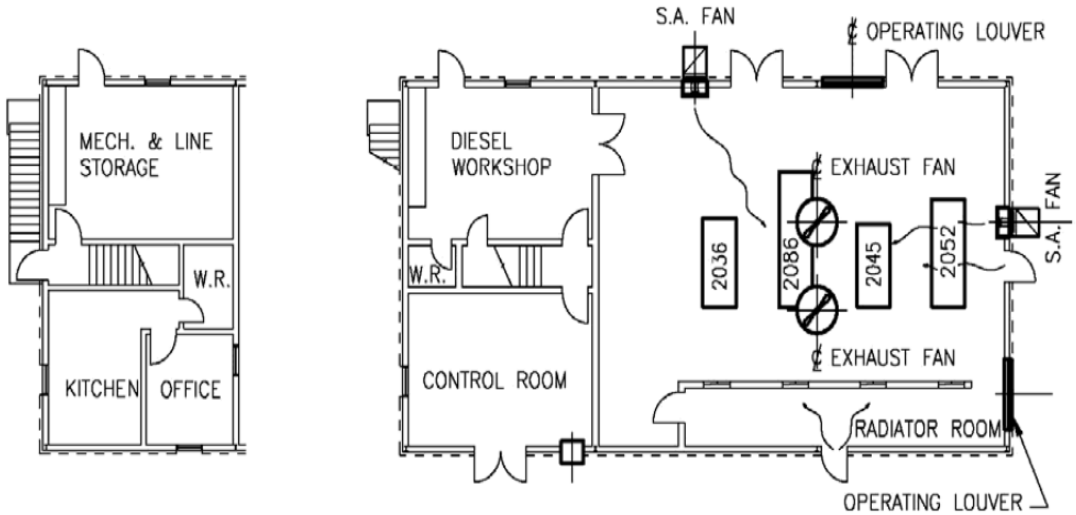

Figure 2: Cartwright Plant Ventilation Existing Arrangement

Operating Experience

The ventilation system in the Cartwright Diesel Plant was designed and installed when the plant was originally constructed in 1986. Since construction, further generation has been added and presently the ventilation system does not provide adequate cooling of the engine hall.

As outlined in the 2015 Capital Budget Application, inadequate ventilation can cause the temperatures in Cartwright Diesel Plant to exceed 40°C, which violates the generator manufacturer's suggested temperature rise of between 8.5°C – 12.5°C above ambient room temperate without the generators running. This operating environment results in generator components being exposed to excessive temperatures, which have the potential to lead to poor performance, overheating, and decreased service life.

Development of Alternatives

The construction of a new powerhouse building and the relocation of generators and associated assets has a higher capital cost. There is no planned replacement of the Cartwright Diesel Plant in the foreseeable future. Therefore, it was determined that the construction of a new powerhouse building is not a viable alternative.

Conclusion

The operating temperatures within the Cartwright Diesel Plant's Generator Hall are above the temperature criterion recommended by the diesel manufacturer, risking accelerated deterioration of the equipment. Upgrades are required to the plant's ventilation system to ensure continued reliable operation of the generating units.

Project Schedule

The anticipated project schedule is below in Table 2.

Table 2: Project Schedule

Activity 2018		Start Date	End Date
Planning	Open project, Consultant contracts and PO required	January 2018	March 2018
Design	Tender	February 2018	February 2018
Procurement	Order Equipment	March 2018	March 2018
Construction	Remove old ventilation equipment, Install new ventilation equipment Install filters and insulation on diesels	August 2018	August 2018
Commissioning	Commission Ventilation System	September 2018	October 2018
Closeout	Project Close-Out	November 2018	November 2018

Project Title: Replace Light-Duty Mobile Equipment

Location: Various

Category: General Properties - Transportation

Type: Other

Classification: Normal

Project Description

This project proposes the replacement of 13 all-terrain vehicles, six snowmobiles, five heavy duty trailers and four light-duty trailers in accordance with the established replacement criteria as follows:

- Snowmobiles/All-Terrain Vehicles: Transmission Line crews 3-5 years
- Snowmobiles/All-Terrain Vehicles: Other 5-7 years
- Light-Duty Trailers 6-8 years
- Heavy-Duty Trailers 12-15 years

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	392.5	0.0	0.0	392.5
Labour	2.5	0.0	0.0	2.5
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	14.2	0.0	0.0	14.2
Contingency	19.8	0.0	0.0	19.8
TOTAL	**429.0**	**0.0**	**0.0**	**429.0**

Justification

Hydro operates in many diverse locations across the province and it is critical that employees are provided with safe and reliable equipment in order to provide economical and reliable electricity.

Existing System

Newfoundland and Labrador Hydro (Hydro) operates a fleet of light-duty mobile equipment comprised of approximately 120 snowmobiles, 70 all-terrain vehicles, 120 trailers, ten forklifts and ten miscellaneous attachments (for example, lawn mowers, backhoes, salt spreaders, snow plows, etc.).

The mobile equipment fleet is strategically distributed across Hydro's operating areas throughout the Province and is utilized on a daily basis to support staff engaged in the maintenance and repair of the electrical system.

The Transportation Department of Hydro maintains a close liaison with other Canadian Utilities through participation on the Canadian Utility Fleet Council and has established mobile equipment replacement guidelines, which consider the age and operating conditions for the equipment.

Age of Equipment or System

Please see Appendix A for a detailed listing of the age of the assets being replaced under this project.

Operating Experience

Failure to replace units in accordance with the replacement policy will lead to increasing maintenance costs and less reliable vehicles. Employees maintain the electrical system 24 hours a day, seven days a week, and require dependable and safe vehicles for their work. As equipment ages, it experiences increasing downtime, which could negatively impact response times for emergency outages or planned maintenance.

Historical Information

Table 2 provides a history of light-duty mobile equipment purchases.

Table 2: Mobile Equipment Less than $50,000

Year	Units Purchased					Budget ($000)	Actual ($000)
	All Terrain Vehicles	Snowmobiles	Trailers	Forklifts	Attachments		
2017B	10	10	3	1	1	270.9	
2016	13	8	6	0	0	348.0	351.3
2015	7	33	4	0	0	494.4	505.9
2014	11	18	9	0	0	579.1	465.3
2013	14	21	3	1	0	476.5	448.2

<u>Evaluation of Alternatives</u>

Purchase of this equipment is the only viable option to support the maintenance of Hydro assets.

Conclusion

This project provides for the normal replacement of light-duty mobile equipment that is approaching the end of its useful life and is no longer dependable. Purchase of this equipment is the only viable option to support the maintenance of Hydro's assets.

Project Schedule

This project is to be completed by December 31, 2018.

APPENDIX A

Light-Duty Mobile Equipment Replacements

Type	Unit	Age at retire	AGE	Condition	LTD[1] Maint Cost
ATV	V7116	10.7	X		$4,114
ATV	V7237	8.2	X		$19,170
ATV	V7238	8.8	X		$1,591
ATV	V7248	7.1	X		$4,188
ATV	V7250	7.1	X		$2,228
ATV	V7273	6.2	X		$2,895
ATV	V7277	6.2	X		$7,161
ATV	V7288	5.1	X		$5,918
ATV	V7290	5.1	X		$4,846
ATV	V7295	5.0	X		$1,035
ATV	V7296	5.0	X		$2,281
ATV	V7297	5.0	X		$2,279
ATV	V7298	5.0	X		$3,132
HD Equipment/ Salt Spreader	V9842	5.7		SEVERE RUST	$3,582
HD Trailer	V8782	26.2	X		$4,858
HD Trailer	V8831	19.6	X		$27,877
HD Trailer	V8854	16.9	X		$11,541
HD Trailer	V8855	16.9	X		$22,633
LD Trailer	V8890	8.6	X		$1,900
LD Trailer	V8919	7.8	X		$9,107
LD Trailer	V8941	6.7	X		$7,233
LD Trailer	V8944	6.7	X		$8,774
Snowmobile	V7207	8.6	X		$1,358
Snowmobile	V7210	8.2	X		$2,881
Snowmobile	V7257	6.7	X		$1,725
Snowmobile	V7263	6.7	X		$3,727
Snowmobile	V7264	6.7	X		$3,276
Snowmobile	V7283	5.9	X		$1,708

[1] Life to Date

Project Title: Install Energy Efficient Lighting in Isolated Diesel Plants

Location: Various

Category: Transmission and Rural Operations - Properties Labrador

Type: Other

Classification: Justifiable

Project Description:

This proposal is a three year project to install new Light Emitting Diode (LED) lighting fixtures to replace existing metal halide and fluorescent fixtures in nine diesel plants located at Cartwright, Charlottetown, Francois, Grey River, Makkovik, McCallum, Nain, Norman Bay, and St. Lewis. This proposed project is to replace approximately 80 metal halide, 45 wall packs, and 110 fluorescent fixtures with new LED lighting at these nine sites.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	2020	Total
Material Supply	24.3	37.2	34.9	96.4
Labour	57.7	54.3	56.5	168.5
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	5.6	9.2	12.5	27.3
Contingency	16.4	18.3	18.3	53.0
TOTAL	**104.0**	**119.0**	**122.2**	**345.2**

Justification

LED lighting is more energy-efficient than the existing metal halide and fluorescent lighting currently being used. LED light bulbs last longer, are more durable, and offer comparable or better light quality than other types of lighting. A cost benefit analysis was used to determine the cost effectiveness of this project.

Existing System

At present, a combination of metal halide and fluorescent lighting is used in the diesel plants identified within the scope of this project. The existing lighting systems for these diesel plants were installed in the early to mid 1990's.

Development of Alternatives

A cost benefit analysis was completed to compare the following alternatives:

- Replace the lighting in the diesel plants; or
- Status quo (continue operating with the existing lights).

The cost estimate to complete the replacement of the lighting includes the material, labour, project overheads, and contingency required to complete the project over the scheduled duration of three years.

For the status quo alternative, the difference in energy required to operate the existing lighting versus the energy required to operate the modern energy efficient lighting was calculated. An average cost of $0.30 per kWh was used to determine the cost for this alternative.

Evaluation of Alternatives

The two alternatives were evaluated based upon least cost. The term "least-cost" refers to the lowest Cumulative Present Worth (CPW) of all capital and operating costs associated with a particular alternative over its useful economic life. The least cost alternative is shown to be "Replace Lighting", as presented in Table 2. Replacement of the lighting has a positive net present value and a total savings of $374,429 over the study period of 20 years.

Table 2: Results of Cost Benefit Analysis

Replace Lighting - Various Diesel Plants		
Alternative Comparison *Cumulative Net Present Value* *To The Year* **2017**		
Alternatives	**Cumulative Net Present Value (CPW)**	**CPW Difference between Alternative and the Least Cost Alternative**
Replace Lighting	285,691	0
Status Quo	660,119	374,429

Conclusion

Replacement of the lighting has a positive net present value and a total savings of $374,429 over a period of 20 years.

Project Schedule

The anticipated schedule for this project is shown in Table 3. The planning for the project will be completed in Year 1. Each of the three years will involve procurement, construction, and project closeout for three of the nine diesel plants.

Table 3: Annual Project Schedule – 2018 to 2020

Activity		Start Date	End Date
Planning	Scope, schedule, cost, risk, quality and communications planning	January, 2018	February, 2018
Design	Complete detailed design	March, 2018	April, 2018
Procurement	Specify and order equipment / prepare work packages	May	May
Construction	Installation and Commissioning	June	August
Closeout	As built drawings	September	October

Project Title: Install Recloser Remote Control

Location: English Harbour West and Barachoix

Category: Transmission and Rural Operations - Distribution Central

Type: Other

Classification: Normal

Project Description:

This project proposes the installation of a recloser remote control and monitoring at the English Harbor West and Barachoix Terminal Stations for use by the Energy Control Center in St. John's. This includes the following reclosers:

- EH1-R1 - English Harbour West Terminal Station; and
- BA4-R1 - Barachoix Terminal Station.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	43.9	0.0	43.9
Labour	56.0	125.7	0.0	181.7
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	3.7	29.2	0.0	32.9
Interest and Escalation	4.0	24.5	0.0	28.5
Contingency	0.0	51.7	0.0	51.7
TOTAL	**63.7**	**275.0**	**0.0**	**338.7**

Justification

The project will reduce outage durations incurred by English Harbor West and Barachoix customers by reducing crew travel time associated with troubleshooting and repair activities related to the operation of the recloser. In addition, data such as load data, recloser events, number of operations, and monthly peak loads will be available on-line to aid troubleshooting activities and maintenance planning.

Existing System

Reclosers are installed on distribution lines to interrupt fault current caused by either temporary or permanent electrical faults to the distribution systems. Reclosers are also used as a means to disconnect power to a distribution line for the purpose of maintenance and troubleshooting activities.

Currently, the reclosers at the English Harbour West and Barachoix terminal stations can only be operated locally by personnel at the terminal stations. For these reclosers, during troubleshooting and repair activities due to failed equipment faults, the line crew has to travel from the fault location to the terminal station in order to operate the appropriate recloser and return back to the location of the fault to perform repairs. After the repair is complete, the line crew has to travel back to the recloser site to energize the feeder. The time consumed by line crews to operate reclosers increases the customer power outage duration and therefore negatively impacts the System Average Interruption Duration Index (SAIDI).

Reliability Performance

Table 2 lists the five year average (2011 to 2015) for SAIFI[1] and SAIDI[2] data for the English Harbour West, Barchoix, and entire Hydro system. The table indicates that SAIDI and SAIFI values for EHW L1 and BCX L4 are above Hydro Corporate average.

Table 2: Five Year Averages KPI (2011 to 2015)

System	All Causes		Planned Outage		Loss of supply		All Causes excluding planned outage and loss of supply	
	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI	SAIFI	SAIDI
English Harbour West L1	5.11	17.42	0.04	0.04	1.60	7.87	3.46	**9.52**
Barachoix L4	4.95	18.78	0.26	0.65	2.20	12.13	2.48	**6.01**
Hydro Corporate	6.10	15.76	1.17	4.41	3.05	6.82	1.88	**4.53**

Historical Information

[1] System Average Interruption Frequency Index.
[2] System Average Interruption Duration Index.

Hydro received approval from the Board, under Board Order NO. P.U. 45(2016), to install a recloser remote control at the Bottom Waters Terminal Station in 2017-18, at a budget cost of $465,700.

Development of Alternatives

The project will be completed using Hydro's established practices for remotely controlling reclosers. Therefore, there are no alternatives to be considered.

Conclusion

The reclosers at the English Harbour West and Barachoix terminal stations can only be operated locally by personnel at the terminal stations. The time consumed by line crews to operate reclosers increases the duration of customer power outages and negatively impacts the System Average Interruption Duration Index (SAIDI).

This project will reduce outage times related to travel time associated with troubleshooting and repair activities requiring operation of the recloser.

Project Schedule

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity		Start Date	End Date
Planning	Complete Work Breakdown Schedules	January 2018	March 2018
Design	Complete site visits and detailed designs with drawings	April 2018	December 2018
Procurement	Order and receive all equipment	January 2019	April 2019
Construction	Install, configure and test equipment at the terminal stations	April 2019	August 2019
Commissioning	Commission each site to ECC	August 2019	September 2019
Closeout	Complete all drawings and project closeout accounting and reporting	September 2019	December 2019

Future Plan

Hydro has 50 additional three-phase reclosers in the Island Interconnected System, which are not connected to Hydro’s SCADA network. Hydro will establish a remote control installation program for submission in a future capital budget application.

Project Title: Upgrade Aluminum Support Structures

Location: Holyrood Thermal Generating Station

Category: Transmission and Rural Operations - Terminal Stations

Definition: Other

Classification: Normal

Project Description:

This project is the final year of a three-year program to upgrade aluminum support structures at the Holyrood Terminal Station. The 2018 work will refurbish the remaining priority 'A' and 'B' structures identified in the 2015 report titled, *"Re-Assessment of Aluminum Structures",* which was previously appended to Hydro's 2017 Capital Budget Application. The scope of work includes: the engagement of a third party consultant to complete the detailed engineering design; the installation of temporary support bracing; the removal of existing nuts and washers; the replacement of existing aluminum baseplates with galvanized steel plates; the replacement of damaged anchor bolts; the cleaning of the concrete foundation surface; and the installation of new nuts and washers. The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	1.5	0.0	0.0	1.5
Labour	109.3	0.0	0.0	109.3
Consultant	15.0	0.0	0.0	15.0
Contract Work	117.5	0.0	0.0	117.5
Other Direct Costs	3.9	0.0	0.0	3.9
Interest and Escalation	15.7	0.0	0.0	15.7
Contingency	24.7	0.0	0.0	24.7
TOTAL	**287.6**	**0.0**	**0.0**	**287.6**

Justification

Corrosion of the aluminum baseplates, for the high voltage support structures at the Holyrood Terminal Station, has resulted in the accumulation of aluminum corrosion byproducts between the baseplate and the surface of the concrete foundation (Figure 1).

Figure 1: Example of Aluminum Oxide Formation between Concrete Surface and Aluminum Baseplate

With time, the increasing accumulation of aluminum oxide has created stress on both the support structures and their associated anchor bolts. As a result of these stresses, aluminum structural members have deformed and a number of anchor bolts have failed. If the source of this accumulation is not addressed, the resulting damage will jeopardize the integrity of the support structures (Figures 2 and 3).

Figure 2: Example of Deformation of Baseplate Due to Aluminum Oxide Uplift

Figure 3: Example of Deformation of Aluminum Structure Legs as Result of Uplift Stresses

These structures support high voltage electrical equipment. This equipment is critical to the Island Interconnected System and its continued operation is required to ensure the delivery of safe, reliable power to Hydro's customers. To ensure their ability to perform as originally designed, the proposed upgrades must be completed. Failure to address the growth would lead to a failure of the anchoring system.

Existing System

The Holyrood Terminal Station was constructed in three stages. Aluminum support structures were used in stage 1 and 2 of the terminal station construction and galvanized steel was used for the stage 3 support structures.

Stage 1 was completed in 1965, stage 2 in 1975, and stage 3 followed in 1982. The support structures are original to each respective stage and have not received any major work or upgrades since their original installation until the start of this three year program in 2016.

Operating Experience

The re-assessment of aluminum structures program was initiated in 2012 following the failure of multiple anchor bolts on a support structure for 230kV bus 11. The failures required the enactment of emergency repairs to restore the structure's integrity and prevent its collapse.

Investigation into the cause of the failure revealed that it was the result of overstressing, induced via the accumulation of aluminum oxide between the base plate and concrete foundation surface. The aluminum oxide is a byproduct of a corrosive reaction, resulting from the direct contact of the two surfaces.

The Holyrood Terminal Station connects the Holyrood Thermal Generating Station to the Island Interconnected System via three 230 kV transmission lines (TL217 Holyrood to Western Avalon, TL218 Holyrood to Oxen Pond, and TL242 Holyrood to Hardwoods), one 138 kV transmission line (39L Holyrood Western Avalon 138 kV loop) and one 66 kV transmission line 38L (Holyrood to Chamberlains and on to Hardwoods). A support structure failure could result in a long term outage to either of these lines, which would have adverse effects on the Island

Interconnected System and loss of power supply to St. John’s and the Avalon area.

Maintenance History

The aluminum support structures are mostly self-sufficient and do not require any maintenance, as they do not corrode and deteriorate in typical weather conditions. The corrosion and subsequent deterioration in this case is the result of a corrosive reaction that occurs at the interface between the underside of the structure baseplate and the concrete foundation’s surface. The corrosion is due to the absence of a corrosion preventive coating during stage 1 construction. Structures erected during stage 2 yard construction appear to have been fitted with a coating and there is no evidence of any corrosion and deterioration on these structures. Likewise, the stage 3 structures all appear to be in sound condition, given their galvanized steel make-up.

The only maintenance record for the aluminum support structures involves the emergency structure upgrades completed in 2013. Four structures were upgraded at a cost of $91,747.

Outside of routine visual inspections completed for all of Hydro’s support structures, no future maintenance costs are anticipated for the aluminum support structures refurbished under this 3-year program.

Historical Information

Hydro became aware of the deterioration of the aluminum support structures in 2012. The issue was discovered after the sudden failure of three of four anchor bolts on the tension side of a high voltage bus structure, which required emergency repairs to restore the structure’s integrity. As a result of this failure, Hydro assessed the condition of the remaining support structures and investigated the root cause of the anchor bolt failure. Based on the assessment’s findings, Hydro enacted emergency repairs on four structure bases and implemented monitoring of the remaining structure bases.

In 2014, Hydro completed a re-assessment, which included a visual inspection of the structure bases to determine if their condition had changed since the original assessment; the completion of "wrench" removal tests on a select sample of anchor bolts; and the completion of ultrasonic thickness[1] (UT) tests on sample fabricated anchor bolts to determine the effectiveness of UT tests for the remaining bolts. The information garnered through the completion of the testing aided in the development of a repair strategy.

While minimal change was noted in the condition of the structure bases, when cross-referenced with the 2012 assessment findings it is recognized that the process of aluminum oxide build-up had continued. Failure to mitigate the build-up of aluminum oxide will result in the failure of the structure bases and/or the anchor bolts. The only means of eliminating aluminum oxide is to eliminate contact between the aluminum base plates and the concrete foundations. Consequently, in the 2015 Hydro implemented a three year program to upgrade the aluminum structures.

Anticipated Useful Life

The service life of these structures is estimated to be approximately 65 years.

Development of Alternatives

The support structures at the Holyrood Terminal Station are subject to overstressing as a result of an aluminum corrosion byproduct, which is accumulating at the aluminum-concrete interface. A number of structures have failed and others may continue to fail if they are not rehabilitated. There are no viable alternatives outside of the completion of the proposed refurbishment.

Conclusion

The aluminum support structures are subject to a build-up of aluminum oxide, which is

[1] Ultrasonic thickness testing is a method of performing non-destructive measurement (gauging) of the local thickness of a solid element (typically made of metal, if using ultrasound testing for industrial purposes) basing on the time taken by the ultrasound wave to return to the surface. This type of measurement is typically performed with an ultrasonic thickness gauge.

occurring between the baseplate and the concrete foundation. The progressive accumulation of this byproduct is generating stress on both the aluminum structures and their associated anchor bolts. The magnitude of the stress and its potential impact on the structures became evident after the sudden failure of a structure in 2012.

The structures support high voltage electrical equipment. This equipment is critical to the Island Interconnected System and its continued operation is required to ensure the delivery of power to Hydro's customers. To maintain the reliable operation of the electrical system at Holyrood, the proposed refurbishment must be completed.

Project Schedule

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Scheduling, Risk Management, Scope Statement, Resource Allocation	January 2018	February 2018
Consultant Engagement	Prepare Request For Proposal, Select Third Party Consultant	February 2018	March 2018
Detailed Engineering	Technical Specification and Drawing preparation	March 2018	April 2018
Tender	Tender and Award Support Structure Upgrade Contract	May 2018	June 2018
Construction	Complete Support Structure Upgrades	July 2018	August 2018
Commissioning	Final Inspection and Acceptance	-	September 2018
Closeout	Project Closeout	-	November 2018

Project Title: Replace Human Machine Interface

Location: St. Lewis

Category: Transmission and Rural Operations - Generation Northern

Type: Other

Classification: Normal

Project Description:

This project proposes the replacement of the existing Human Machine Interface (HMI)[1] at the St. Lewis Diesel Plant. The scope of work includes the:

- Replacement of the HMI computer server;
- Installation of Trihedral VTScada software for the HMI;
- Installation of two network switches;
- Modification of the load management program to align with the new HMI screen displays; and
- Installation of a modern Schneider Electric Programmable Logic Controller (PLC) that has Ethernet capability and supports the latest software.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	54.3	0.0	0.0	54.3
Labour	133.9	0.0	0.0	133.9
Consultant	4.7	0.0	0.0	4.7
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	29.8	0.0	0.0	29.8
Interest and Escalation	13.6	0.0	0.0	13.6
Contingency	44.5	0.0	0.0	44.5
TOTAL	**280.8**	**0.0**	**0.0**	**280.8**

[1] Human Machine Interface (HMI) includes the electronics required to signal and control equipment.

Justification

This project will replace the failed HMI which will restore automated, centralized monitoring and control of the plant's generators, electronic recording and display of engine parameters metering and alarms, and to provide centralized operator interaction with the equipment.

Existing System

The HMI at St. Lewis was installed in 2006 when the diesel generating plant was rebuilt to provide automated, centralized monitoring, and control of the plant's generators, electronic recording, and display of engine parameters metering and alarms. The HMI also provides centralized operator interaction with the equipment

In 2006, a central managing programmable logic controller (PLC) processor was installed to monitor and control the diesel generators. This processor exchanges information with the HMI through the plant's communication network. The PLC and communication network were installed in 2006. The PLC and the communication network switches are not compatible with newer HMI hardware and software technology.

There have been no major upgrades to the HMI system and PLC processor since installation.

Operating Experience

The HMI is not working because its computer server has failed. The existing HMI uses Schneider Electric Monitor Pro 7.2 SCADA software, which is no longer available and all support for this software will cease on December 31, 2017. In addition, the HMI computer server has Windows 2003 operating software installed, which is no longer supported by Microsoft and the installed Monitor Pro software is not compatible with newer server operating software.

The loss of the HMI has eliminated the electronic logging and display of metering data and alarms, which eliminates the centralized control of the plant by the operators.

The PLC and the communication network switches are not compatible with new hardware and software required in the replacement of the HMI.

Reliability Performance

The HMI worked reliably until the server failed.

Vendor Recommendations

Schneider Electric recommends the replacement of the HMI software program.

Maintenance or Support Arrangements

Hydro does not have maintenance or support agreements with the supplier.

Maintenance History

The five-year maintenance history for the HMI system is shown in the following table:

Table 2: Five-Year Maintenance History

Year	Preventive Maintenance ($000)	Corrective Maintenance ($000)	Total Maintenance ($ 000)
2016	1.7	0.0	1.7
2015	0.0	0.0	0.0
2014	0.0	0.0	0.0
2013	0.0	0.0	0.0
2012	0.0	2.2	2.2

Historical Information

Hydro started a program in 2016 to replace the HMIs at diesel plants due to the systems approaching the end of their life cycles and modifications cannot be made. The first HMI replacement was at Port Hope Simpson in 2016 and further replacements at Hawke's Bay and Ramea will be completed in 2017. The capital budget proposal was approved for $434,000 under Board Order NO. P.U. 33(2015).

Conclusion

The HMI system at the St. Lewis Diesel Plant has failed, as has the central managing PLC processor. The PLC communications network switches are not compatible with HMI replacement hardware and software. This project will restore the plant's control and automation system for operators.

Project Schedule

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity		Start Date	End Date
Planning	Prepare scope statement	January 2018	January 2018
Design	Prepare engineering drawings Complete office programming (VTScada, M340)	March 2018 April 2018	June 2018 June 2018
Procurement	Order material	February 2018	February 2018
Construction	Installation Complete site programming(VTScada,M340)	July 2018 July 2018	August 2018 August 2018
Commissioning	Commission and run out system	August 2018	August 2018
Closeout	Project closeout information As built drawings and documentation	September 2018 September 2018	September 2018 September 2018

Project Title: Replace Personal Computers

Location: Hydro Place

Category: Generation – Information Systems

Definition: Other

Classification: Normal

Project Description:

The Personal Computer (PC) Replacement Program is an on-going program required to enhance the efficiency of employees by replacing the PCs used for their day to day requirements.

This project will enable Hydro to replace 240 computers and 60 monitors that were deployed up to, and including 2014. There are 127 Laptops and 113 Desktops to be replaced.

The assignment of a particular device is determined by the employee's manager or supervisor. Generally, if an employee is expected to use their computer while away from the office, a laptop is assigned.

The projected costs of the units are as follows:

- Laptop - $2,100
- Desktop - $1,125
- Monitor - $258

In 2015, Hydro released a tender for the supply of PC equipment. This tender was awarded for a period of two years with the possibility of three one-year extensions.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	325.2	0.0	0.0	325.2
Labour	33.6	0.0	0.0	33.6
Consultant	0.0	0.0	0.0	0.0
Contract Work	39.9	0.0	0.0	39.9
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	14.6	0.0	0.0	14.6
Contingency	79.7	0.0	0.0	79.7
TOTAL	**493.0**	**0.0**	**0.0**	**493.0**

Justification

Hydro must keep computers current to adequately support and protect the Information Technology applications and information required to operate its business. The replacement and addition of PC components to achieve this goal requires investment over the life cycle of the computers.

The refresh program makes it possible for computers to be replaced in a planned and consistent manner. This allows for the timely replacement of computers to maintain efficient support while ensuring availability and reliability of computer hardware to support user applications. Continued review of the computer life cycle allows Hydro to adjust plans based on performance, technology changes and new business requirements.

In addition, the computers to be replaced under this project are approaching the end of their useful lives and failures can be expected, which would result in loss of productivity due to the computers not being available for the user to do their day-to-day work. The maintenance agreements for these computers will have expired and replacement parts can no longer be guaranteed.

Existing System

Hydro has approximately 1,150 end-user personal computers in service. It is important to refresh this equipment on a regular cycle to keep the technology current to maintain a reliable, efficient, and productive workforce. Refreshing is the replacement of end-user equipment, such as desktops, laptops and thin clients, on a life cycle depending on the type of device.

Minimum specifications for replacement of personal computers are reviewed on an annual basis to ensure that the PCs in service continue to remain effective. Industry best practices, technology and application trends are taken into consideration when specifications for computer devices are decided for the current year. The annual review continues the replacement life cycle for laptops of every four years, desktops every five years, and workstations and thin clients every six years. The replacement of monitors and required hardware upgrades are assessed based on failure, compatibility with newer hardware, and user application requirements.

Age of Equipment or System

The existing PCs that are to be replaced under this project will have been in service between four and six years depending on the hardware platform used.

Availability of Replacement Parts

Replacement parts are readily available for the duration of the maintenance agreements. Once the maintenance agreement has expired there is no guarantee that replacement parts can be obtained.

Operating Experience

Status Quo

If the end user infrastructure is not kept current the following scenarios could potentially occur:

- New applications may not run on the old hardware platform;
- Decreased speed may result in lost production;
- Failure rates will exceed 50 percent;

- Maintenance agreements will not be offered by vendor; and
- Operating systems may be unsupported.

Alternatives

The only alternative is to consider leasing the equipment and a cost benefit analysis will be done in the year of replacement to ensure the least cost option is chosen in consideration of incentives or other benefits that may be offered by the providers.

Industry Experience

Hydro has a similar life cycle plan for computer equipment as other companies in the utility industry, including Newfoundland Power.

Maintenance or Support Arrangements

Hydro has purchased maintenance agreements with Lenovo Corporation, the manufacturer, that cover laptops for four years and desktops for five years. This agreement was established through public tendering.

Historical Information

Historical information on computer replacement over the last five years as well as those budgeted for 2017 is presented in Table 2.

Table 2: Historical Information

Year	Capital Budget ($000)	Actual Expenditures ($000)	Units	Cost per unit ($000)
2017B	401.0			
2016	861.7	849.9	211	2.31
2015	573.3	571.8	358	1.60
2014	463.9	529.1	271	1.95
2013	463.9	518.2	237	2.18
2012	490.6	499.0	183	2.73

Anticipated Useful Life

According to Gartner[1], the useful life for a laptop is three years while for a desktop is four to five years. Gartner also states that notebooks (laptops) have higher failure rates than desktop PCs. In their research, Gartner recommends that organizations plan on a three-year replacement cycle for notebooks while exercising the option to extend the life another six to 12 months provided warranty has been extended to match the anticipated extended lifetime of the notebook. The North American industry standard life cycle for end-user devices is three years for laptops and five years for desktops. Hydro has adopted a four to five year life cycle and utilizes extended warranties to ensure reliable operation.

Economic Analysis

This project is subject to a lease or purchase cost benefit analysis to determine the lowest cost alternative. The cost benefit analysis is done in the year of replacement to ensure consideration of incentives or other benefits that may be offered by the providers.

Conclusion

The PC Replacement Program as proposed in this project is justified for the following reasons:

- It enables the end user equipment to remain current.
- It improves workforce efficiency by providing reliable hardware.

Project Schedule

The project is scheduled to start in January 2018 and be completed before December 31, 2018.

[1] Gartner Inc. provides research and analysis on the global Information Technology industry. They assist companies in making informed technology and business decisions by providing in-depth analysis and advice on virtually all aspects of technology.

Project Title: Replace Radomes

Location: Various

Category: General Properties - Telecontrol

Type: Pooled

Classification: Normal

Project Description:

This project is an ongoing program to replace microwave antenna radomes.[1] Hydro has initiated a radome replacement program for the microwave antennas of the corporate network to reduce the probability of system outages resulting from radome failure. The radome replacement program proposed by Hydro is based on operational experience and the manufacturers' recommendations. Due to operational risks associated with the failure of corporate microwave equipment, this project is a proactive approach to minimize the likelihood of failure of microwave antenna radomes.

Radomes are replaced at different sites throughout the network each year, depending on age and condition. The radome replacement schedule for 2018-2022 is provided in Appendix A. Sixteen radomes are scheduled to be replaced in 2018. This project will be completed as a joint effort with an external contractor who will perform the actual work, and internal personnel who will provide project management and technical support.

The budget estimate for this project is shown in Table 1.

[1] Radomes are the protective covers that enclose the delicate components of the microwave antennas in Hydro's microwave radio system.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	62.6	0.0	0.0	62.6
Consultant	0.0	0.0	0.0	0.0
Contract Work	207.0	0.0	0.0	207.0
Other Direct Costs	15.3	0.0	0.0	15.3
Interest and Escalation	18.4	0.0	0.0	18.4
Contingency	57.0	0.0	0.0	57.0
TOTAL	**360.3**	**0.0**	**0.0**	**360.3**

Justification:

During the installation of the East Coast Microwave System in 2001, approximately 20 antennas were installed. To avoid the logistical challenges that would be created by replacing each of these radomes in the same year, Hydro decided that the replacement program should be distributed over multiple years. The current schedule for the next five years is included in Appendix A.

Due to the decision to distribute the replacement of radomes, some radomes will be left in-service for longer periods than recommended. To avoid in-service failure of the radomes, Hydro has developed an inspection program to identify radomes that are torn or otherwise damaged, as illustrated in Figure 2. These radomes must be replaced as soon as the damage is identified to ensure the integrity of the microwave system. A radome failure could result in the microwave system failing.

The impact of a microwave failure today could have a greater effect than the the incident of 1996[2] due to the fact that teleprotection signals, which protect transmission lines in the event of a system disturbance, are now transmitted using the microwave network. Today, protection signals for 17 of Hydro's 24 critical 230kV transmission lines are carried on the microwave network. Therefore, a microwave failure would cause the Energy Control Centre to lose control of the system stations and likely cause and/or extend customer outages.

[2] Refer to the Operating Experience section of this document for further details

Existing System:

Hydro has a network of microwave radios, by which corporate communications and system data are transmitted. The microwave radio system provides the backbone for all corporate voice and data communications. Traffic carried over the microwave system includes:

- Teleprotection signals for the provincial transmission system;
- Data pertaining to the provincial Supervisory Control and Data Acquisition (SCADA) system;
- Data pertaining to the corporate administrative system; and
- Operational and administrative voice systems.

Microwave radio signals are transmitted from one location to the next using parabolic antennas attached to towers. These antennas are mounted up to heights of 120 meters and range in diameter from two meters to five meters. At such extreme heights, the antennas are subjected to high wind and ice loading when storms occur and must be protected. To provide this protection, the feed horn of the antennas (responsible for sending and receiving microwave radio signals) are covered with a flexible covering, stretched over the antenna shroud, known as a radome. These covers are made of advanced plastics known as Hypalon and Teglar that prevent the accumulation of ice and snow which could bend or break the feed horn, and do not interfere with the microwave radio signals. The white cover illustrated in Figure 1 is an example of a radome on an uninstalled antenna.

Figure 1: Microwave Antenna with Radome

Damage to radomes can occur in several ways. Exposure to wind, sun, rain, and ice causes the radomes to deteriorate over time. When the radome weakens, tears form in the fabric, as shown in Figure 2. Left unchecked, the tears quickly grow in size (Figure 3), and the material can be torn free by wind. Such tears may result in severe damage to the delicate antenna components.

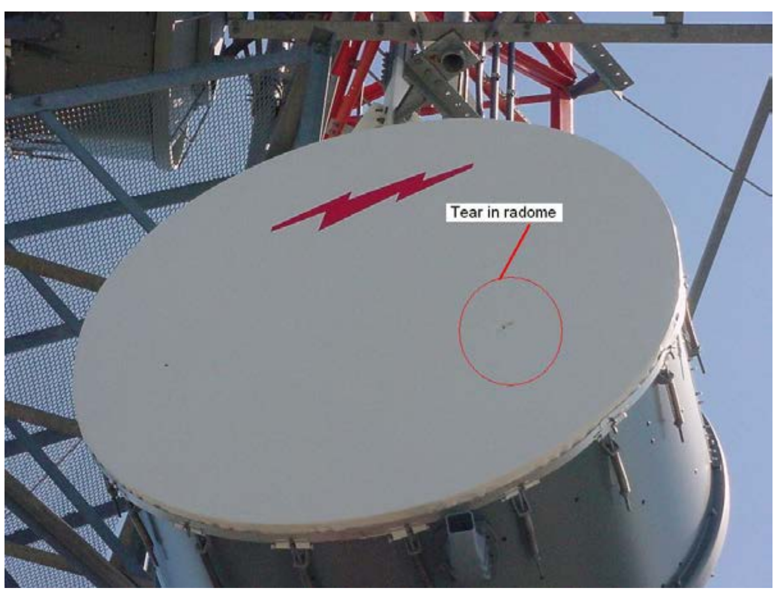

Figure 2: Tear in Radome

Figure 3: Heavily Damaged Radome

Other modes of failure are less common. Ice falling from the tower can damage radome components, such as the hardware that hold the radome in place, as shown in Figure 4. Vandalism by the use of shotguns, rocks, or other projectiles has also occurred at sites that are accessible by road. Each of these occurrences has the potential to damage the radome and make it prone to complete failure.

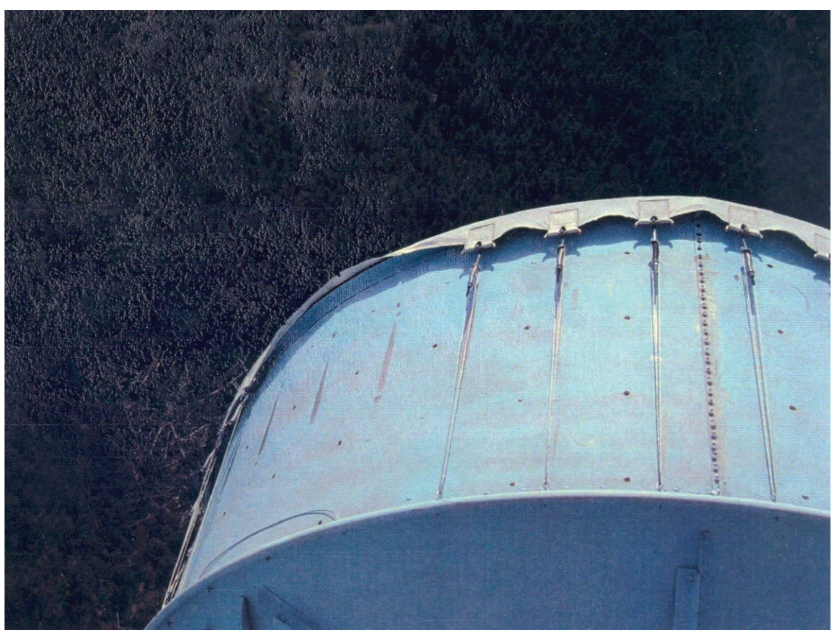

Figure 4: Missing Radome Mounts

There are 77 radomes throughout Hydro's system. They are installed on towers from St. John's west to Deer Lake, and south to Bay d'Espoir. Figure 5 shows Hydro's Telecommunication Network.

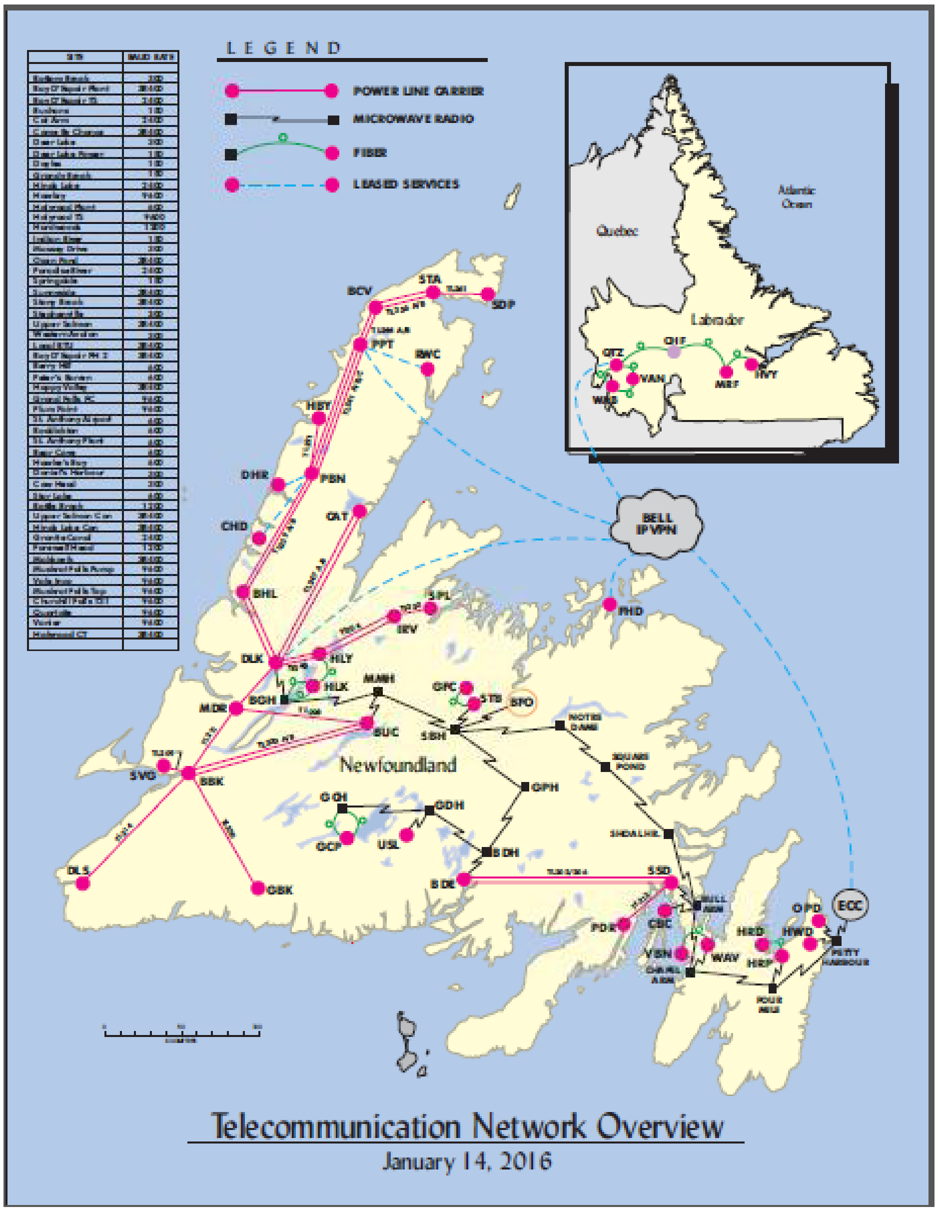

Figure 5: Location of Towers

<u>Major Work and/or Upgrades</u>

There are no upgrades available for a radome. It must be replaced based upon the estimated useful life or upon observed damage during inspection.

Operating Experience:

Outage Statistics

In the winter of 1996, a wind storm resulted in the failure of two separate radomes at the Sandy Brook Hill and Mary March Hill Microwave Sites, which caused a significant and sustained outage to a part of Hydro's communications network. Despite routine inspections, the radomes were torn and the material of the shells became entangled in the antenna feed horns. As a result, critical components at both sites were irreparably damaged and the antennas required replacement. Once the storm cleared and the cause of the outage was identified, the antennas could not be replaced until three weeks later, due to lead times associated with material procurement and weather related delays.

In total, the microwave radio system was out of service for approximately six weeks. During that time, temporary leased services were procured and installed, resulting in unanticipated labour and materials costs.

There have been no other communication outages caused by radome failures since the 1996 wind storm.

Vendor Recommendations

As a result of the costs and outage time associated with the 1996 storm, personnel from Hydro consulted with manufacturers to develop a proactive radome replacement plan. Based on discussions with representatives from radome manufacturers Andrew Solutions and CableWave, the following replacement frequency was developed:

- CableWave radomes (made of Hypalon material) should be replaced on a seven-year cycle; and
- Andrew Solutions radomes (made of Teglar material) should be replaced on an eight-year cycle.

Andrew Solutions radomes, with a slightly longer life, cannot be substituted for CableWave radomes on CableWave antennas due to the structural differences associated with each type of antenna.

Maintenance or Support Arrangements

There are no maintenance or support arrangements associated specifically with radomes. Radome inspection is included as part of an overall tower inspection which occurs annually.

Maintenance History

Radomes are visually inspected each year when the tower is inspected, or as soon as practical after any extremely severe storm that might have affected a particular site. A visual inspection may also be required as part of any corrective maintenance investigation into any loss or degradation of signal that may have been caused by a radome tear damaging the feed horn assembly. The radomes are inspected for any tears and any failure of the mounting hardware. Radomes cannot be repaired and must be replaced when a tear of any size is visually detected. Even a small tear is unacceptable as it will become much larger due to the high stresses caused by wind and other environmental factors including icing.

Historical Information

Table 2 shows the historical information for the Radome Replacement Program since 2013.

Table 2: Capital Budget and Expenditures Since 2013

Year	Capital Budget ($000)	Actual Expenditures ($000)	Units	Cost per unit ($000)	Comments
2017	0.0	0.0	0.0		None Required
2016	235.2	230.0	11.0	20.9	Complete within Budget
2015	0.0	0.0	0.0	0.0	None Required
2014	324.9	217.8	14.0	15.6	Favorable weather during construction; contingency not

					required.
2013	336.0	263.0	18.0	18.7	Not Complete.

Anticipated Useful Life

Hydro's microwave antennas are supplied primarily by two manufacturers, Andrew Solutions and CableWave. Each manufacturer uses a different radome. Radomes used on antennas manufactured by CableWave have a useful life of seven years, and the radomes used on Andrew antennas have a useful life of eight years.

Alternatives

No viable alternatives exist to radome replacement.

Conclusion:

Hydro's Radome Replacement Program is necessary in order to prevent outages caused by radome damage.

The radome replacement program is based on operational experience and manufacturers' recommendations. Historically, this project has been executed by external contractors and supported by internal resources and this joint effort will continue in 2018.

Due operational risks associated with the failure of corporate microwave equipment, this project is a proactive approach to minimizing failures of microwave antenna radomes.

Future Plans:

Future plans will be proposed in future capital budget applications. Radome replacements are planned for each of the next five years as listed in Appendix A.

Project Schedule:

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity		Start Date	End Date
Planning	Prepare Project Plan and site visits	January 2018	February 2018
Design	Complete Tender Package	February 2018	March 2018
Procurement	Purchase Radomes	April 2018	April 2018
Installation	Install Radomes	May 2018	September 2018
Commissioning	Site Inspections	October 2018	October 2018
Closeout	Project Closeout	November 2018	December 2018

APPENDIX A

Radome Replacement Schedule

2018 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
CAH	FMH (main)	3.0m (10')	Andrew	HP10-71D	2010
CAH	FMH (div)	2.4m (8')	Andrew	HP8-71D	2010
CAH	BAH (main)	3.0m (10')	Andrew	HP10-71D	2010
CAH	BAH (div)	2.4m (8')	Andrew	HP8-71D	2010
CAH	WAP	2.4m (8')	Andrew	HP8-71D	2010
FMH	PHH (main)	3.0m (10')	Andrew	HP10-71D	2010
FMH	CAH (main)	3.0m (10')	Andrew	HP10-71D	2010
FMH	CAH (div)	2.4m (8')	Andrew	HP8-71D	2010
FMH	HRP	2.4m (8')	Andrew	HP8-71D	2010
MMH	BUC	1.8m (6')	CW	DA6-71hp	2011
OPD	PHH	1.8m (6')	Andrew	HP6-71E	2010
PHH	FMH (div)	1.8m (6')	Andrew	HP6-71E	2010
STB	SBH	1.8m (6')	CW	DA6-71hp	2011
WAP	CAH	2.4m (8')	Andrew	HP8-71D	2010
WAP	WAV	2.4m (8')	Andrew	HP8-71D	2010
WAV	WAP	1.8m (6')	Andrew	HP6-71E	2010

2019 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
BAH	SHH (main)	2.4m (8')	Andrew	HP8-71GE	2011
BAH	SHH (div)	2.4m (8')	Andrew	HP8-71GE	2011
CBC	BAH	1.8m (6')	Andrew	HP6-71E	2011
DLP	DLK	3m x 4.9m	Microflect	90392	2011
ECC	PHH	1.8m (6')	Andrew	HP6-71E	2011
HWD	PHH	2.4m (8')	Andrew	HP8-71D	2011
MMH	SBH	3.0m (10')	Andrew	HP10-71D	2011
PHH	OPD	1.8m (6')	Andrew	HP6-71E	2011
PHH	HWD	1.8m (6')	Andrew	HP6-71E	2011
SSD	BAH	1.8m (6')	Andrew	HP6-71E	2011

2020 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
BAH	CAH	3.0m(10')	Andrew	HP10-71D	2012
BGH	MMH	2.4m(8')	CW	DA8-71hp	2013
BGH	DLP	3.6m(12')	CW	DA12-71hp	2013
GCH	GDH	3.0m(10')	Andrew	HP10-71D	2012
GCH	GDH	2.4m(8')	Andrew	HP8-71D	2012
GDH	GCH (main)	3.0m(10')	Andrew	HP10-71D	2012
GDH	GCH (div)	2.4m(8')	Andrew	HP8-71D	2012
GDH	BDH	3.0m(10')	CW	DA10-71hp	2013
GDH	USL	3.0m(10')	CW	DA10-71hp	2013
HRP	FMH	2.4m(8')	Andrew	HP8-71D	2012
MMH	SBH	3.6m(12')	CW	DA12-71hp	2013
MMH	BGH	2.4m(8')	CW	DA8-71hp	2013
PHH	ECC	2.4m(8')	Andrew	HP8-71D	2012
SBH	MMH	3.6m(12')	CW	DA12-71hp	2013
USL	GDH	3.0m(10')	CW	DA10-71hp	2013

2021 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
BDE	BDH	1.8m(6')	CW	DA6-71hp	2014
BDH	GPH	1.8m(6')	CW	DA6-71hp	2014
BDH	BDE	1.8m(6')	CW	DA6-71hp	2014
BFI	SBH	2.4m(8')	Andrew	HP8-71GE	2013
BUC	MMH	1.8m(6')	CW	DA6-71hp	2014
DLK	DLP	4.5m(15')	Gabriel	SR15-71B	2013
FMH	PHH (div)	1.8m(6')	Andrew	HP6-71E	2013
NDH	SPH (main)	3.6m(12')	Andrew	HP12-71E	2013
NDH	SPH (div)	3.6m(12')	Andrew	HP12-71E	2013
NDH	SBH (main)	3.6m(12')	Andrew	HP12-71E	2013
NDH	SBH (div)	3.6m(12')	Andrew	HP12-71E	2013

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
SBH	NDH (main)	3.6m(12')	Andrew	HP12-71E	2013
SBH	NDH (div)	3.0m(10')	Andrew	HP10-71D	2013
SBH	BFI	2.4m(8')	Andrew	HP8-71GE	2013

2022 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model #	Last Replaced
BDH	GPH	2.4m(8')	Andrew	HP8-71D	2014
BDH	GDH	3.0m(10')	Andrew	HP10-71D	2014
SHH	BAH (main)	2.4m(8')	Andrew	HP8-71GE	2014
SHH	BAH (div)	2.4m(8')	Andrew	HP8-71GE	2014
SHH	SPH (main)	3.6m(12')	Andrew	HP12-71E	2014
SHH	SPH (div)	3.6m(12')	Andrew	HP12-71E	2014
SPH	SHH (main)	3.6m(12')	Andrew	HP12-71E	2014
SPH	SHH (div)	3.6m(12')	Andrew	HP12-71E	2014
SPH	NDH (main)	3.6m(12')	Andrew	HP12-71E	2014
SPH	NDH (div)	3.6m(12')	Andrew	HP12-71E	2014

Abv	Site Name
BAH	Bull Arm Hill Microwave/Repeater
BDE	Bay D'Espoir Terminal Station
BDH	Bay D'Espoir Hill Microwave/Repeater
BFI	Bishop Falls Office
BGH	Blue Grass Hill Microwave/Repeater
BUC	Buchans Terminal Station
CAH	Chapel Arm Hill Microwave/Repeater
CBC	Come By Chance Terminal Station
DLK	Deer Lake Terminal Station
DLP	Deer Lake Passive Repeater
ECC	Energy Control Center
FMH	Four Mile Hill Microwave/Repeater
GCH	Granite Canal Hill Microwave
GDH	Godaleich Hill Microwave/Repeater
GPH	Gull Pond Hill Microwave

Abv	Site Name
HRP	Holyrood Plant
HWD	Hardwoods Terminal Station
MMH	Mary March Hill Microwave
NDH	Notre Dame Hill
OPD	Oxen Pond Terminal Station
PHH	Petty Harbour Hill Microwave/Repeater
SBH	Sandy Brook Hill Microwave
SHH	Shoal Harbour Hill
SPH	Square Pond Hill
SSD	Sunnyside Terminal Station
STB	Stony Brook Terminal Station
USL	Upper Salmon Plant
WAP	Western Avalon Passive Repeater
WAV	Western Avalon Terminal Station

Project Title: Upgrade Hydro Core IT Infrastructure

Location: Hydro Place

Category: General Properties - Information Systems

Type: Other

Classification: Normal

Project Description:

This project involves the replacement, addition, and upgrade of hardware components and software related to Hydro Energy Management System (EMS) server and storage infrastructure.

Based on the age of existing systems, each year an appropriate number of units will be refreshed. This ensures that Hydro has a reliable, secure infrastructure environment to support efficient operations.

The scope of this project includes the addition of two virtual server hosts, the replacement of four virtual server hosts, and the replacement of two enterprise storage units:

- One new virtual server host will be added to the Hydro system to increase capacity and reduce impacts during system maintenance activities;
- Three virtual server hosts in the Hydro Place EMS environment are at end of life and will be replaced with similar units;
- One virtual server host in the Backup Control Center environment is at end of life and will be replaced with a similar unit;
- One virtual server host and software licensing will be added to the Hydro Place Production environment to add capacity and reduce maintenance impacts related to additional workloads added to this environment since its original design;
- One enterprise storage unit in the Hydro Place environment will be replaced by a new unit with performance and capacity to support current and future workloads; and
- One enterprise storage unit in the Backup Control Center environment will be

replaced by a new unit with performance and capacity to support current and future workloads.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	236. 7	0. 0	0. 0	236. 7
Labour	48. 7	0. 0	0. 0	48. 7
Consultant	0. 0	0. 0	0. 0	0. 0
Contract Work	0. 0	0. 0	0. 0	0. 0
Other Direct Costs	0. 0	0. 0	0. 0	0. 0
Interest and Escalation	9. 9	0. 0	0. 0	9. 9
Contingency	57. 1	0. 0	0. 0	57. 1
TOTAL	**352. 4**	**0. 0**	**0. 0**	**352. 4**

Justification

The factors that are driving Hydro's proposal to upgrade servers in its environment include:

- Maintaining vendor support;
- Providing security/managing the infrastructure; and
- Supporting current versions of applications.

Maintaining vendor support – Without vendor support, the functions and services reliant on the core IT infrastructure are at risk as security and support patches for the operating system will no longer be available. As a result, Hydro's ability to support and ensure continuation of these functions and services is impeded. At this time, the vendor support and inventory of spare parts are discontinued and these servers are used by Hydro employees to provide support in running the business on a daily basis. Loss of availability of these servers would have a negative impact on employee productivity by not allowing access to software applications.

Providing security/managing the infrastructure – improved system management technologies improve the security of the servers and simplify server management including hardware remote access, system diagnostics, and automated alerting. Hardware and software, however, must to be maintained at modern and supported levels to take advantage of such benefits.

The storage systems provide critical functionality to the server systems used by Hydro employees to provide support in running the business on a daily basis. Loss of availability of these services would have a negative effect on employee productivity by not allowing access to software applications and the data housed within the storage system.

Supporting current versions of applications – As applications are upgraded and new applications are implemented, the underlying infrastructure must provide the required performance and capacity to run these systems and provide reliable operations to the business.

Existing System

This is an ongoing refresh program to maintain server performance. Hydro continues to seek efficiencies in system's management tools and reducing energy, space and cooling usage by virtualizing eligible systems upon the end of the physical server's service life.

There are both physical and virtual servers which support and run various applications for the organization. The applications that run on these servers include the Energy Management System and numerous other applications which comprise the Hydro operating environment. These applications are used by staff in running the business on a day-to-day basis and fall into one of four classification levels (0 to III) for the purpose of assigning a hardware replacement age, see Table 2.

Table 2: Hardware Replacement Age Criteria

Classification	Criteria	Age
Level 0	Critically important to business operations; hardware is known to have a longer general life expectancy; This classification requires additional measures for redundant components, application fault tolerance architectures, and signoff by system owners to extend the standard lifecycle timeframes accepting all associated risks in doing so.	8+ years
Level I	Critically important to business operations; access required on daily basis; outage/failure will have immediate negative impact on business and requires expedited problem resolution within 1 day or less.	5 years
Level II	Standard operating importance; used/accessed daily to weekly; outage would have less impact to business and requires immediate attention/resolution within 1 – 3 days.	6 years
Level III	Non-critical to business operations; accessed occasionally or performs automated procedures on a scheduled basis; outage would not impact business significantly unless not recovered after 3 days or more.	7 years

Operating Experience

This budget proposal is for routine replacement of hardware and software related to Hydro's core IT infrastructure.

Reliability Performance

Hydro's servers and storage are used on a continuous basis. The systems are active for the life of the unit once placed in service. Hydro's standard is to use enterprise grade hardware for energy management applications. Hydro has had reliability performance from this hardware as a result.

Industry Experience

Hydro must keep its servers current in order to adequately support and protect the Operational Technology Infrastructure required to operate its business. Failure to keep this infrastructure current will put Hydro at risk of unplanned outages, possible data loss and data corruption. The replacement, addition, and upgrading of hardware components to achieve this goal requires investment over the lifecycle of the infrastructure.

Vendor Recommendations

General industry practice is that servers be replaced on a five year lifecycle. Parts may not be available after five years for the servers, depending on the component that fails.

Maintenance or Support Arrangements

The IBM Software Support Lifecycle Policy applies to the software which powers Hydro's systems, including the enterprise server and storage subsystems, drivers, firmware, and management tools. A minimum of five full years of standard support from the date the product release was made generally available by IBM, with the option to purchase support extensions for an additional three years following a product's service end date for an extra charge set by IBM.

IBM warranty support for the servers is discontinued. Hydro has determined that the standard three year manufacturer warranty is not sufficient for its Intel Server Infrastructure and increases this warranty to five years at time of purchase. After the initial five year warranty, the server is placed on a maintenance program with IBM that is renewed quarterly until the server is replaced.

Development of Alternatives

The alternative to a server refresh program is to replace servers as they fail. This would put the infrastructure at risk of unplanned outages, possible data loss, and possible data corruption. This alternative would also cause a significant increase in maintenance costs as repairs would need to be completed and spare equipment would need to be kept on hand. This is not a viable alternative.

Conclusion

This is an ongoing refresh program to maintain system reliability and performance. Hydro continues to seek efficiencies in systems management tools and reducing energy, space, and cooling usage by virtualizing eligible systems upon the end of the asset service life. Future replacements and upgrades will be proposed in future budget applications.

Project Schedule

The project is scheduled to start in April 2018 and be completed by the end of July 2018 as set out in Table 3.

Table 3: Project Schedule

Activity		Start Date	End Date
Planning	Create/review work plan and schedules	April 2018	April 2018
Design	Generate detailed design and specification	April 2018	April 2018
Procurement	Tender for hardware; 20 day delivery time (avg)	April 2018	May 2018
Construction	Assembly, software installation, testing	May 2018	June 2018
Commissioning	Install assets, migrations, and documentation	June 2018	June 2018
Closeout	Decommissioning and project closeout	July 2018	July 2018

Project Title: Upgrade Energy Management System

Location: Hydro Place

Category: General Properties - Information Systems

Type: Other

Classification: Normal

Project Description

This project is required to upgrade the OSI Monarch Energy Management System (EMS) used by the Energy Control Centre (ECC) in St John's on a 24 hour basis to control and monitor the provincial transmission grid and generation facilities operated by Hydro.

The system software is upgraded on an annual basis to allow for the inclusion of fixes and functionality changes to the software. The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	40.1	0.0	0.0	40.1
Consultant	0.0	0.0	0.0	0.0
Contract Work	231.7	0.0	0.0	231.7
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	10.6	0.0	0.0	10.6
Contingency	54.4	0.0	0.0	54.4
TOTAL	**336.8**	**0.0**	**0.0**	**336.8**

Justification:

This project is a normal continuation of annual upgrades to ensure proper functionality. The EMS is essential to the continued efficient and reliable operation of the provincial transmission grid and generation facilities operated by Hydro. The EMS provides a critical function for Hydro and the operation of the Island Interconnected System. Without a properly functioning EMS, remote control of any system would be impossible and therefore all major stations would have to be staffed.

Existing System

The existing system was installed in 2006 and the software has been upgraded on an annual basis.

The EMS system is used by the Energy Control Centre (ECC) in St John's on a 24 hour basis to control and monitor the provincial transmission grid and generation facilities operated by Hydro.

Table 2 outlines the upgrades that have occurred over the past five years.

Table 2: Major Work or Upgrades

Year	Major Work/Upgrade	Comments
2016	Software Upgrade	Elimination of software bugs and increased functionality of software
2015	Software Upgrade	Elimination of software bugs and increased functionality of software
2014	Software upgrade and Server Upgrade	Replaced servers and upgraded software for elimination of software Bugs and increased functionality of software
2013	Software Upgrade	Elimination of software bugs and increased functionality of software
2012	Software Upgrade	Elimination of software bugs and increased functionality of software

Operating Experience:

The EMS was purchased from Open Systems International in June 2006 and has been in continuous operation since commissioning. The software had been upgraded on an annual basis from 2007 to 2017 to remove any software bugs and to take advantage of any functionality that would benefit the operation of the power system.

<u>Industry Experience</u>

Hydro must keep the software it uses to control and monitor the provincial transmission grid and generation facilities up to date. Failure to keep this software current will put Hydro at risk of unplanned computer system outages that would affect the control and monitoring of the transmission grid and generation facilities. Other utilities use this approach.

Vendor Recommendations

The vendor recommends that the software be upgraded on an annual basis to allow known software bugs to be eliminated and to receive functionality improvements made to the software.

Maintenance or Support Arrangements

The software is on maintenance support, which allows for the following from Open Systems International:

- Dedicated support staff for handling incoming support calls;
- After hours on-call support service;
- 24/7 support coverage;
- Web-based Customer Support portal;
- Fast response for critical support requests; and
- Comprehensive database tracking and reporting on support requests.

Historical Information

Table 3 provides information from previous capital budget applications.

Table 3: Historical Information

Year	Capital Budget ($000)	Actual Expenditures ($000)
2017B	427.0	
2016	246.2	256.5
2015	194.4	185.1
2014	187.9	184.3
2013	129.9	133.7

Conclusion:

This project is necessary as to allow Hydro to control and monitor the provincial transmission grid and generation facilities operated by Hydro. This project is performed on an annual basis to eliminate software bugs and increase the functionality of the software.

Project Schedule:

This project will start in April 2018 and be completed by the end of September 2018.

Project Title: Replace Peripheral Infrastructure

Location: Various

Category: General Properties - Information Systems

Type: Other

Classification: Normal

Project Description:

The Peripheral Infrastructure Replacement Project is an ongoing program to replace the printers, copiers, fax machines, and video conference equipment used in the day-to-day operation of the business. For 2018, this project will consist of the replacement of 72 Multi-Function Devices (MFDs) used for printing, copying, faxing and scanning, including 12 devices with support for large format printing. There are 13 units to be replaced at Holyrood, nine at Bishops Falls, two at Deer Lake, six at Bay d'Espoir, ten at Happy Valley Goose Bay, two at Port Saunders, one at Stephenville, and one at Wabush, as well as 29 printing devices in terminal stations and diesel plants. In addition, this budget includes funds for the replacement of 22 video projectors.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	173.1	0.0	0.0	173.1
Labour	35.7	0.0	0.0	35.7
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	7.8	0.0	0.0	7.8
Contingency	41.8	0.0	0.0	41.8
TOTAL	**258.4**	**0.0**	**0.0**	**258.4**

Justification:

This is the continuation of the Peripheral Infrastructure Replacement Project to replace peripheral devices as they reach the end of their useful lives. The units scheduled for replacement in 2018 have all been in service for five years or more and maintenance contracts and warranties have expired. While the manufacturer will provide extended maintenance (at an increased cost) they will not guarantee the performance of these devices after five years. In this case Hydro would have to incur an unbudgeted capital expense in order to replace the device and it could take several weeks before the unit is replaced. Smaller area offices have a single MFD and would have no services during this time.

Hydro must keep its peripheral infrastructure current in order to adequately support the needs of its business. This project makes it possible for such equipment to be replaced in a planned and consistent manner. This allows for even distribution of expenditures and ensures that these peripherals are available and reliable to support the user's needs. Continued review of the products' lifecycle allows Hydro to adjust plans based on performance, technology changes, and new business requirements.

Existing System

Table 2 presents a list of peripheral devices in service at different Hydro sites.

Table 2: Peripheral Devices in Service

Office Location	Number of Printers	Number of Employees	Buildings Per Location
Bay d'Espoir	16	93	4
Happy Valley Goose Bay	3	50	2
St. Anthony	4	22	2
Stephenville	2	20	2
Deer Lake	3	6	1
Wabush	1	10	2
Whitbourne	1	26	2
Bishop's Falls	10	89	3
Holyrood	32	111	4
Port Saunders	4	20	1
Springdale	2	08	1

Age of Equipment or System

The units scheduled for replacement have been in service for over five years.

The decision to replace a printer or MFD is based on many criteria, including:

- Vendor's product roadmap (new features like secure print and scanning will not be supported on older equipment);
- Users' printing requirements (color need, print volumes and speed);
- Number of users supported by the equipment;
- Availability of alternate printing;
- Available support for the equipment; and
- Age of equipment.

Availability of Replacement Parts

Replacement parts are readily available for the duration of the maintenance agreements and warranties. Once these agreements and warranties have expired replacement parts may or may not be available.

Operating Experience:

Status Quo

If the peripheral infrastructure is not kept current, there is a risk of increase in failure rates and lack of maintenance agreements offered by vendor.

Alternatives

The only alternative is to consider leasing the equipment. The lease versus buy decision will be evaluated during the tendering process.

Industry Experience

Industry best practices indicate that the typical service life for a peripheral device is four to five years. Hydro has a life cycle plan for peripheral devices similar to that of other companies in the utility industry.

Maintenance or Support Arrangements

Hydro has purchased a maintenance agreement with a supplier (Xerox) that covers the larger multi-function devices for five years. This agreement was established through public tendering. Smaller laser printers have a manufacturer's warranty of one to three years duration.

Vendor Recommendations

The vendor (Xerox) recommends a maximum lifespan of five years for these devices. Other major vendors have not stated their recommended lifespan.

Historical Information

Table 3 contains a five-year history as well as the 2017 budget for the Peripheral Infrastructure Replacement Project.

Table 3: Historical Information

Year	Capital Budget ($000)	Actual Expenditures ($000)	Units	Cost per Unit[1] ($000)
2016	611.1	569.4	65	8.7
2015	200.5	201.7	43	4.6
2014	200.7	220.4	54	4.1
2013	309.9	298.6	41	7.3
2012	327.5	328.5	45	7.3

Anticipated Useful Life

According to Gartner[2], the useful life for a color printer is three years while a black and

[1] The variability in unit costs are due to specifications of the printers being replaced such as pages per minute, memory, fax and scanning capability.

[2] Gartner Inc. provides research and analysis on the global Information Technology industry. They assist companies in making informed technology and business decisions by providing in-depth analysis and advice on virtually all aspects of technology.

white printer is between three and five years. The average age of Hydro’s printers is five to seven years.

Evaluation of Alternatives:

There is no viable alternative to the planned replacement of peripheral infrastructure.

Conclusion:

The ongoing program involves a coordinated effort to keep Hydro's peripheral infrastructure in good working order and use current technologies while delivering a cost effective solution to the end-user.

Project Schedule:

The project is scheduled to start in January 2018 and be completed before December 31, 2018.

E. Projects over $50,000 but Less Than $200,000

PROJECT DESCRIPTION	Expended to 2017	2018	Future Years	Total	Definition	Classification	Page Ref
GENERATION							
Install Fire Detection in Outbuildings - Holyrood		198.6		198.6	Other	Nomal	E-2
TOTAL GENERATION	0.0	198.6	0.0	198.6			
TRANSMISSION AND RURAL OPERATIONS							
Purchase Meters and Metering Equipment - Various		198.5		198.5	Other	Nomal	E-5
Replace Front End Loader Unit No. 9628 - Bay d'Espoir		170.2		170.2	Other	Nomal	E-7
Purchase Tools and Equipment less than $50,000 - Labrador		146.4		146.4	Other	Nomal	
Purchase Tools and Equipment less than $50,000 - Northern		93.9		93.9	Other	Nomal	
TOTAL TRANSMISSION AND RURAL OPERATIONS	0.0	609.0	0.0	609.0			
GENERAL PROPERTIES							
Replace Network Communications Equipment - Various		199.5		199.5	Other	Nomal	E-10
Remove Safety Hazards - Various		199.4		199.4	Other	Nomal	E-12
Upgrade RTUs - Various		118.3		118.3	Other	Nomal	E-16
Upgrade Software Applications - Hydro Place		114.7		114.7	Other	Nomal	E-19
Replace Air Conditioners - Various		74.4		74.4	Other	Nomal	E-21
Refresh Security Software - Hydro Place		62.2		62.2	Other	Nomal	E-23
TOTAL GENERAL PROPERTIES	0.0	768.5	0.0	768.5			
TOTAL PROJECTS OVER $50,000 AND UNDER $200,000	0.0	1,576.1	0.0	1,576.1			

Project Title: Install Fire Detection in Outbuildings

Location: Holyrood Thermal Generating Station

Category: Generation - Thermal

Definition: Other

Classification: Normal

Project Description:

The scope of this proposed project is the installation of fire detection systems in the Training Center/Storage Building, Storage Building A, and Storage Building B (Outbuildings) that are located on the Holyrood Thermal Generating Station (Holyrood) site. These fire detection systems will be tied into the site's main warehouse building fire detection panel, and through existing cabling from the main warehouse's fire detection panel to the thermal generating station's fire detection panel.

A contractor will be engaged to design, supply, install, and test the outbuildings' fire detection systems and connections to the Main Warehouse and Thermal Generating Station fire detection panels.

The budget estimate for this project is shown in Table 1.

Table 1: Budget estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	5.0	0.0	0.0	5.0
Labour	71.0	0.0	0.0	71.0
Consultant	18.8	0.0	0.0	18.8
Contract Work	60.0	0.0	0.0	60.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	12.8	0.0	0.0	12.8
Contingency	31.0	0.0	0.0	31.0
TOTAL	**198.6**	**0.0**	**0.0**	**198.6**

Operating Experience:

In the Holyrood outbuildings, Hydro has stores, critical spare equipment, and parts that allow for a prompt response to equipment failures in both the Holyrood Thermal Generating Station and the Holyrood Combustion Turbine Station in order to maintain reliable operation of this infrastructure. Some of these spares have long lead procurement times.

The training section of the Training /Storage Building is unoccupied after normal work hours and the storage section of the Training /Storage Building and all of Storage Building A and Storage Building B are normally unoccupied. While these buildings are equipped with sprinkler systems, none of the buildings have remotely monitored fire detection systems. If a fire occurred, it could progress undetected, or once the sprinkler system was activated water damage could continue until the system was de-activated.

For a number of other buildings on site which have remotely monitored fire detection systems, personnel in the Holyrood Thermal Generating Station Control Room, which is staffed continuously, will initiate the emergency response upon indication of trouble from the fire detection system panel in the Control Room.

The outbuildings will continue to function as warehouses, storing critical spares, after the Muskrat Falls Generating Station is in service to support synchronous mode operation of Unit 3 and the continued operation of the Holyrood Combustion Turbine.

Project Justification:

Installation of outbuildings' fire detection systems, remotely monitored by thermal generating station control room personnel, will allow earlier response times to fires, or operation of the sprinkler systems, and minimize damage to critical spare equipment.

Conclusion

The outbuildings store critical spares for the Holyrood Thermal Generation Station and the

Holyrood Combustion Turbine Plant, but are not equipped with remotely monitored fire detection systems. Installing remotely monitored fire detection systems in these buildings enables earlier response to fires and sprinkler system operations to minimize damage to these buildings and critical spare equipment in the event of a fire.

Project Schedule:

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Kickoff meeting, safety plan, communication plan, open project in JDE, complete WBS	January 2018	February 2018
Procurement	Prepare Technical Conditions for Tender, develop contract documents and issue for tender, award tender	February 2018	March 2018
Design	Site visit with consultant, detailed requirements for replacements, procurement.	April 2018	May 2018
Construction	Site Work Assessment / Site Safety Tour, On site orientation, installation/tie-in of new fire alarms to the main fire alarm panel in the power house control room.	August 2018	September 2018
Commissioning	Commissioning of new fire alarm by certified technician.	October 2018	October 2018
Closeout	Asset Assignment Forms, PIR Form, Lessons Learned Meeting, Contract Close Out Certificate	November 2018	December 2018

Project Title: Purchase Meters and Metering Equipment

Location: Various

Category: Transmission and Rural Operations - Metering

Definition: Other

Classification: Normal

Project Description:

This project consists of purchasing 112 demand meters, 63 terminal station meters, and other associated equipment for use in revenue metering, which require replacement each year due to government retest, technology changes, or obsolescence.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2017**	**2018**	**Beyond**	**Total**
Material Supply	100.0	0.0	0.0	100.0
Labour	55.0	0.0	0.0	55.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	12.5	0.0	0.0	12.5
Contingency	31.0	0.0	0.0	31.0
TOTAL	**198.5**	**0.0**	**0.0**	**198.5**

Operating Experience:

Hydro's electromechanical revenue meters have reached or surpassed their life expectancy of 25 years. They are obsolete and can no longer be purchased. Electromechanical meters can still be recertified and sealed; however, Measurement Canada has shortened its seal period from six years to four years due to accuracy concerns. Purchasing new electronic meters to replace these obsolete meters will improve metering accuracy and reliability.

Project Justification:

Revenue meters are required to be purchased each year so that meters are available for new service applications and for replacement due to government retest, damaged meters, technology changes, and obsolescence. Under the Electricity & Gas Inspection Act and Regulations, Hydro is mandated by Measurement Canada to ensure that in-service meters are accurate and in good working condition. Furthermore, revenue meters must be certified and sealed and the requirement states that these meters are to be removed from service before the expiry date. Failure to replace meters that are due to be replaced may result in monetary penalties as per the new requirements under the *Electricity & Gas Inspection Act* and *Regulations*.

It is more economical to purchase new electronic meters then it is to certify and seal electromechanical meters because the capital and operating costs of new electronic meters is less than the cost of re-sealing electromechanical meters. As well, it is more efficient, accurate, and cost effective to certify and seal electronic meters.

Project Schedule:

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Prepare Orders	January 2018	January 2018
Design	Prepare Drawings	January 2018	February 2018
Procurement	Order Meters and Equipment	January 2018	April 2018
Construction	Install Meters and Equipment	May 2018	October 2018
Commissioning	Verify Installations	May 2018	October 2018
Closeout	Closeout Projects	November 2018	December 2018

Project Title: Replace Front End Loader - Unit V9628

Location: Bay d'Espoir

Category: General Properties - Transportation

Definition: Other

Classification: Normal

Project Description:

The scope of this work is to replace asset V9628, a 13 year old front end loader located in Bay d'Espoir, with a similar sized unit.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	155.4	0.0	0.0	155.4
Labour	0.5	0.0	0.0	0.5
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	6.5	0.0	0.0	6.5
Contingency	7.8	0.0	0.0	7.8
TOTAL	**170.2**	**0.0**	**0.0**	**170.2**

Operating Experience:

This project provides for the replacement of the Front End Loader due to its unreliability. The unit has experienced several transmission failures and power train problems over the past five years. These costs are reflected in the five-year maintenance history shown in Table 2.

Table 2: Five-Year Maintenance History

Year	Preventive Maintenance ($000)	Corrective Maintenance ($000)	Total Maintenance ($000)
2016	1.8	12.7	14.5
2015	0.0	7.1	7.1
2014	2.7	7.0	9.7
2013	1.5	11.3	12.8
2012	1.1	10.8	11.9

A cost benefit analysis was performed to compare the rebuild of the unit with the cost of a purchasing a new unit. The analysis considered a study period of five years, 2018 to 2022.

Alternative 1:

Purchase a new unit with a more fuel efficient engine, lower emissions and more functional attachments. The capital cost of a new unit is $170,200. After five years, the resale value of the unit was considered at $145,000 as a benefit towards this alternative in the cost benefit analysis. The new unit is expected to have a useful life of 15 years.

Alternative 2:

Rebuild a thirteen year old unit that is at the end of its reliable service life. The estimated rebuild cost is $121,600. The rebuilt equipment is expected to last five years, at which time its salvage value is expected to be $30,000, and is applied as a benefit towards this alternative in the cost benefit analysis. A new unit will then have to be purchased.

Table 3 shows the results of the cost benefit analysis. It indicates that there is a positive net present worth of $34,530 in favor of purchasing a new unit.

Table 3: Cost Benefit Analysis

Replace Back Hoe Loader V9628		
Alternative Comparison ***Cumulative Net Present Value*** ***To The Year*** **2017**		
Alternatives	**Cumulative Net Present Value (CPW)**	**CPW Difference between Alternative and the Least Cost Alternative**
Purchase Unit	64,488	0
Rebuild Unit	99,017	34,530

Conclusion:

A cost benefit analysis has shown that is preferable to purchase a new loader than to rebuild the existing one that has reached the end of its life expectancy.

Project Schedule:

This project is scheduled to be completed by December 2018.

Project Title: Replace Network Communications Equipment

Location: Various

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

Hydro has five networking devices in its communications network that have been deemed End-of-Life (EoL) since 2013 and 20 devices that have been deemed EoL since 2015 by the vendor, Cisco Systems. The five devices deemed EoL in 2013 are Cisco 2950-24 Ethernet switches and the 20 deemed EoL in 2015 are Cisco 2950G-24-DC. Replacement of these switches will be with updated technology equivalents from the same vendor (Cisco Systems).

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	**2018**	**2019**	**Beyond**	**Total**
Material Supply	69.6	0.0	0.0	69.6
Labour	80.7	0.0	0.0	80.7
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	6.3	0.0	0.0	6.3
Interest and Escalation	11.6	0.0	0.0	11.6
Contingency	31.3	0.0	0.0	31.3
TOTAL	**199.5**	**0.0**	**0.0**	**199.5**

Operating Experience:

Cisco Systems networking devices have been proven to be reliable and secure when properly maintained and kept up to date. Cisco regularly releases software updates to address any identified deficiencies and security updates. These updates only continue until Cisco deems the devices EoL as per its product life cycle management.

Project Justification:

The networking devices are critical to daily operations for hundreds of users in the Hydro System that require corporate network access to e-mail, file server access, and basic internet connection. The 25 devices that are now considered EoL are no longer covered by Cisco's maintenance and support packages. Cisco also no longer releases software updates to address software deficiencies, or security updates, for these devices and devices not updated could leave Hydro's network susceptible to new security vulnerabilities.

Future Plans:

Hydro will continue to identify End-of-Life devices in its network and propose to replace them on a year to year basis, as required.

Project Schedule:

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Scope statement, resource and network outage schedule	January 2018	February 2018
Design	Network drawings and design packages, refine bill of materials	February 2018	March 2018
Procurement	Submit requisition for Cisco equipment (Standing offer)	March 2018	April 2018
Construction	Configure and install new equipment	April 2018	November 2018
Commissioning	Test network connectivity	May 2018	November 2018
Closeout	Update as-built drawing and close out project	November 2018	December 2018

Project Title: Remove Safety Hazards

Location: Various

Category: General Properties - Administrative

Definition: Other

Classification: Normal

Project Description:

This project is required to ensure adequate capital budget is available to quickly address safety hazards that should be addressed by a capital project, as they are identified through Hydro's Safe Work Observation Program (SWOP). SWOP involves identifying, reporting and addressing hazardous conditions that can potentially lead to an incident. The budget estimate for the project is shown in Table 1.

Table 1: Project Cost

Project Cost: ***($ x1,000)***	**2018**	**2019**	**Beyond**	**Total**
Material Supply	46.0	0.0	0.0	46.0
Labour	90.0	0.0	0.0	90.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	45.0	0.0	0.0	45.0
Other Direct Costs	6.7	0.0	0.0	6.7
Interest and Escalation	11.7	0.0	0.0	11.7
Contingency	0.0	0.0	0.0	0.0
TOTAL	**199.4**	**0.0**	**0.0**	**199.4**

Existing Systems:

In Hydro's 2016 Capital Budget Application, the Board approved a budget of $198,600 to remove safety hazards in the workplace. Table 2 lists the work completed in 2016, which totaled $175,400.

Table 2: Work Completed in 2016

Location	Work Description	Cost ($000)
Holyrood	Install chemical shower and eye wash station water heater	$93.0
Holyrood	Unit 3 – upgrade continuous blowdown throttling valve	$57.1
Holyrood	Unit 3 – upgrade main steam valve above seat drain valves	$25.3
TOTAL:		**$175.4**

Process for Selecting Eligible Work:

Safety hazards are identified through Hydro's SWOP by employees, contractors, and others who access Hydro facilities. Often mitigation of the safety hazard can be accomplished through an operating or procedural change, for example, a communication, or corrective work, which is an operating expense. When it is determined that the appropriate mitigation measure requires a capital expenditure, a cost estimate is prepared and submitted to the Project Execution Department of Hydro's Engineering Services Division for consideration under the Remove Safety Hazards Project. These requests are reviewed and, if warranted, approved to proceed by the Manager of Project Execution under this project.

Historical Information:

Table 3 shows the budget and actual expenditures for years 2013 – 2017(Budget) for the Remove Safety Hazards Project.

Table 3: Capital Expenditure History

Year	Capital Budget ($000)	Actual Expenditures ($000)
2017B	198.6	
2016	199.3	175.4
2015	194.9	176.9
2014	257.8	207.6
2013	250.5	67.0

Some variability in actual expenditures is expected from year to year since the number of hazards identified and nature of the required mitigation work is unknown.

Project Justification:

This project is justified based on Hydro's requirement to provide a safe work environment for its employees in compliance with the Occupational Health and Safety Regulations, Section 14 which states:

> *14. (1) An employer shall ensure, so far as is reasonably practicable, that all buildings, structures, whether permanent or temporary, excavation, machinery, workstations, places of employment and equipment are capable of withstanding the stresses likely to be imposed upon them and of safely performing the functions for which they are used or intended.*
>
> *(2) An employer shall ensure that necessary protective clothing and devices are used for the health and safety of his or her workers.*

To prevent injury and/or fatality, Hydro has a Safe Work Observation Program (SWOP). The SWOP involves workers actively looking for safety hazards that may otherwise go unnoticed, which could lead to health and/or safety issues for Hydro customers, employees, contractors, and the general public. This project provides Hydro with the budget to address unsafe conditions where capital work is identified as the solution and enables Hydro to respond quickly to address unsafe conditions rather than waiting for the normal capital budget timelines. These hazardous conditions, as reported under the SWOP, need to be expeditiously corrected to provide a safe work environment.

Future Plans:

Hydro intends to propose a Remove Safety Hazards Project in each subsequent annual capital budget application. Also see five-year capital plan (2018 Capital Plan Tab of this capital Budget Application, Appendix A).

Project Schedule:

As this budget relates to unanticipated safety hazards and mitigation, no schedule is currently available.

Project Title: Upgrade Remote Terminal Units

Location: Various

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

A critical component of the Hydro's Supervisory Control and Data Acquisition (SCADA) network is the GE Multilin D20-based remote terminal unit (RTU). It can be found in substations, generating stations, or any part of the network from which data must be collected and sent back to the Energy Control Centre (ECC) for monitoring of the Hydro system, and to allow the ECC to send signals to stations to control the electrical system. Hydro has used the D20 RTU since the early 1990s and has an installed base of 75 units throughout the Province.

In order to minimize the probability of an outage attributable to the RTU, it is proposed that the processor modules in three older RTUs be replaced with the latest model of the D20 processor. The original D20 RTU processor card, the D20M++, has been discontinued by the manufacturer and cannot be repaired. Replacement with new D20MX processors will maintain reliability and provide increased functionality with the advanced communications features, such as Ethernet, built into the newer processors. Due to operational risks associated with the failure of any portion of the SCADA network, this project is a proactive approach to ensuring that the likelihood of in-service failure of the oldest D20 modules is minimized.

This project will be completed using Hydro personnel. All changes will be fully tested in a lab environment before deployment to the field due to the critical role that the RTU plays in the monitoring and control of the network.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	31.4	0.0	0.0	31.4
Labour	53.9	0.0	0.0	53.9
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	7.0	0.0	0.0	7.0
Interest and Escalation	7.5	0.0	0.0	7.5
Contingency	18.5	0.0	0.0	18.5
TOTAL	**118.3**	**0.0**	**0.0**	**118.3**

Operating Experience:

The GE D20 RTU processors have proven to be very reliable for Hydro. This, combined with regular attention to maintenance, has helped to minimize complete SCADA outages attributable to the D20M++ processor. The last failure, in July of 2014, required that a spare be used to complete repairs as GE indicated that they can no longer repair defective modules. Table 2 shows the existing D20 processor units in service.

Table 2: D20 Installed Base

GE Multilin D20 Processor Model	Installed Base
D20M++ (1990s)	22
D20ME (2000s)	48
D20MX (2013+)	5
Total	75

Project Justification:

The D20 RTU processor card, the D20M++, has been discontinued by the manufacturer since the late 1990s. Due to the unavailability of electronics components for the D20M++, the manufacturer will no longer accept defective modules for repair. As a result, the Hydro spares inventory has been depleted. A failure of the D20M++ processor will lead to a forced and unscheduled upgrade of the D20 RTU, which would lead to extended periods during which ECC would have no monitoring or control ability of the affected station(s), which could lead to extended customer outages.

Future Plans:

Upgrades will continue to be proposed in future capital budget applications. It is anticipated that RTU upgrades will be completed over the period from 2018 to 2020.

Project Schedule:

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity		Start Date	End Date
Planning	Prepare Project Plan and site visits	January 2018	February 2018
Design	Complete Tender Package	February 2018	March 2018
Procurement	Purchase Upgrade Kits	April 2018	April 2018
Construction	Install Upgrade Kits	May 2018	September 2018
Commissioning	Site Inspections	October 2018	October 2018
Closeout	Project Closeout	November 2018	December 2018

Project Title: Upgrade Software Applications

Location: Hydro Place

Category: General Properties - Information Systems

Definition: Other

Classification: Normal

Project Description:

This project is to upgrade software applications:

- PI database software used by the Energy Management System for reporting and historic operating data information;
- Lightening tracking software used by System Operations to track lightning storms for system reliability; and
- Work Protection software across Hydro for isolation of equipment for work permits.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	30.0	0.0	0.0	30.0
Labour	21.9	0.0	0.0	21.9
Consultant	40.0	0.0	0.0	40.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	4.4	0.0	0.0	4.4
Contingency	18.4	0.0	0.0	18.4
TOTAL	**114.7**	**0.0**	**0.0**	**114.7**

Operating Experience:

Hydro reviews its software application portfolio on an annual basis and uses two main criteria to determine if an upgrade is warranted. First, the status of vendor support for the applications is reviewed and, if unsupported, then the software is upgraded. Second, software functionality is reviewed in the context of providing business value either through improved functionality or improvements in service. The corporate applications and supporting systems enable Hydro to operate more efficiently.

Project Justification:

The upgrades are made to continue reliable operations of the software that is used in the running of the electrical system and to maintain customer service systems. By keeping software in a supported state, vendor notification is received of any software bugs and associated available fixes. In addition, newer releases can increase functionality of the software and can increase efficiency.

Future Plans:

All software will be reviewed on an annual basis and upgrades to the software will be put forward in future capital budget applications.

Project Schedule:

The project is scheduled to start in January 2018 and be completed by December 2018.

Project Title: Replace Air Conditioning Unit

Location: Buchans Terminal Station

Category: General Properties - Telecontrol

Definition: Other

Classification: Normal

Project Description:

The scope of this proposed project is to replace the air conditioning unit at the Buchans Terminal Station. The Buchan's Terminal Station is approximately 110 km southwest of Grand Falls, Newfoundland.

As per Board Order No. P.U. 33(2015), Hydro has established a program to install air conditioning units at all of its terminal stations and microwave sites. This project is a continuation of that program.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	1.0	0.0	0.0	1.0
Labour	25.5	0.0	0.0	25.5
Consultant	7.5	0.0	0.0	7.5
Contract Work	21.0	0.0	0.0	21.0
Other Direct Costs	3.6	0.0	0.0	3.6
Interest and Escalation	4.1	0.0	0.0	4.1
Contingency	11.7	0.0	0.0	11.7
TOTAL	**74.4**	**0.0**	**0.0**	**74.4**

Operating Experience:

The air conditioning unit service provider advised Hydro that air conditioning units have a service life of 20 years and have recommended that any units older than that age should be replaced to ensure proper operation and availability of parts. The air conditioning unit at the

Buchans Terminal Station is 20 years old and the service provider, based on visual inspection of the unit, has recommended its replacement.

Project Justification:

Proper air conditioning is essential for the reliable operation of communications equipment because it ensures that the equipment does not overheat. Air conditioning units should be replaced before a permanent failure occurs. A "run to failure" approach is not acceptable due the possibility of interruption of communication services and the possible loss of remote control of the electrical system at the Buchans Terminal Station.

Project Schedule:

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity		Start Date	End Date
Planning	Open project in JDE, WBS, Design transmittal, scope and budget review.	January 2018	January 2018
Procurement	Based on current sizing and design, procure contractor for supply and install at Buchan's.	February 2018	March 2018
Construction	Contractor to remove existing unit and supply and install the new unit at Buchan's	August 2018	August 2018
Commissioning	Commission unit.	August 2018	August 2018
Closeout	Post implementation review, lessons learned	September 2018	September 2018

Project Title: Refresh Security Software

Location: Hydro Place

Category: General Properties - Information Systems

Definition: Other

Classification: Normal

Project Description:

This project will refresh Hydro's Information Security and Cyber Safety tools and improve Hydro's cyber threat detection and mitigation capabilities.

The budget estimate for this project is shown in Table 1.

Table 1: Budget Estimate

Project Cost: *($ x1,000)*	2018	2019	Beyond	Total
Material Supply	23.5	0.0	0.0	23.5
Labour	14.0	0.0	0.0	14.0
Consultant	12.4	0.0	0.0	12.4
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	0.0	0.0	0.0
Interest and Escalation	2.3	0.0	0.0	2.3
Contingency	10.0	0.0	0.0	10.0
TOTAL	**62.2**	**0.0**	**0.0**	**62.2**

Operating Experience:

Hydro uses and maintains security software tools and hardware to mitigate threats to computers systems and networks. The security software tools are used by Information System Security staff and Information System Support staff on a daily basis. While Hydro has been successful in protecting its Information Technology assets from malicious threats, continual updates and improvements are necessary to protect against the global growth and increasing sophistication of cyber threats and the cybercriminal industry.

Project Justification:

Hydro's increasing reliance on information systems and expanding data networks increases exposure to information security threats to its critical infrastructure. Major risk exposures in this environment relate to information security (e.g. loss of critical infrastructure stability and processing capability due to hardware/software failure or threat of virus attacks), availability of information (e.g. loss of communication across the wide area network) and risk of corporate data loss (e.g. loss of data through cybercriminal malware and attacks).

External threats to Hydro's computer systems are mitigated through the use of firewalls, anti-virus tools and detection/intrusion prevention appliances. Internet access is tightly controlled and managed by security appliances and software that help reduce the risk of potential computer viruses. A serious incident involving access to critical business, plant or energy control systems, or the loss of corporate data, could negatively affect the provinces power grid, and would result in unplanned costs to contain, investigate and remediate the incident. Additional investments to change systems and/or processes after such an incident might also be required.

Future Plans:

Hydro's computer systems and network infrastructure require constant protection from cyber threats. This is accomplished through continuous evaluation and maintenance of Information System security tools and services.

Project Schedule:

This project will begin January 2018 and be completed by December 2018.

F. Leasing Costs

2018 Leasing Costs

THERE ARE NO ITEMS FOR THIS SECTION

G. Capital Expenditures 2013 -2022

	ACTUALS				BUDGET					
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GENERATION	43,000	122,571	54,189	64,260	25,844	58,856.7	45,086.8	40,332.2	33,585.4	32,746.3
TRANSMISSION AND RURAL OPERATIONS	35,820	75,771	62,202	130,612	236,079	139,701.1	91,642.6	117,233.4	99,775.5	108,524.9
GENERAL PROPERTIES	5,935	6,386	8,729	9,069	9,342	7,614.8	9,927.9	7,462.4	9,984.8	6,380.9
TOTAL CAPITAL EXPENDITURES	84,755	204,728	125,119	203,941	271,266	206,173	146,657	165,028	143,346	147,652

H. Status Report

Total Capital Project Variance
2017 Overview
($000)

Asset Type	Board Approved Budget	Total Project Expenditures and Forecast	Variance
HYDRAULIC	36,468	35,822	(646)
THERMAL	14,274	15,165	891
GAS TURBINES	2,807	2,807	0
TERMINAL STATIONS	107,460	107,568	108
TRANSMISSION	327,299	327,299	0
DISTRIBUTION	16,726	16,726	0
RURAL GENERATION	25,824	25,502	(322)
PROPERTIES	7,666	7,666	0
METERING	3,333	3,349	16
RURAL SYSTEMS TOOLS AND EQUIPMENT	1,139	1,049	(90)
INFORMATION SYSTEMS	3,264	3,264	0
TELECONTROL	6,649	6,649	0
TRANSPORTATION	4,933	4,933	0
ADMINISTRATIVE	1,470	1,470	0
ALLOWANCE FOR UNFORESEEN	1,500	1,500	0
SUPPLEMENTAL PROJECTS	367,377	50,962	(316,415)
PROJECTS APPROVED FOR LESS THAN $50,000	337	337	0
TOTAL CAPITAL BUDGET	**928,526**	**612,068**	**(316,458)**

2017 Capital Expenditures By Year
($000)

Summary	Capital Budget[1]									
	A					B	C	D (B+C)	E	F (A+C+E)
	2012	2013	2014	2015	2016	Carryover 2017	Original 2017	Revised 2017	2018 and Beyond	Total
2017 Projects							85,252.0	85,252.0	49,296.1	134,548.1
2016 Projects					40,698.9	9,556.0	64,281.4	73,837.4	56,668.9	161,649.2
2015 Projects				1,872.4	2,293.3	1,118.2	245.1	1,363.3	-	4,410.8
2014 Projects			37,964.6	167,846.5	205,566.0	27,270.5	150,797.3	178,067.8	62,075.0	624,249.4
2013 Projects		593.2	552.8	538.4	1,511.7	311.0	471.9	782.9	-	3,668.0
Grand Total	-	593.2	38,517.4	170,257.3	250,069.9	38,255.7	301,047.7	339,303.4	168,040.0	928,525.5

Summary	Actual Expenditure and Forecast									
	G					H	I	J	K (G+H+I+J)	K-F
	2012	2013	2014	2015	2016	YTD 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance
2017 Projects						21,090.0	65,069.3	49,296.1	135,455.4	907.3
2016 Projects					29,674.5	22,287.1	45,218.7	63,173.3	160,353.6	(1,295.6)
2015 Projects				1,559.9	1,586.6	480.4	1,129.6	-	4,756.5	345.7
2014 Projects			11,315.3	2,732.2	60,601.1	103,106.2	112,661.0	17,418.3	307,834.1	(316,415.3)
2013 Projects	9.6	230.7	699.0	755.5	1,190.3	192.8	590.1	-	3,668.0	(0.0)
Grand Total	9.6	230.7	12,014.3	5,047.6	93,052.5	147,156.5	224,668.7	129,887.7	612,067.6	(316,457.9)

2017 Capital Budget Approved by Board Order No. P.U. 45 (2016)	271,265.6
New Project Approved by Board Order No. 20 (2016)	1,533.0
New Project Approved by Board Order No. 5 (2017)	3,045.0
New Project Approved by Board Order No. 7 (2017)	2,731.5
New Project Approved by Board Order No. 10 (2017)	1,349.2
New Project Approved by Board Order No. 11 (2017)	2,585.2
New Project Approved by Board Order No. 13 (2017)	11,425.2
New Project Approved by Board Order No. 20 (2017)	2,610.0
New Project Approved by Board Order No. 21 (2017)	3,714.8
New Project Approved by Board Order No. 15 (2017)	500.0
2016 New Projects under $50,000 Approved by Hydro	288.2
Total Approved Capital Budget Before Carryovers	301,047.7
Carryover Projects 2016 to 2017	38,255.70
TOTAL APPROVED CAPITAL BUDGET	339,303.4

[1] Annual budgets previous to 2017 pertain to projects that have expenditures in 2017.

[2] The construction of the Labrador West Transmission was approved by OC2014-033, February 2, 2014. The capital expenditures associated with this project are included in Work In Progress and as a result are currently excluded from average rate base. The costs to be included in rate base will be subject to review by the Board of Commissioners of Public Utilities.

2017 Capital Expenditures By Category
($000)

Hydraulic Generation Projects	Capital Budget								Actual Expenditure and Forecast								
	A			B	C	D (B+C)	E	F (A+C+E)	G			H	I	J	K (G+H+I)	K-F	
	2014	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2014	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects																	
Install Asset Health Monitoring System - Upper Salmon	-	-	-	-	438.0	438.0	203.4	641.4	-	-	-	120.5	317.5	203.4	641.4	-	
Refurbish Main Generator Breaker - Upper Salmon	-	-	-	-	271.1	271.1	-	271.1	-	-	-	20.1	251.0	-	271.1	-	
Water System Replacements - Bay d'Espoir and Cat Arm	-	-	-	-	265.5	265.5	2,288.3	2,553.8	-	-	-	21.0	244.5	2,288.3	2,553.8	-	
Refurbish Powerhouse Station Services - Bay d'Espoir	-	-	-	-	413.2	413.2	3,933.9	4,347.1	-	-	-	30.4	382.8	3,933.9	4,347.1	-	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	-	-	-	-	119.2	119.2	3,227.8	3,347.0	-	-	-	17.4	101.8	3,227.8	3,347.0	-	
Upgrade Ventilation in Powerhouse 1 and 2 - Bay d'Espoir	-	-	-	-	134.1	134.1	863.8	997.9	-	-	-	14.2	119.9	863.8	997.9	-	
Upgrade Public Safety Around Dams and Waterways - Bay d'Espoir	-	-	-	-	489.0	489.0	-	489.0	-	-	-	129.9	359.1	-	489.0	-	
Purchase Capital Spares - Hydraulic	-	-	-	-	487.4	487.4	-	487.4	-	-	-	5.2	482.2	-	487.4	-	
Replace Slip Rings Units 1-6 - Bay d'Espoir	-	-	-	-	312.6	312.6	159.7	472.3	-	-	-	38.5	274.1	159.7	472.3	-	
Refubish Sump Level System for Powerhouse 2 - Bay d'Espoir	-	-	-	-	38.7	38.7	264.5	303.2	-	-	-	2.3	36.4	264.5	303.2	-	
Install Wind Monitoring Station North Salmon Dam SD-2 - Bay d'Espoir	-	-	-	-	165.5	165.5	-	165.5	-	-	-	14.0	151.5	-	165.5	-	
Replace Floor Annunciator Panels - Bay d'Espoir	-	-	-	-	46.8	46.8	-	46.8	-	-	-	37.0	9.8	-	46.8	-	
Control Structure Refurbishments	-	-	-	-	1,735.3	1,735.3	452.9	2,188.2	-	-	-	379.8	1,355.5	452.9	2,188.2	-	
Overhaul Turbine/Generators - Cat Arm	-	-	-	-	305.4	305.4	-	305.4	-	-	-	93.9	211.5	-	305.4	-	
Purchase Tools and Equipment Less than $ 50,000	-	-	-	-	113.4	113.4	-	113.4	-	-	-	26.2	87.2	-	113.4	-	
2016 Projects																	
Install Hydrometeorological Equipment - Various Sites	-	-	314.1	309.8	0.0	309.8	-	314.1	-	-	4.3	10.1	299.7	-	314.1	-	
Replace Control Room/Communications Room Air Conditioning - Hinds Lake	-	-	41.3	10.3	53.0	63.3	-	94.3	-	-	31.0	60.5	2.8	-	94.3	-	
Refurbish Station Water System - Upper Salmon	-	-	96.6	58.3	197.6	255.9	-	294.2	-	-	38.3	80.7	175.2	-	294.2	-	
Upgrade Work - Cat Arm	-	-	558.3	317.9	1,353.0	1,670.9	-	1,911.3	-	-	240.4	232.4	1,438.5	-	1,911.3	-	
Rehabilitate Shoreline Protection - Cat Arm	-	-	112.2	7.5	1,030.7	1,038.2	-	1,142.9	-	-	104.7	33.8	1,004.4	-	1,142.9	-	
Replace Site Facilities - Bay d'Espoir	-	-	928.3	657.9	4,736.3	5,394.2	6,316.7	11,981.3	-	-	270.4	317.9	5,076.3	6,316.7	11,981.3	-	
Replace PH1 Station Service Transformer - Bay d'Espoir	-	-	46.7	1.7	354.5	356.2	-	401.2	-	-	45.0	54.9	301.3	-	401.2	-	
Replace Spherical By-Pass Valves Units 1 and 2 - Bay d'Espoir	-	-	183.6	28.8	167.9	196.7	-	351.5	-	-	154.8	38.6	158.1	-	351.5	-	
Overhaul Turbine/Generator Units #6 and #7 - Bay d'Espoir	-	-	1,345.6	56.2	0.0	56.2	-	1,345.6	-	-	544.5	65.3	(9.10)	-	600.7	(744.9)	1
2015 Projects																	
Replace Station Service Breakers - Cat Arm	-	644.9	363.4	176.3	0.0	176.3	-	1,008.3	-	646.1	185.9	12.4	163.9	-	1,008.3	-	
Replace Pump House and Associated Equipment - Bay d'Espoir	-	22.7	522.5	279.6	0.0	279.6	-	545.2	-	137.0	128.6	12.6	267.0	-	545.2	-	
Upgrade Equipment Doors - Various Sites	-	348.5	-	46.7	0.0	46.7	-	348.5	-	285.4	115.4	3.0	43.7	-	447.5	99.0	
Total Hydraulic Generation Projects	-	1,016.1	4,512.6	1,951.0	13,228.2	15,179.2	17,711.0	36,467.9	-	1,068.5	1,863.3	1,872.6	13,306.6	17,711.0	35,822.0	(645.9)	

2017 Capital Expenditures By Category
($000)

Thermal Generation Projects	Capital Budget							Actual Expenditure and Forecast								
	A		B	C	D (B+C)	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	H-D	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Annual Variance	Notes
2017 Projects																
Overhaul Turbine Valves Unit 2 - Holyrood	-	-	-	2,302.1	2,302.1	-	2,302.1	-	-	69.1	2,233.0	-	2,302.1	-	-	
Purchase Capital Spares Holyrood	-	-	-	321.5	321.5	-	321.5	-	-	179.4	142.1	-	321.5	-	-	
Condition Assessment and Miscellaneous Upgrades - Holyrood	-	-	-	2,437.3	2,437.3	-	2,437.3	-	-	1,063.6	1,373.7	-	2,437.3	-	-	
Upgrade Holyrood Access Road - Holyrood	-	-	-	579.3	579.3	583.4	1,162.7	-	-	38.9	540.4	583.4	1,162.7	-	-	
Upgrade Underground Plant Drainage System - Holyrood	-	-	-	923.1	923.1	-	923.1	-	-	687.4	1,127.1	-	1,814.5	891.4	891.4	2
Overhaul Pumps - Holyrood	-	-	-	633.0	633.0	-	633.0	-	-	273.9	359.1	-	633.0	-	-	
Purchase Tools and Equipment Less than $ 50,000	-	-	-	16.1	16.1	-	16.1	-	-	3.0	13.1	-	16.1	-	-	
2016 Projects																
Upgrade Powerhouse Building Envelope - Holyrood	-	2,723.8	483.9	2,969.9	3,453.8	784.1	6,477.8	-	2,239.9	1,007.7	2,446.1	784.1	6,477.8	-	-	
Total Thermal Generation Projects	0.0	2,723.8	483.9	10,182.3	10,666.2	1,367.5	14,273.6	-	2,239.9	3,323.0	8,234.6	1,367.5	15,165.0	891.4	891.4	

2017 Capital Expenditures By Category
($000)

Gas Turbine Generation Projects	Capital Budget							Actual Expenditure and Forecast							
	A		B	C	D (B+C)	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Gas Turbine Life Extension - Stephenville	-	-	-	847.5	847.5	505.7	1,353.2	-	-	203.4	644.10	505.7	1,353.2	-	
Gas Turbine Life Extension - Hardwoods	-	-	-	675.3	675.3	281.4	956.7	-	-	71.1	604.20	281.4	956.7	-	
Purchase Capital Spares - Gas Turbines	-	-	-	185.0	185.0	-	185.0	-	-	-	185.00	-	185.0	-	
2016 Projects															
Replace Fuel Piping - Hardwoods and Stephenville	-	44.8	33.2	267.0	300.2	-	311.8	-	11.6	127.5	172.70	-	311.8	-	
Total Gas Turbine Generation Projects	-	44.8	33.2	1,974.8	2,008.0	787.1	2,806.7	-	11.6	402.0	1,606.0	787.1	2,806.7	-	

2017 Capital Expenditures By Category
($000)

Terminal Stations Projects	Capital Budget									Actual Expenditure and Forecast										
	A				B	C	D (B+C)	E	F (A+C+E)	G					H	I	J	K (G+H+I+J)	K-F	
	2013	2014	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2012	2013	2014	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects																				
Upgrade Corner Brook Frequency Converter - Corner Brook	-	-	-	-	-	194.6	194.6	2,749.2	2,943.8	-	-	-	-	-	17.6	177.0	2,749.2	2,943.8	-	
Replace 66 kV Station Service Feed - Holyrood	-	-	-	-	-	62.8	62.8	1,198.6	1,261.4	-	-	-	-	-	41.7	21.1	1,198.6	1,261.4	-	
Replace Substation - Holyrood	-	-	-	-	-	439.4	439.4	758.6	1,198.0	-	-	-	-	-	78.6	360.8	758.6	1,198.0	-	
Replace Power Transformers - Oxen Pond	-	-	-	-	-	297.5	297.5	850.1	1,147.6	-	-	-	-	-	40.3	257.2	850.1	1,147.6	-	
In-Service Failures - Various Sites	-	-	-	-	-	1,000.0	1,000.0	-	1,000.0	-	-	-	-	-	243.4	756.6	-	1,000.0	-	
Purchase Capital Spares - Terminal Stations	-	-	-	-	-	495.8	495.8	-	495.8	-	-	-	-	-	27.4	468.4	-	495.8	-	
Upgrade Aluminum Support Structures - Holyrood	-	-	-	-	-	352.9	352.9	-	352.9	-	-	-	-	-	56.9	296.0	-	352.9	-	
Purchase Backup Diesel For Station Service - Grand Falls and Buchans	-	-	-	-	-	188.9	188.9	-	188.9	-	-	-	-	-	17.2	171.7	-	188.9	-	
Terminal Station Refurbishment and Modernization - Various Sites	-	-	-	-	-	10,831.3	10,831.3	16,550.8	27,382.1	-	-	-	-	-	2,279.3	8,552.0	16,550.8	27,382.1	-	
2016 Projects																				
Upgrade Circuit Breakers - Various Sites (2016-2020)	-	-	-	6,969.1	1,369.6	10,808.7	12,178.3	43,682.7	61,460.5	-	-	-	-	5,599.5	4,847.4	7,330.9	43,682.7	61,460.5	-	
Replace Surge Arrestors - Various Sites	-	-	-	144.4	(30.7)	53.0	22.3	-	197.4	-	-	-	-	175.1	2.5	19.8	-	197.4	-	
Replace Protective Relays - Various Sites	-	-	-	700.6	(725.2)	1,156.4	431.2	-	1,857.0	-	-	-	-	1,425.8	752.6	(321.4)	-	1,857.0	-	
Replace Disconnect Switches - Various Sites (2016-2017)	-	-	-	646.9	515.2	1,320.9	1,836.1	-	1,967.8	-	-	-	-	131.7	503.4	1,332.7	-	1,967.8	-	
Upgrade Digital Fault Recorders - Various Sites	-	-	-	197.9	(23.3)	304.6	281.3	-	502.5	-	-	-	-	221.2	204.2	77.1	-	502.5	-	
Upgrade Data Alarm Systems - Various Sites	-	-	-	74.4	24.7	234.1	258.8	-	308.5	-	-	-	-	49.7	61.5	197.3	-	308.5	-	
Install Breaker Failure Protection - Various Sites	-	-	-	65.7	(16.1)	211.3	195.2	-	277.0	-	-	-	-	81.8	222.0	(26.8)	-	277.0	-	
Install Fire Protection in 230 kV Stations - Bay d'Espoir	-	-	-	200.0	108.6	566.0	674.6	-	766.0	-	-	-	-	91.4	57.4	725.0	-	873.8	107.8	3
Upgrade Terminal Station for Mobile Substation - Cow Head	-	-	-	40.0	12.5	444.7	457.2	-	484.7	-	-	-	-	27.5	92.0	365.2	-	484.7	-	
2013 Projects																				
Replace Instrument Transformers - Various Sites	593.2	552.8	538.4	1,511.7	311.0	471.9	782.9	-	3,668.0	9.6	230.7	699.0	755.5	1,190.3	192.8	590.1	-	3,668.0	-	
Total Terminal Stations Projects	593.2	552.8	538.4	10,550.7	1,546.3	29,434.8	30,981.1	65,790.0	107,459.9	9.6	230.7	699.0	755.5	8,994.0	9,738.2	21,350.7	65,790.0	107,567.7	107.8	

2017 Capital Expenditures by Category
($000)

Transmission Projects	Capital Budget A 2014	A 2015	A 2016	B Carryover 2016	C Original 2017	D Revised 2017	E 2018 and Beyond	F (A+C+E) Total	Actual Expenditure and Forecast G 2014	G 2015	G 2016	H YTD Actual 2017	I Forecast Jul-Dec 2017	J 2018 and Beyond	K(G+H+I+J) Total	K-F Project Variance	Notes
2017 Projects																	
Transmission Line Upgrades - TL212 and TL218	-	-	-	-	1,378.2	1,378.2	1,133.3	2,511.5	-	-	-	1.0	1,377.2	1,133.3	2,511.5	-	
Replace Insulators - TL227	-	-	-	-	145.6	145.6	271.3	416.9	-	-	-	13.1	132.5	271.3	416.9	-	
Wood Pole Line Management Program - Various Sites	-	-	-	-	2,404.1	2,404.1	-	2,404.1	-	-	-	253.1	2,151.0	-	2,404.1	-	
2016 Projects																	
Construct 230 kV Transmission Line - Soldiers Pond to Hardwoods	-	-	3,699.0	197.4	17,489.8	17,687.2	5,372.1	26,560.9	-	-	3,501.6	4,832.1	6,350.70	11,876.5	26,560.9	-	
Replace Aircraft Markers at Grand Lake Crossing - TL228	-	-	589.6	527.8	978.3	1,506.1	-	1,567.9	-	-	61.8	512.4	993.7	-	1,567.9	-	
2014 Projects																	
Refurbish Anchors and Footings TL202 and TL206 - Bay d'Espoir to Sunnyside	211.5	28.4	1,038.4	1,018.7	901.6	1,920.3	-	2,179.9	211.5	28.2	19.9	28.8	1,891.5	-	2,179.9	-	
230 kV Transmission Line - Bay d'Espoir to Western Avalon	-	4,403.0	75,284.3	26,108.6	149,895.7	176,004.3	62,075.0	291,658.0	-	2,018.2	59,317.8	102,590.3	110,313.40	17,418.3	291,658.0	-	
Total Transmission Projects	211.5	4,431.4	80,611.3	27,852.5	173,193.3	201,045.8	68,851.7	327,299.2	211.5	2,046.4	62,901.1	108,230.8	123,210.0	30,699.4	327,299.2	-	

2017 Capital Expenditures By Category
($000)

Distribution Projects	Capital Budget							Actual Expenditure and Forecast							
	A		B	C	D (B+C)		F (A+C+E)	G	H		I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Provide Service Extensions - All Service Areas	-	-	-	4,414.0	4,414.0	-	4,414.0	-	-	1,669.7	2,744.3	-	4,414.0	-	
Provide Service Extensions - All Service Areas - CIAC	-	-	-	(84.0)	(84.0)	-	(84.0)	-	-	(78.3)	(5.7)	-	(84.0)	-	
Upgrade Distribution Systems - All Service Areas	-	-	-	3,861.0	3,861.0	-	3,861.0	-	-	1,557.3	2,303.7	-	3,861.0	-	
Upgrade Distribution Systems - All Service Areas - CIAC	-	-	-	(51.0)	(51.0)	-	(51.0)	-	-	(8.9)	(42.1)	-	(51.0)	-	
Distribution Upgrades - Various Sites (2017-2018)	-	-	-	64.2	64.2	1,130.9	1,195.1	-	-	2.0	62.2	1,130.9	1,195.1	-	
Install Recloser Remote Control - Bottom Waters	-	-	-	47.1	47.1	418.6	465.7	-	-	85.5	(38.4)	418.6	465.7	-	
Install Demand Metering - Various Sites	-	-	-	89.7	89.7	-	89.7	-	-	34.4	55.3	-	89.7	-	
Replace Recloser - Wabush	-	-	-	199.2	199.2	-	199.2	-	-	47.1	152.1	-	199.2	-	
2016 Projects															
Upgrade Distribution Systems - Various Sites (2016/2017)	-	285.6	(76.2)	6,350.3	6,274.1	-	6,635.9	-	361.8	1,135.5	5,138.6	-	6,635.9	-	
Total Distribution Projects	-	285.6	(76.2)	14,890.5	14,814.3	1,549.5	16,725.6	-	361.8	4,444.3	10,370.0	1,549.5	16,725.6	-	

2017 Capital Expenditures By Category
($000)

Rural Generation Projects	Capital Budget									Actual Expenditure and Forecast										
	A				B	C	D	E	F (A+C+E)	G					H	I	J	K (G+H+I+J)	K-F	
	2013	2014	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2012	2013	2014	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects																				
Overhaul Diesel Engines - Various Sites	-	-	-	-	-	2,095.9	2,095.9	-	2,095.9	-	-	-	-	-	846.7	1,249.2	-	2,095.9	-	
Diesel Plant Engine Auxiliary Upgrades - Various Sites	-	-	-	-	-	790.6	790.6	416.3	1,206.9	-	-	-	-	-	444.4	346.2	416.3	1,206.9	-	
Inspect Fuel Storage Tanks - Various Sites	-	-	-	-	-	1,058.8	1,058.8	-	1,058.8	-	-	-	-	-	58.9	999.9	-	1,058.8	-	
Replace Automation Equipment - Mary's Harbour	-	-	-	-	-	120.3	120.3	1,021.7	1,142.0	-	-	-	-	-	33.5	86.8	1,021.7	1,142.0	-	
Replace Fuel Tank 22E - St. Anthony	-	-	-	-	-	199.8	199.8	-	199.8	-	-	-	-	-	105.5	94.3	-	199.8	-	
Diesel Genset Replacements - Port Hope Simpson and Charlottetown	-	-	-	-	-	658.8	658.8	5,148.0	5,806.8	-	-	-	-	-	59.6	599.2	5,148.0	5,806.8	-	
2016 Projects																				
Upgrade Human Machine Interface - Various Sites	-	-	-	114.0	(11.3)	320.0	308.7	-	434.0	-	-	-	-	125.3	122.8	185.9	-	434.0	-	
Install Variable Frequency Drives - Grey River	-	-	-	46.9	(2.8)	123.0	120.2	-	169.9	-	-	-	-	49.7	93.0	92.20	-	234.9	65.0	
Install Fire Protection Systems - Cartwright and Nain	-	-	-	3,030.7	1,557.1	1,376.4	2,933.5	-	4,407.1	-	-	-	-	782.8	715.5	2,218.0	-	3,716.3	(690.8)	4
Upgrade Transformer Systems - Postville and Cartwright	-	-	-	465.2	169.2	-	169.2	-	465.2	-	-	-	-	296.0	74.5	94.7	-	465.2	-	
Additions for Load Growth - Various Sites	-	-	-	883.4	693.0	4,746.0	5,439.0	-	5,629.4	-	-	-	-	190.4	1,627.5	3,811.5	-	5,629.4	-	
Replace Diesel Units - Charlottetown				1,384.9	-	46.1	46.1	-	1,431.0	-	-	-	-	1,442.2	12.5	33.6	-	1,488.3	57.3	
2015 Projects																				
Replace Programmable Logic Controllers - Various Sites	-	-	366.9	346.0	(29.8)	245.1	215.3	-	958.0	-	-	-	397.2	345.5	218.5	243.50	-	1,204.7	246.7	5
2014 Projects																				
Upgrade Diesel Plant Production Data Collection Equipment-Various	-	268.9	269.8	280.7	143.2	-	143	-	819.4	-	-	107.8	57.8	510.6	93.0	50.20	-	819.4	-	
Total Rural Generation Projects	0.0	268.9	636.7	6,551.8	2,518.6	11,780.8	14,299.4	6,586.0	25,824.2	-	-	107.8	455.0	3,742.5	4,505.9	10,105.2	6,586.0	25,502.4	(321.8)	

2017 Capital Expenditures By Category
($000)

Properties Projects	Capital Budget						Actual Expenditure and Forecast							
	A		B	C	D	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Upgrade Office Facilities & Control Buildings - Various Sites	-	-	-	2,197.3	2,197.3	-	2,197.3	-	-	90.8	2,106.5	-	2,197.3	-	
Line Depot Condition Assessment and Refurbishment Program - Various Sites	-	-	-	1,458.8	1,458.8	-	1,458.8	-	-	51.3	1,407.5	-	1,458.8	-	
Construct New Facilities - Various Sites	-	-	-	422.0	422.0	1,034.1	1,456.1	-	-	38.6	383.4	1,034.1	1,456.1	-	
Install Fall Protection Equipment - Various Sites	-	-	-	194.7	194.7	-	194.7	-	-	30.9	163.8	-	194.7	-	
2016 Projects															
Upgrade Warehouse Lighting - Bishop's Falls	-	15.2	(12.9)	180.4	167.5	-	195.6	-	28.1	55.0	112.5	-	195.6	-	
Replace Roof on Service Building - Bishop's Falls	-	612.8	285.0	-	285.0	-	612.8	-	327.8	141.3	143.7	-	612.8	-	
2015 Projects															
Replace Accommodations and Septic System - Ebbegunbaeg	489.4	1,061.4	645.4	-	645.4	-	1,550.8	94.2	811.2	233.9	411.5	-	1,550.8	-	
Total Properties Projects	489.4	1,689.4	917.5	4,453.2	5,370.7	1,034.1	7,666.1	94.2	1,167.1	641.8	4,728.9	1,034.1	7,666.1	-	

2017 Capital Expenditures By Category
($000)

Metering Projects	Capital Budget 2015 (A)	2016	Carryover 2016 (B)	Original 2017 (C)	Revised 2017 (D)	2018 and Beyond (E)	Total F (A+C+E)	Actual 2015 (G)	2016 (H)	YTD Actual 2017 (I)	Forecast Jul-Dec 2017	2018 and Beyond (J)	Total K (G+H+I+J)	Project Variance K-F	Notes
2017 Projects															
Install Automated Meter Reading - Happy Valley (2017-2018)	-	-	-	78.6	78.6	1,891.6	1,970.2	-	-	45.6	33.0	1,891.6	1,970.2	-	
Purchase Meters and Metering Equipment - Various Sites	-	-	-	198.8	198.8	-	198.8	-	-	58.8	140.0	-	198.8	-	
Purchase New Meter Calibration Test Console - Hydro Place	-	-	-	196.9	196.9	-	196.9	-	-	0.1	212.7	-	212.8	15.9	
2016 Projects															
Install Automated Meter Reading - Labrador West	-	433.8	303.4	533.4	836.8	-	967.2	-	130.4	624.9	211.9	-	967.2	-	
Total Metering Projects	-	433.8	303.4	1,007.7	1,311.1	1,891.6	3,333.1	-	130.4	729.4	597.6	1,891.6	3,349.0	15.9	

2017 Capital Expenditures By Category
($000)

Tools and Equipment	Capital Budget							Actual Expenditure and Forecast							
	A		B	C	D	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Replace Light Duty Mobile Equipment - Various Sites	-	-	-	270.9	270.9	-	270.9	-	-	150.3	120.6	-	270.9	-	
Purchase Front End Loader with Backhoe - Wabush	-	-	-	133.2	133.2	-	133.2	-	-	-	133.2	-	133.2	-	
Tools and Equipment Less than $ 50,000	-	-	-	423.0	423.0	-	423.0	-	-	190.6	232.4	-	423.0	-	
2016 Projects															
Purchase Excavator - Bay d'Espoir	-	312.0	35.0	-	35.0	-	312.0	-	187.0	36.5	(1.5)	-	222.0	(90.0)	
Total Tools and Equipment	-	312.0	35.0	827.1	862.1	-	1,139.1	-	187.0	377.4	484.7	-	1,049.1	(90.0)	

2017 Capital Expenditures By Category
($000)

Information Systems Projects	Capital Budget						Actual Expenditure and Forecast							
	A		B	C	D	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Upgrade Energy Management System - Hydro Place	-	-	-	427.0	427.0	-	427.0	-	-	215.6	211.4	-	427.0	-	
Replace Personal Computers - Hydro Place	-	-	-	401.4	401.4	-	401.4	-	-	253.0	148.4	-	401.4	-	
2016 Projects															
Implement Industrial Billing Software - Hydro Place	-	443.1	273.6	-	273.6	-	443.1	-	169.5	101.3	172.3	-	443.1	-	
Upgrade Microsoft Project - Hydro Place	-	683.7	26.8	953.4	980.2	957.3	2,594.4	-	656.9	47.8	932.4	957.3	2,594.4	-	
Cost Recoveries	-	(317.1)	(12.3)	(442.2)	(454.5)	(444.0)	(1,203.3)	-	(304.8)	(22.0)	(432.5)	(444.0)	(1,203.3)	-	
Upgrade Enterprise Storage Capacity - Hydro Place	-	628.8	164.3	-	164.3	-	628.8	-	464.5	97.8	66.5	-	628.8	-	
Cost Recoveries	-	(291.6)	(76.1)	-	(76.1)	-	(291.6)	-	(215.5)	(45.4)	(30.7)	-	(291.6)	-	
Upgrade Server Technology Program - Hydro Place	-	492.5	41.4	-	41.4	-	492.5	-	451.1	84.2	(42.8)	-	492.5	-	
Cost Recoveries	-	(228.5)	(19.2)	-	(19.2)	-	(228.5)	-	(209.3)	(39.1)	19.9	-	(228.5)	-	
Total Information Systems Projects	-	1,410.9	398.5	1,339.6	1,738.1	513.3	3,263.8	-	1,012.4	693.2	1,044.9	513.3	3,263.8	-	

2017 Capital Expenditures By Category
($000)

Telecontrol Projects	Capital Budget							Actual Expenditure and Forecast							
	A		B	C	D	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Purchase Tools and Equipment less than $50,000	-	-	-	45.2	45.2	-	45.2	-	-	31.1	14.1	-	45.2	-	
Replace Battery Banks and Chargers - Various Sites (2017-2018)	-	-	-	379.3	379.3	566.2	945.5	-	-	65.6	313.7	566.2	945.5	-	
Replace Network Communications Equipment - Various Sites	-	-	-	199.3	199.3	-	199.3	-	-	9.8	189.5	-	199.3	-	
Upgrade Site Facilities	-	-	-	49.0	49.0	-	49.0	-	-	9.6	39.4	-	49.0	-	
Upgrade Access Roads to Microwave Sites - Various Sites	-	-	-	118.4	118.4	-	118.4	-	-	1.9	116.5	-	118.4	-	
Upgrade Telecontrol Facilities - Mary March Hill and Blue Grass Hill	-	-	-	91.2	91.2	665.9	757.1	-	-	14.7	76.5	665.9	757.1	-	
2016 Projects															
Replace Battery Banks and Chargers - Various Sites	-	425.0	59.3	456.6	515.9	-	881.6	-	365.7	120.1	395.8	-	881.6	-	
Replace MDR 4000 Microwave Radio East - Various Sites	-	77.4	(36.0)	1,093.1	1,057.1	-	1,170.5	-	113.4	717.7	339.4	-	1,170.5	-	
Replace UPS Systems - Hydro Place	-	889.8	(38.8)	-	-38.8	-	889.8	-	928.6	43.0	(81.8)	-	889.8	-	
Replace Air Conditioners - Various Sites	-	39.9	(11.3)	152.0	140.7	-	191.9	-	51.2	19.0	121.7	-	191.9	-	
Replace Powerline Carrier - Various Sites	-	73.4	(4.0)	763.4	759.4	-	836.8	-	77.4	223.9	535.5	-	836.8	-	
Upgrade Telecontrol Facilities - Sandy Brook Hill	-	101.6	19.9	462.4	482.3	-	564.0	-	81.7	62.6	419.7	-	564.0	-	
Total Telecontrol Projects	-	1,607.1	(10.9)	3,809.9	3,799.0	1,232.1	6,649.1	-	1,618.0	1,319.0	2,480.0	1,232.1	6,649.1	-	

2017 Capital Expenditures By Category
($000)

Transportation	Capital Budget						Actual Expenditure and Forecast							
	A		B	C	D	E	F (A+C+E)	G		H	I	J	K (G+H+I+J)	K-F	
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects															
Replace Vehicles and Aerial Devices - Various Sites (2017-2018)	-	-	-	2,001.4	2,001.4	398.8	2,400.2	-	-	31.6	1,969.8	398.8	2,400.2	-	
2016 Projects															
Replace Vehicles and Aerial Devices - Various Sites (2016-2017)	-	1,443.3	410.6	534.2	944.8	-	1,977.5	-	1,032.7	130.4	814.4	-	1,977.5	-	
Purchase Vehicles and Aerial Devices - Various Sites	-	382.5	(87.9)	172.7	84.8	-	555.2	-	470.4	130.1	(45.3)	-	555.2	-	
Total Transportation	-	1,825.8	322.7	2,708.3	3,031.0	398.8	4,932.9	-	1,503.1	292.1	2,738.9	398.8	4,932.9	-	

Administrative	Capital Budget							Actual Expenditure and Forecast							
	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Variance	Notes
2017 Projects															
Remove Safety Hazards - Various Sites	-	-	-	198.6	198.6	-	198.6	-	-	10.4	188.2	-	198.6	-	
Replace Roof - Hydro Place	-	-	-	923.4	923.4	-	923.4	-	-	340.1	583.3	-	923.4	-	
Purchase Tools and Equipment less than $50,000	-	-	-	83.6	83.6	-	83.6	-	-	1.0	82.6	-	83.6	-	
2016 Projects															
Replace Air Conditioning Units 8 and 14 - Hydro Place	-	34.6	3.6	229.5	233.1	-	264.1	-	31.0	47.3	185.8	-	264.1	-	
Total Administrative	-	34.6	3.6	1,435.1	1,438.7	-	1,469.7	-	31.0	398.8	1,039.9	-	1,469.7	-	

2017 Capital Expenditures By Category
($000)

Allowance For Unforeseen	Capital Budget A 2014	2015	2016	B Carryover 2016	C Original 2017	D Revised 2017	E 2018 and Beyond	F (A+C+E) Total	Actual Expenditure and Forecast G 2014	2015	2016	H YTD Actual 2017	I Forecast Jul-Dec 2017	J 2018 and Beyond	K (G+H+I+J) Total	K-F Project Variance	Notes
2017 Projects																	
Contingency Fund	-	-	-	-	1,000.0	1,000.0	-	1,000.0	-	-	-	-	-	-	-	(1,000.0)	
Transmission Line Emergency Refurbishments	-	-	-	-	-	-	-	-	-	-	-	506.2	-	-	506.2	506.2	
Holyrood Unit 2 Fire Damage Rehabilitation	-	-	-	-	-	-	-	-	-	-	-	541.7	-	-	541.7	541.7	
Allowance for Unforeseen Top Up P.U. No. 15 (2017)	-	-	-	-	500.0	500.0	-	500.0				-	452.1	-	452.1	(47.9)	
Total Allowance For Unforeseen	-	-	-	-	1,500.0	1,500.0	-	1,500	-	-	-	1,047.9	452.1	-	1,500.0	0.0	

Supplemental Projects	Capital Budget 2014	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	Actual Expenditure and Forecast 2014	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects																	
Additions for Load Growth - Bottom Waters	-	-	-	-	3,045.0	3,045.0	-	3,045.0	-	-	-	811.8	2,233.2	-	3,045.0	-	
Acquisition of two 230 kV Transmission Lines - Labrador West	-	-	-	-	2,731.5	2,731.5	-	2,731.5	-	-	-	181.5	2,550.0	-	2,731.5	-	
Unit 3 Turbine Rehabilitation - Bay d'Espoir	-	-	-	-	2,361.5	2,361.5	-	2,361.5	-	-	-	1,130.2	1,231.3	-	2,361.5	-	
Exciter Controls Replacement - Holyrood	-	-	-	-	1,349.2	1,349.2	-	1,349.2	-	-	-	234.1	1,115.1	-	1,349.2	-	
Terminal Station Upgrades - Wabush	-	-	-	-	2,585.2	2,585.2	327.3	2,912.5	-	-	-	284.2	2,301.0	327.3	2,912.5	-	
Penstock #2 Refurbishment - Bay d'Espoir	-	-	-	-	9,063.7	9,063.7	-	9,063.7	-	-	-	3,895.0	5,168.7	-	9,063.7	-	
Refurbish and Replace Critical Systems and Equipment - Holyrood	-	-	-	-	2,610.0	2,610.0	-	2,610.0	-	-	-	295.8	2,314.2	-	2,610.0	-	
Repair and Advanced Overhaul of the Happy Valley Gas Turbine	-	-	-	-	3,714.8	3,714.8	-	3,714.8	-	-	-	63.4	3,651.4	-	3,714.8	-	
2016 Projects																	
Purchase of 12 MW Diesel Generation - Holyrood	-	-	4,700.0	916.0	-	916.0	-	4,700.0	-	-	3,784.0	131.7	784.3	-	4,700.0	-	
TL 227 Distribution Line Sally's Cove L1	-	-	717.0	530.7	1,533.0	2,063.7	-	2,250.0	-	-	186.3	1,224.7	839.0	-	2,250.0	-	
Refurbish Gas Generator Engines - Hardwoods and Stephenville	-	-	3,047.1	508.4	-	508.4	-	3,047.1	-	-	2,538.7	428.7	79.7	-	3,047.1	-	
2014 Projects																	
Labrador West Transmission Project - Construction Phase	37,484.2	163,145.3	128,962.6	-	-	-	-	329,592.1	10,996.0	628.0	752.8	394.1	405.9	-	13,176.8	(316,415.3)	6
Total Supplemental Projects Approved by PUB	37,484.2	163,145.3	137,426.7	1,955.1	28,994	30,949.0	327.3	367,377.4	10,996.0	628.0	7,261.8	9,075.2	22,673.8	327.3	50,962.1	(316,415.3)	

Projects Less than $50,000	Capital Budget 2014	2015	2016	Carryover 2016	Original 2017	Revised 2017	2018 and Beyond	Total	Actual Expenditure and Forecast 2014	2015	2016	YTD Actual 2017	Forecast Jul-Dec 2017	2018 and Beyond	Total	Project Variance	Notes
2017 Projects																	
Three Phase Construction - Bishop's Falls	-	-	-	-	49.6	49.6	-	49.6	-	-	-	3.2	46.4	-	49.6	-	
Tools Procurement - Hardwoods and Stephenville Gas Turbine	-	-	-	-	47.2	47.2	-	47.2	-	-	-	25.0	22.2	-	47.2	-	
Replace Powerhouse #2 Lighting - Bay d'Espoir	-	-	-	-	48.0	48.0	-	48.0	-	-	-	1.2	46.8	-	48.0	-	
Replace Powerhouse Lighting - Paradise River	-	-	-	-	43.9	43.9	-	43.9	-	-	-	6.5	37.4	-	43.9	-	
Domestic Waterline Replacement - Holyrood	-	-	-	-	49.6	49.6	-	49.6	-	-	-	1.6	48.0	-	49.6	-	
Stage 1 Pumphouse Siding Replacement - Holyrood	-	-	-	-	49.9	49.9	-	49.9	-	-	-	-	49.9	-	49.9	-	
2016 Projects																	
Replace Radiator Unit 2029 Makkovik	-	-	49.0	21.5	-	21.5	-	49.0	-	-	27.5	27.4	(5.9)	-	49.0	-	
Total Projects Less than $50,000	-	-	49.0	21.5	288.2	309.7	-	337	-	-	27.5	64.9	244.8	-	337.2	-	

Explanations are provided below for projects whose overall expenditures, on a total project basis, have a forecasted variance of more than $100,000 and 10% from the budgeted amount. Due to this being a mid-year report, variances are based on focused management and reforecasting efforts, and are subject to change throughout the year as the projects proceed. Actual variances at completion of each project will be discussed in the year-end Capital Expenditures Report when annual expenditures are final.

Hydraulic Generation Projects

1. Overhaul Turbine and Generator – Unit 6 and 7 – Bay d'Espoir

Original Budget:	**$1,345.6**	**Forecast to Completion:**	**$600.7**	**Variance:**	**($744.9)**

This was a one year project that commenced and was substantially completed in 2016, carried over into 2017, and is now complete. The cost variance is attributed to a scope reduction. Due to unresolved contract terms with the original equipment manufacturer, and schedule conflicts with other on-going work, it was decided to limit part of the rotor scope that was included in the whole project. The rotor scope was to address unacceptable vibration levels and was limited to design only, with construction deferred until 2017. The generator bearing was replaced during the outage and resulted in a significant improvement to the operating vibration levels. Based on this improved performance, it was decided to cancel the remaining rotor scope instead of deferring it to 2017 in order to provide a timeframe to assess the long term performance of the generator with the new bearing. The carry over into 2017 was a result of the refurbishment of the old generator bearing to enable it to be returned as a capital critical spare, at a cost of approximately $60,000.

Thermal Generation Projects

2. Upgrade Underground Plant Drainage System - Holyrood

Original Budget:	**$923.1**	**Forecast to Completion:**	**$1,814.5**	**Variance:**	**$891.4**

This is a single year project that is in progress in 2017. The forecast cost variance is attributed to a scope increase and higher contract pricing compared to the budget estimate. Unforeseen scope and cost risks were realized during the development of the technical specification for this project, and additional scope was identified as required in order to meet the project objective to ensure the reliable functioning of the Holyrood underground plant drainage system. The additional scope items included:

1. replacement, as opposed to refurbishment, of the oil water separators, since vendors would not commit to reliable refurbishment of the vessels;
2. replacement of additional segments of the underground piping system due to further deterioration since the original project scope was developed;
3. use of a vacuum truck for isolation of the system during construction, a requirement that was not identified in the original budget; and
4. asbestos abatement and disposal for piping, a requirement that was not identified in the original budget.

In addition to this increase in scope, construction tender prices came in higher than originally estimated. This project was justified based on environmental compliance, which remains valid as continued non-compliance has the potential to result in penalties, fines, and in the worst case a cease order for all plant operations until the non-compliance is resolved.

Terminal Station Projects

3. Install Fire Protection in 230 kV Stations - Bay d'Espoir

Original Budget:	**$766.0**	**Forecast to Completion:**	**$873.8**	**Variance:**	**$107.8**

This is a two year project that commenced in 2016, is continuing in 2017, and will carry over into 2018. The forecast cost variance is attributed to an increase in scope. This fire protection project is dependent on completion of work related to the construction of the new transmission line from Bay d'Espoir to Western Avalon (a separate project). Work associated with the new transmission line (TL 267) includes an extension to the Terminal Station No. 2 Control Building at Bay d'Espoir, as well as changes to the existing building ventilation equipment, which have to be incorporated into the design of the new fire suppression system. The TL 267 work is scheduled to be completed in late 2017 and therefore the fire protection system construction will be delayed to 2018. The additional forecast expenditure is to associated with the additional equipment, labour, materials and engineering to protect the TL 267-related control building extension, which was not included in the original estimate.

Rural Generation Projects

4. Install Fire Protection Systems – Cartwright and Nain

Original Budget:	**$4,407.1**	**Forecast to Completion:**	**$3,716.3**	**Variance:**	**($690.8)**

This is a two year project that commenced in 2016 and is ongoing in 2017. The forecast cost variance is attributed to anticipation that the project contingency will not be required. The design is complete and all material supply and construction contracts have been awarded for fixed prices. With these known costs, the project contingency is not anticipated to be required and has been removed from the total project final forecast cost at completion.

5. Replace Programmable Logic Controllers - Various Sites

Original Budget:	**$958.0**	**Forecast to Completion:**	**$1,204.7**	**Variance:**	**$246.7**

This is a three year project that commenced in 2015, continued in 2016, and is ongoing in 2017. The variance is attributed to additional engineering and construction labour to execute the work. The original project scope was to install new programmable logic controllers (PLCs) to replace obsolete systems at five diesel plants. Upon further site investigation at St. Anthony Diesel Plant, it was determined that the control system at that location is complex and the project could not be executed as budgeted. The work at St. Anthony Diesel Plant was removed from the project scope and may form part of a future capital budget application. The work is complete for two diesel plants and ongoing for the remaining two diesel plants. The engineering and construction effort was more than estimated for the two sites completed to date, resulting in a revised total project forecast cost at completion.

Supplemental Projects

6. Labrador West Transmission Project – Construction Phase (2014)

Original Budget:	**$329,592.1**	**Forecast to Completion:**	**$13,176.8**	**Variance:**	**$316,415.3**

In 2014, the Provincial Government approved the construction of the third transmission line in Labrador to help supply power for planned new developments in Labrador West, such as the Kami Iron Ore Project, and improve reliability for all customers in the region. In September 2014, work on the line was temporarily suspended until completion of Alderon's financing plan. All project costs incurred to date, are covered by the security Alderon has already provided. Construction will proceed should additional funding be secured.