2020 Capital Budget Application

August 1, 2019

An Application to the Board of Commissioners of Public Utilities

newfoundland labrador
hydro
a nalcor energy company

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August 1, 2019

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: 2020 Capital Budget Application

Please find enclosed eight copies, plus the original, of Newfoundland and Labrador Hydro's ("Hydro") 2020 Capital Budget Application ("Application"), filed in accordance with the Provisional Capital Budget Application Guidelines issued by the Board of Commissioners of Public Utilities ("Board") in October 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). Through this Application, Hydro is seeking approval of $108.5 million in capital expenditures. Hydro is also seeking approval of its 2015 and 2016 average rate base in the amounts of $1,747,308,000 and $1,885,849,000, respectively.

The 2020 Capital Budget Application financial schedules include a planned total value of $111.9 million; however, the Application seeks approval of $108.5 million. The Application excludes the planned 2019–2022 Additions for Load – Increase Capacity Labrador West Project as Hydro is developing a supplemental application to the 2019 Capital Budget to address the base load forecast for Labrador West. The technical analysis for this supplemental application is not yet complete.

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 & LABRADOR HYDRO

SWalsh

Shirley A. Walsh
Senior Legal Counsel, Regulatory
SAW:sk/las

Encl.

cc: Gerard M. Hayes, Newfoundland Power
Paul L. Coxworthy, Stewart McKelvey
Dean A. Porter, Poole Althouse
Dennis Browne, Q.C., Browne Fitzgerald Morgan & Avis
Denis J. Fleming, Cox & Palmer

ecc: Gregory Moores, Stewart McKelvey
Senwung Luk, Olthuis Kleer Townshend LLP

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Application

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

IN THE MATTER OF an application by Newfoundland and Labrador Hydro ("Hydro") for an order approving: (i) its 2020 Capital Budget pursuant to s.41(1) of the *Act*; (ii) its 2020 capital purchases and construction projects in excess of $50,000 pursuant to s.41(3)(a) of the *Act*; (iii) its estimated contributions in aid of construction for 2020 pursuant to s.41(5) of the *Act*; and (iv) for an order pursuant to s.78 of the *Act* fixing and determining its average rate base for 2015 and 2016.

To: The Board of Commissioners of Public Utilities ("Board")

THE APPLICATION OF HYDRO STATES THAT:

A. Background

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*.

B. Application

2. Section A to this Application is Hydro's proposed 2020 Capital Budget 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. The 2020 Capital Budget financial schedules include a planned total value of $111.9 million; however, this Application seeks approval of $108.5 million as further work is ongoing on the planned 2019–2022 Additions for Load – Increase Capacity Labrador West project and it is not ready for submission.

4. Section B to this Application is Hydro's proposed 2020 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.

5. Section C to this Application is a list of the proposed 2020 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.

6. Section D to this Application is a list of the proposed 2020 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.

7. Section E to this Application is a list of the proposed 2020 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.

8. Section F indicates no new leases in excess of $5,000 per year are proposed for 2020.

9. Section G to this Application is a schedule of Hydro's capital expenditures, actuals for 2018, and budgeted for 2019 and beyond, for the period 2015 to 2024.

10. Section H to this Application is a report on the current 2019 capital expenditures to June 30, 2019 and any associated variances between the approved budget and the forecasted total budget.

11. Section I sets out the proposed 2015 and 2016 rate base for Hydro.

12. Volume II to this Application contains the supplementary reports referred to in various capital budget proposals greater than $500,000.

13. The proposed capital expenditures for 2020 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*.

14. Hydro has estimated the total of contributions in aid of construction for 2020 to be approximately $290,000 for distribution upgrades and service extensions. The information contained in the Section A of the 2020 Capital Budget Application 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.

C. Newfoundland and Labrador Hydro's Request

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

(i) Approving $108.5 million of Hydro's 2020 capital budget as set out in Section A hereto, pursuant to section 41(1) of the *Act;*

(ii) Approving Hydro's 2020 capital purchases and construction projects in excess of $50,000 as set out in Sections C, D, and E hereto pursuant to section 41(3) of the *Act*;

(iii) Approving the proposed estimated contributions in aid of construction as set out in paragraph 14 hereof for 2020 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; and

(iv) Fixing and determining Hydro's average rate base for 2015 and 2016 in the amounts of $1,747,308,000 and $1,885,849,000, respectively, pursuant to section 78 of the *Act*.

D. Communications

16. Communications with respect to this Application should be forwarded to Shirley A. Walsh, Senior Legal Counsel, Regulatory for Hydro.

DATED at St. John's in the Province of Newfoundland and Labrador this 1 day of August 2019.

NEWFOUNDLAND AND LABRADOR HYDRO

SWalsh

Shirley A. Walsh
Counsel for the Applicant
Newfoundland and Labrador Hydro,
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St. John's, Newfoundland, A1B 4K7
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IN THE MATTER OF the *Public Utilities Act*, (the "*Act*"); and

IN THE MATTER OF an application by Newfoundland and Labrador Hydro ("Hydro") for an order approving: (i) its 2020 Capital Budget pursuant to s.41(1) of the *Act*; (ii) its 2020 capital purchases and construction projects in excess of $50,000 pursuant to s.41(3)(a) of the *Act*; (iii) its estimated contributions in aid of construction for 2020 pursuant to s.41(5) of the *Act*; and (iv) for an order pursuant to s.78 of the *Act* fixing and determining its average rate base for 2015 and 2016.

AFFIDAVIT

I, Terry Gardiner, Professional Engineer, of Torbay in the Province of Newfoundland and Labrador, make oath and say as follows:

1. I am the Vice President, Engineering and Technology of 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 1 day of August 2019,)
before me:)

S Walsh

Barrister – Newfoundland and Labrador

Terry Gardiner

Terry Gardiner, P. Eng.

2020 Capital Projects
Overview

2020 Capital Budget Application
2020 Capital Projects Overview

July 2019

A report to the Board of Commissioners of Public Utilities

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Appendix A: 2020 Project Prioritization

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*, Newfoundland and Labrador Hydro ("Hydro") is required to provide reliable service to its customers at the lowest possible cost. The requirement to provide safe, reliable, least-cost supply of electricity necessitates Hydro's continuous maintenance, refurbishment, renewal, and expansion of its generation, transmission, distribution, and other assets that support those systems. Hydro must also address changing environmental and regulatory requirements and challenges that often require the development and integration of new assets or improvements to existing assets. Hydro's long-term planning and investment initiatives are developed in the context of the following key drivers:

- The interconnection between Labrador and the Island via the HVdc link, Labrador-Island Link("LIL");
- The interconnection of the Island with the Nova Scotia system via the Maritime Link;
- Continued load growth on the Avalon Peninsula; and
- Considerations for the impact of forecast increases in electricity rates for customers.

This Capital Projects Overview ("Overview") discusses the new projects proposed for 2020 as well as the material changes made during project execution in 2019 that affect current (previously approved) projects. Details regarding the justification of projects discussed in this overview can be found in the 2020 Capital Budget Application ("CBA"), Sections C, D, and E, and in the corresponding reports for projects greater than $500,000, where appropriate. Discussion of the five-year plan is contained in the 2020–2024 Capital Plan provided with the 2020 CBA.

2.0 2019 Execution

Section H of the 2020 CBA contains the 2019 Capital Expenditure Status Report, including financial tables for capital projects as of June 30, 2019, and project variances and explanations. The explanations also include the cancellation of the Diesel Plant Fire Protection (2019-2020) – Black Tickle project. This project is further discussed in section 4.2.2 of this Overview.

Given the dynamic nature of the in-service failures projects, and Hydro's commitment to keep the Board informed, the 2019 Capital Expenditure Status Report also includes a summary of work completed to-date or in-progress for each of the 2019 Thermal Generation, Hydraulic Generation, and Terminal Stations In-Service Failures projects.

3.0 2020 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, correct reliability criteria violations, improve productivity, or increase efficiency.

The majority of Hydro's installed assets, including the hydroelectric installation at Bay d'Espoir, the Holyrood Thermal Generating Station ("Holyrood TGS"), the Stephenville Gas Turbine, the Hardwoods Gas Turbine, and much of Hydro's transmission and distribution systems, are more than 40–50 years old.

The proposals addressing sustaining capital projects contained in the 2020 CBA and previous applications focus on appropriate maintenance or replacement of existing assets with consideration given to condition, performance, and asset age, as well as availability of more efficient technologies. In other proposals, newer, more efficient technologies (e.g., LED lighting) justify the replacement of equipment.

The age of Hydro's assets also has implications for efficient operation. A portion of Hydro's generating plants were constructed at a time when systems and auxiliary equipment were manually operated. With the automation and remote operation of equipment, operating methods have changed, allowing for enhanced safety and efficiency. Included in the 2020 CBA are proposals to implement automation or improvements in the control and monitoring of equipment. An example is the installation of a recloser remote control for the Hampden Terminal Station and Upper Salmon Hydroelectric Generating Station, which allows the Energy Control Centre to remotely de-energize and re-energize the feeders from these two facilities. This reduces the duration of outages for the affected feeders and improves safety.

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

- System performance and reliability criteria;
- Hydro's long-term asset management strategy;
- Mandatory criteria (including legislative, Orders from the Board of Commissioners of Public Utilities ("Board"), 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 engineering and operations judgment.

There are three broad categories of replacement criteria:

1) Time and condition based: hours of operation and condition, for example, diesel generators (100,000 hours of operation for 1,800 rpm units) and vehicles (combination of years and operating hours for some classes);
2) Condition based: in-situ condition of the assets, for example, decay in transmission line wood poles; and
3) Technical assessment based: an evaluation of reliability, performance, condition, costs, and other factors, such as the inspection of fuel tanks and subsequent upgrade where required.

3.1 Reassessment of Planned Capital Expenditures

Hydro recognizes the need to balance system investment to maintain reliability with the management of cost to minimize upward pressure on customer rates. During each annual Capital Budget Application, Hydro refines its next five-year capital plan. In the 2020 plan, in an effort to further reduce the cost impact for customers, while maintaining reliable service, Hydro has additionally adjusted its capital budget plans. To ensure the right cost and reliability balance, Hydro had a goal of further reducing capital where prudent and where Hydro would not be placing the system at inappropriate risk. No priority work activities or projects were deferred.

Through its review, Hydro realigned projects based on condition of assets, enabling adjustment to the time frames associated with project execution such that, in some instances, projects are included at later times than previously assessed, thus better balancing capital investment with customer expectations for cost management and reliability.

The 2020 forecast in the 2019 CBA was $133.6 million. Through the continued focus to maintain the right balance between cost and reliability, the 2020 planned capital expenditure has been reduced to $111.9 million.[1] Hydro continues to advance its processes with respect to asset condition review and is working toward continued refinement of capital expenditure timelines for its assets. This effort also extends to Hydro's five-year capital plan, as discussed in the 2020–2024 Capital Plan.

3.2 Reassessment of Planned and Actual Capital Expenditures

Hydro is implementing a number of improvements that are expected to ensure actual annual capital project costs meet the budget plan as submitted to the Board in this and future years.

- Improve estimates of project contingency. The analysis of the last two years has shown that contingency estimates have been higher than required for some projects. For projects that closed in 2018, the overall contingency was estimated at 17.5% and 9% was required. As a result of this analysis, Hydro will apply the analysis findings to the amount of contingency estimated for projects, starting with the 2020 budget cycle.
- Improvements to review process prior to finalizing project proposals. Improvements commenced in the 2019 budget cycle, and are now fully implemented for the 2020 budget cycle.

Hydro has been taking steps for earlier and improved planning of the overall Integrated Annual Work Plan to ensure completion of the CBA along with the annual operating maintenance requirements. This should decrease the amount of carryover by ensuring that projects proposed are achievable from

[1] The 2020 Capital Budget Application financial schedules include a planned total value of $111,947,300; however, the 2020 CBA only seeks approval of $108,487,300, and excludes the planned 2019–2022 Additions For Load – Increase Capacity Labrador West project ($3,460,000 in 2020). Please refer to section 4.2.1.

resource and outage availability perspectives. Some benefits of this are being realized in 2019 and 2020, but Hydro expects the material improvements to be realized for the 2021 execution year.

As a result of these efforts, the 2020 CBA projects include an average contingency of approximately 10%, which reduced the overall budget and should improve the difference between planned and actual capital expenditure. Hydro is continuing to improve execution planning to improve completion rates and reduce project carryover requirements.

3.3 Specifically Assigned Assets

A portion of Hydro's asset base is specifically assigned to each of the following industrial customers: Vale Newfoundland and Labrador Limited; NARL Refining Limited Partnership; Teck Resources Limited; and Corner Brook Pulp and Paper Limited. Specifically assigned assets function to serve a single customer exclusively.

The 2020 CBA does not include any new projects that are specifically assigned to any industrial customer. Within the five-year plan, Hydro has a planned project in 2024 to replace the neutral bushings on Transformers T1 and T2 in the Come By Chance Terminal Station, which are specifically assigned assets for NARL. It is suspected that these bushings are contaminated with polychlorinated biphenyls ("PCB"), and are required to be removed by 2025.[2] Specific details will be developed as the project gets closer to execution. There are no other specifically assigned capital projects for the industrial customers currently in the five-year capital plan. Hydro contacted all four industrial customers in July 2019 to discuss the 2020 CBA and the five-year plan with respect to their specifically assigned assets.

4.0 2020 Capital Budget

The 2020 CBA contains 67 projects,[3] 52 of which are new projects,[4] as shown in section A, Capital Budget. These new projects include the refurbishment of generation facilities, capital inspection of gas turbine generation equipment, and modernization and upgrade of terminal stations. The 2020 planned capital expenditure totals $111.9 million,[5] which includes budgets for projects approved in previous

[2] Environment Canada PCB Regulations (SOR/2008-273) prevent the release of PCBs in the environment.
[3] Excludes the planned 2019–2022 Additions for Load - Increase Capacity Labrador West project.
[4] Including projects less than $50,000.
[5] The 2020 Capital Budget Application financial schedules include a planned total value of $111,947,300; however, the 2020 CBA only seeks approval of $108,487,300, and excludes the planned 2019-2022 Additions for Load – Increase Capacity Labrador West project ($3,460,000 in 2020). Please refer to section 4.2.1.

CBAs. The 2020 CBA also includes 2019 front-end engineering and design ("FEED") expenditures necessary to support the development of proposals on a number of projects, as discussed in section 5.3 of this Overview. All 2020 projects address the need to sustain the existing asset base and, when necessary, upgrade to meet growing customer demand such as the 2020 CBA proposals for Makkovik and Hopedale, while maintaining reliability and adhering to Hydro's principles of safety and environmental responsibility.

Figure 1 shows the 2020 Capital Budget Summary by major area. The categories, other than the Allowance for Unforeseen Items, are discussed further in the following sections.

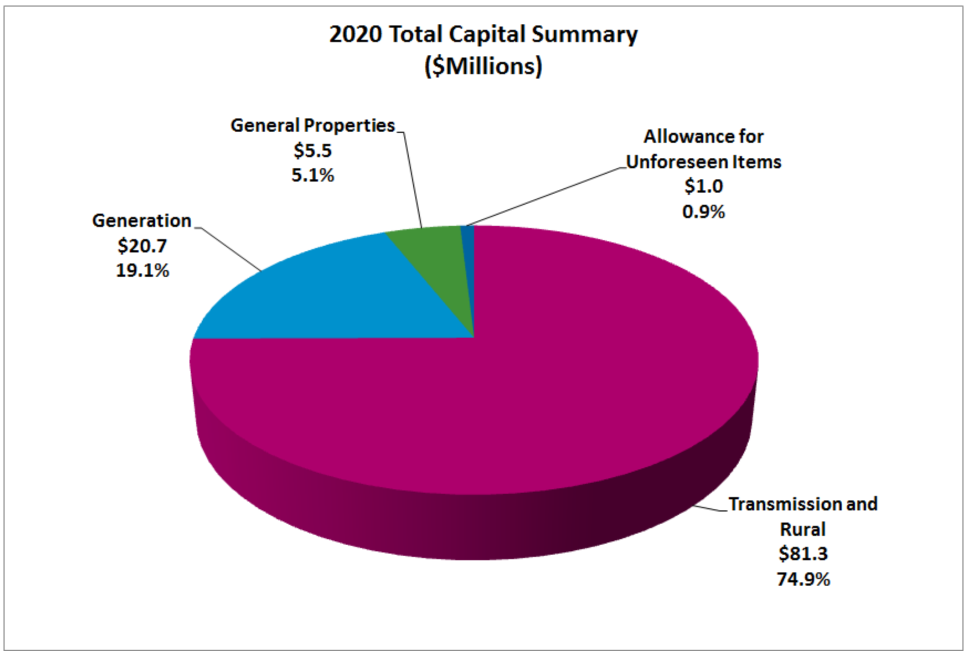

Figure 1: 2020 Capital Budget Summary[6]

4.1 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.

The planned generation area expenditures of $20.7 million account for 19.1% of the overall 2020 CBA. The division of the 2020 Capital Budget for the Generation area among Hydraulic Plant, Thermal Plant,

[6] Excludes the planned 2019–2022 Additions for Load - Increase Capacity Labrador West project ($3,460,000 in 2020).

1 and Gas Turbines expenditures is shown in Figure 2. The historical five-year (2014 to 2018) average
2 capital expenditures for generation are shown in Figure 3.

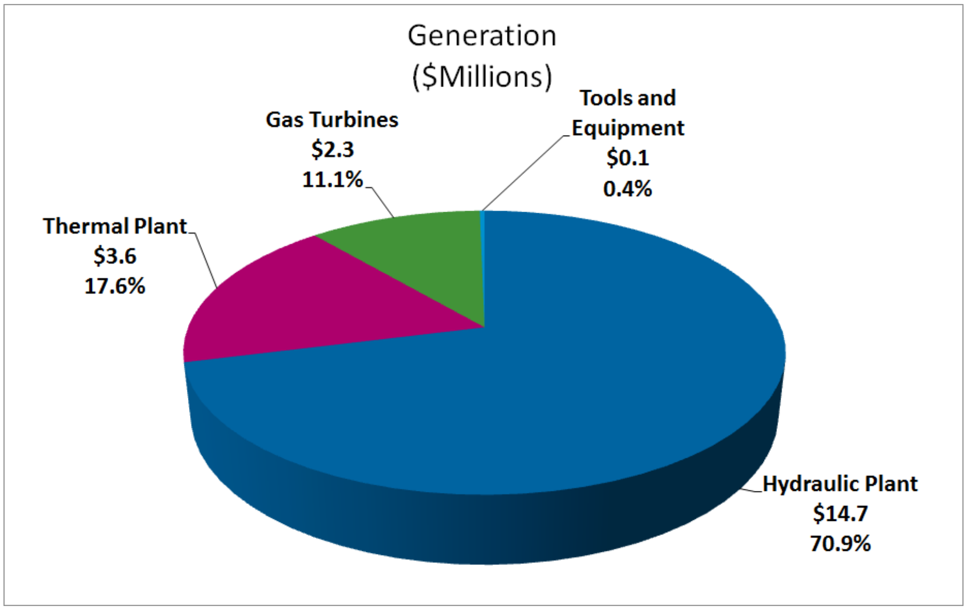

Figure 2: 2020 Capital Budget for Generation

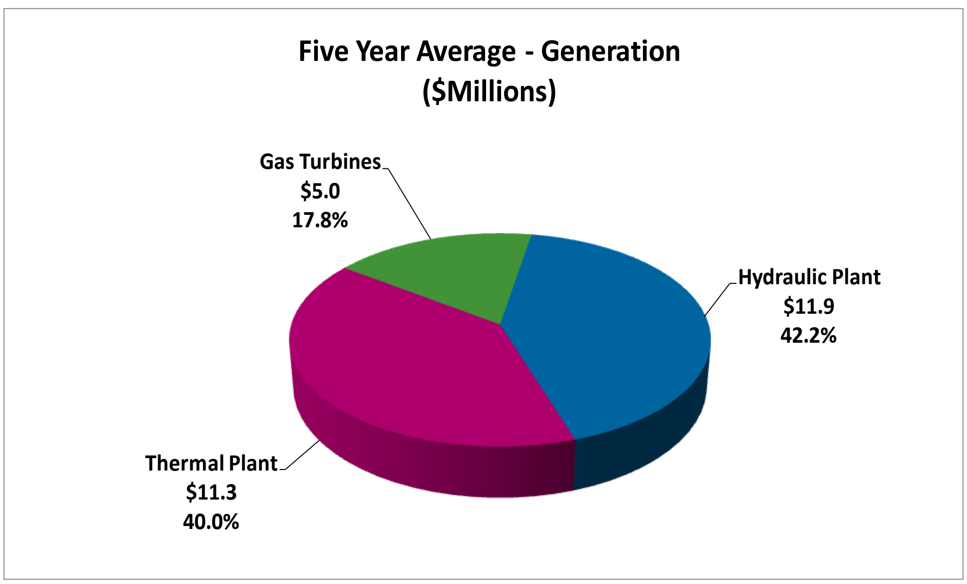

Figure 3: Five-Year Average Capital Expenditures for Generation (2014–2018)

3 The planned capital expenditure for hydraulic plant has increased compared to the average over the
4 past five years. As referenced in section 4.1.1 of this Overview, the increase in hydraulic plant
5 expenditures is primarily a result of the need to refurbish aging assets, particularly at the Bay d'Espoir

Hydroelectric Generating Facility which was originally constructed in the late 1960s. The 2020 proposed expenditure includes year two of the 2019–2020 Hydraulic Generation Refurbishment and Modernization project originally approved in the 2019 CBA, and year one of the new 2020–2021 Hydraulic Generation Refurbishment and Modernization project.

2020 planned thermal plant expenditures are lower than the five-year average as Holyrood TGS transitions to a synchronous condenser facility. The Holyrood TGS continues to require 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 4.1.2 of this Overview, expenditures are focussed on the assets required for the transition to synchronous condenser function for long-term operation.

2020 planned gas turbine expenditures are lower than the previous five-year average. As referenced in section 4.1.3 of this Overview, 2020 capital expenditure is focussed on the Holyrood Gas Turbine and the Happy Valley Gas Turbine.

4.1.1 Hydraulic Plant

Hydro's major hydraulic generating plants range in age from 16 to 52 years. 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 2020, Hydro is proposing to continue the use of the Hydraulic Generation Refurbishment and Modernization project ("Hydraulic Generation R&M"), which consolidates planned hydraulic generation sustaining work into a single project. All 2020 activities are focused on sustaining the Hydraulic assets, with no additional standalone projects other than the Hydraulic In-Service Failures project, similar to previous years.

Since 2016, Hydro has executed several unplanned supplemental and allowance for unforeseen items capital projects to refurbish the three penstocks serving Bay d'Espoir Powerhouse 1. Bay d'Espoir Penstock 1 experienced three ruptures between 2016 and 2017, and all three penstocks have had weld refurbishment and plate re-enforcement projects completed since the first rupture in May 2016. These assets are now functioning reliably. Hydro filed a report with the Board on July 31, 2019, in which there is a recommendation to refurbish the three penstocks serving Bay d'Espoir Powerhouse 1. Based on this recommendation, Hydro is developing updated plans for this refurbishment work, which will be proposed in Hydro's 2021 CBA. Please refer to section 4.1 of the 2020–2024 Capital Plan for details on this plan. Other than a Level II Condition Assessment for the Cat Arm Hydraulic Generation Penstock within the 2020–2021 Hydraulic Generation R&M project, there are no other planned penstock capital refurbishment projects proposed in the 2020 CBA.

4.1.2 Thermal Plant

The three Holyrood TGS units have now exceeded their generally expected service life of 30 years through required investment and life extension activities. The Holyrood TGS remains critical to the supply of reliable power to the Island Interconnected System until the reliable in-service of the Muskrat Falls Project, as Holyrood TGS 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 the Holyrood TGS, given that the plant is expected to produce electricity with a high level of reliability during the construction and commissioning period for the Muskrat Falls project. Scheduled condition assessments and maintenance will continue to ensure Hydro can reliably meet customer demand.

The long-term operational plan for this facility was developed in the context of the development of Muskrat Falls and the HVdc LIL. As noted above, the Holyrood TGS will remain a critical facility during the construction and commissioning of the Muskrat Falls project. During the LIL operation in monopole mode, and when the LIL goes into service in full bipole mode, the Holyrood TGS will be an essential component of the Island Interconnected System. The plant will function as a fully capable standby facility until the new assets are reliably in-service. After this initial period, the thermal assets will be decommissioned and the Holyrood TGS will be partially converted to a synchronous condensing facility.

The challenges faced by Hydro are complex as circumstances require that the Holyrood TGS 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 TGS 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 Facility is completed and power is brought to the Island Interconnected System via the LIL, the Holyrood TGS must continue to be able 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 TGS capital projects contained in this application are necessary to refurbish 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 report for further discussion pertaining to the proposed 2020 Holyrood TGS capital proposals. The Thermal In-Service Failures project is proposed for 2020, similar to previous years; however, the budget for 2020 has been increased reflecting past history of work scopes executed with this project.

4.1.3 Gas Turbines

Located at the Holyrood TGS 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. The 2020 CBA includes two new projects for the Holyrood Gas Turbine— the installation of a partial discharge monitoring system, and a planned combustor inspection. The combustor inspection is a scheduled original equipment manufacturer (“OEM”) recommendation for reliable operation and is required when the unit reaches 1200 equivalent starts. The Holyrood Gas Turbine is expected to reach this milestone in 2021 under planned operational forecasts. Similar to previous overhaul projects proposed on the Holyrood Gas Turbine, Hydro will continue to monitor the equivalent starts and will defer the combustor inspection and overhaul to the following year if the 1200 equivalent starts threshold is not expected to be met in 2021 as anticipated, and assuming the overhaul can be safely deferred beyond the end of the 2021-2022 winter operating season. Additional details can be found in Section C: Projects Over $500,000.

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. Hydro included a report on the Hardwoods and Stephenville Gas Turbine assets in the 2019 CBA. There are no proposed capital projects for Hardwoods or Stephenville in the 2020 CBA or in the five-year Capital Plan.

Hydro’s gas turbine plant in Happy Valley remains an asset in the generation fleet. The 2020 CBA includes two projects for the Happy Valley Gas Turbine—the replacement of the fire suppression system and an assessment of the turbine generator based on OEM recommendations.

4.2 Transmission and Rural Operations

Hydro owns and operates 24 diesel generating stations throughout Newfoundland and Labrador, 20 of which are isolated rural diesel generation plants. Hydro owns and operates approximately 4,400 kilometres of transmission lines and more than 50 high voltage terminal stations at voltages of 230, 138, and 69/66 kV. In addition, Hydro owns and operates approximately 3,400 kilometres 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 the general public, employees, and contractors.

Expenditures in the Transmission and Rural Operations area account for 74.9% of overall planned expenditures for 2020, totaling $81.3 million.[7] Figure 4 shows the division of the 2020 Capital Budget for Transmission and Rural Operations and Figure 5 provides the five-year average expenditures for this area.

Nearly 50% of the planned expenditure for 2020 is in year two of the 2019–2020 Terminal Station Refurbishment and Modernization ("Terminal Station R&M") project. This project provides for the replacement of assets that are at the end of their service life, including replacement of protective relays and disconnects, and upgrading power transformers. Capital expenditures in terminal stations for refurbishment and replacement of aging infrastructure are planned to decrease to the noted five-year average in future CBAs.

2020 planned transmission expenditure is lower than the five-year average. The average was elevated in recent years due to the construction of the TL 267 and TL 266 transmission lines. 2020 expenditures include year two of the Muskrat Falls to Happy Valley Interconnection and the Wood Pole Line Management ("WPLM") Program. Subsequent CBAs in the five-year plan include only the WPLM Program.

[7] Excludes the planned 2019–2022 Additions for Load - Increase Capacity Labrador West project ($3,460,000 in 2020).

The increase in rural generation over the five-year average expenditure is primarily attributable to the proposed replacement of several diesel generators in multiple communities required for continued provision of reliable service. Planned capital reduces to average in the five-year plan.

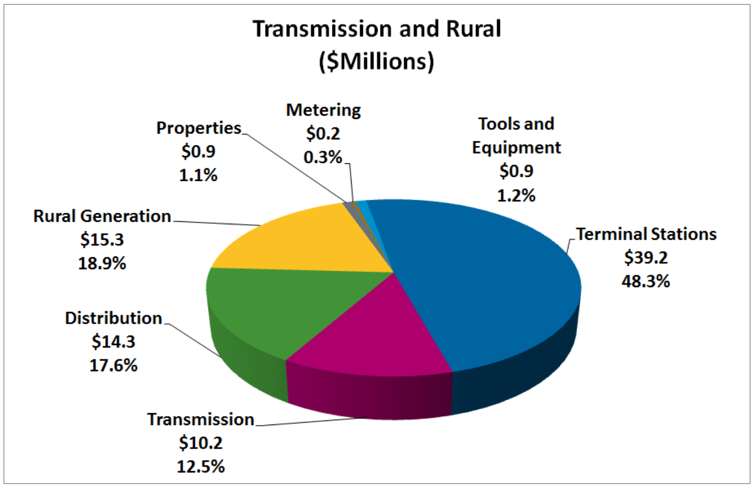

Figure 4: Capital Budget for Transmission and Rural Operations[8]

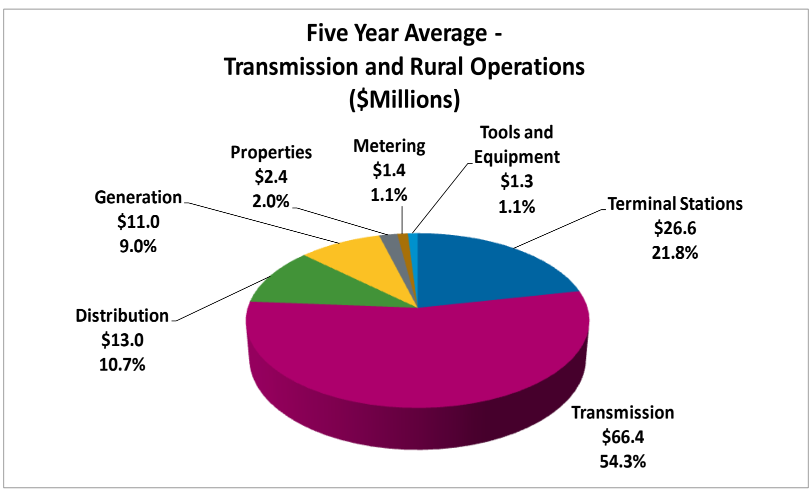

Figure 5: Five-Year Capital Expenditures for Transmission and Rural Operations (2014–2018)

4.2.1 Terminal Stations and Transmission

Many of Hydro's transmission lines and terminal stations were constructed in the 1960s with expected useful lives at that time in the range of 40–50 years. Refurbishment and general upgrades are needed to

[8] Excludes the planned 2019–2022 Additions for Load - Increase Capacity Labrador West project ($3,460,000 in 2020).

ensure that Hydro can continue to extend useful lives where appropriate, providing customers with reliable electrical service. Within the 2020 CBA, projects are proposed for the continued upgrade of power transformers and circuit breakers, as well as the replacement of surge arrestors, instrument transformers, disconnect switches, etc.

In the 2020 CBA, Hydro is proposing to continue the 2019–2020 Terminal Station R&M project and proposes a new 2020–2021 Terminal Station R&M project, both of which consolidate planned terminal station sustaining work into single projects. In addition to this project, other new projects proposed for 2020 include the purchase of a mobile substation, the replacement of the failed T7 Transformer in the Holyrood Terminal Station, and the purchase of SF_6 multi-analyzers. The Terminal Station In-Service Failures project proposed for 2020 is similar to that of previous years; however, the budget for 2020 has been increased reflecting past history of work scopes executed with this project.

In recent years new transmission projects, TL266 and TL267, raised the average historical expenditure in this category. The only new transmission project proposed in the 2020 CBA is the WPLM Program.

A project included in the 2020 Capital Plan is the Additions for Load – Increase Capacity for Labrador West project. Hydro is developing a supplemental application to the 2019 Capital Budget to address the base load forecast for Labrador West; however, the technical analysis is not yet complete. The 2020 CBA does not include approval of the funding for this project; however, it has been included for completeness. Additional details on this project will be included in the Supplemental Capital Budget Application when filed.

4.2.2 Distribution and Rural Generation

Hydro has 24 diesel generating stations, 20 of which are remote electrical systems along the coasts of Labrador and on the Island of Newfoundland. 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.

Maintenance of and investment into the diesel plants is required to ensure that the facilities are safe and efficient, including projects to replace the roof in both L'Anse au Loup and St. Anthony, upgrading the plant ventilation in Nain, and replacement of the fuel storage tank in Charlottetown. The 2020 CBA includes projects specifically directed towards meeting load growth requirements, including the

Additions for Load Growth – Makkovik and Hopedale project and the ongoing Diesel Plant Fire Protection project, with Charlottetown planned to start in 2020. The previously approved Diesel Plant Fire Protection (2019-2020) – Black Tickle project was cancelled based on a reassessment of the criteria regarding prioritization. With a decrease in population and the loss of the fish plant and gas station, the priority fell below six other plants. Hydro felt that, while the project was previously approved, it would not be prudent to proceed at this time. In addition, engine overhauls and replacements will be completed in various diesel plants following the new criteria for 1,200 RPM and 1,800 RPM units, as discussed in the Overhaul Diesel Units project report located in Volume II, Tab 13. The 2020 CBA also includes the Diesel Genset Replacement project for two units in Mary's Harbour.

Hydro also provides service to residential and general service customers on the Island and Labrador Interconnected Systems. Hydro has included projects in the 2020 CBA that are intended to ensure that distribution lines and equipment that require replacement due to condition are replaced prior to failure, thereby reducing the probability of interrupting service to customers. These projects include the Upgrade Distribution Systems and Provide Service Extensions projects to resolve day to day issues and requests throughout the service area. The Distribution Systems Upgrade (2020–2021) project addresses Hydro's worst performing feeders, with four feeders planned for replacement under this project.

4.2.3 Properties

Hydro has facilities across the service areas that require capital upgrades from time to time. For 2020, the Upgrade Line Depots project is proposed similar to previous years, with a focus on the Line Depots in Burgeo and Fogo Island, and Hydro is proposing to upgrade the fire suppression system in the Bishop's Falls regional office.

4.3 General Properties

The General Properties classification's expenditures account for 5.1% of the overall expenditures for 2020, with $5.5 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 2020 CBA also includes proposals for vehicle replacements, telecommunications system replacements, and an upgrade to the elevator motors and control equipment within Hydro Place in St. John's. Figure 6 and Figure 7 show the breakdown of the General Properties Capital Budget for 2020 and the previous five-year average, respectively.

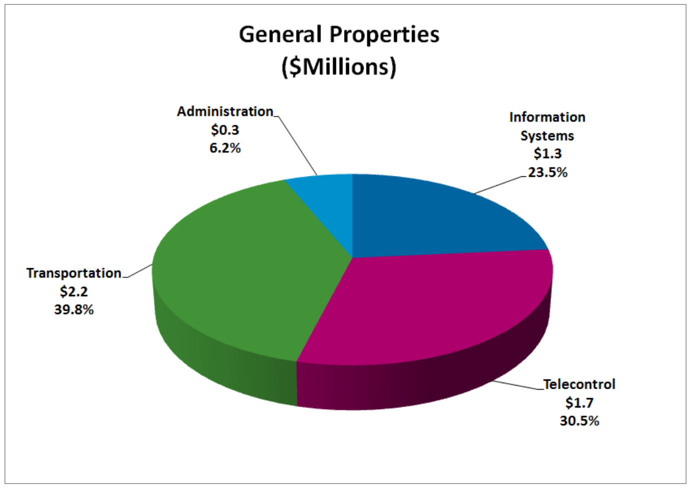

Figure 6: 2020 Capital Budget for General Properties

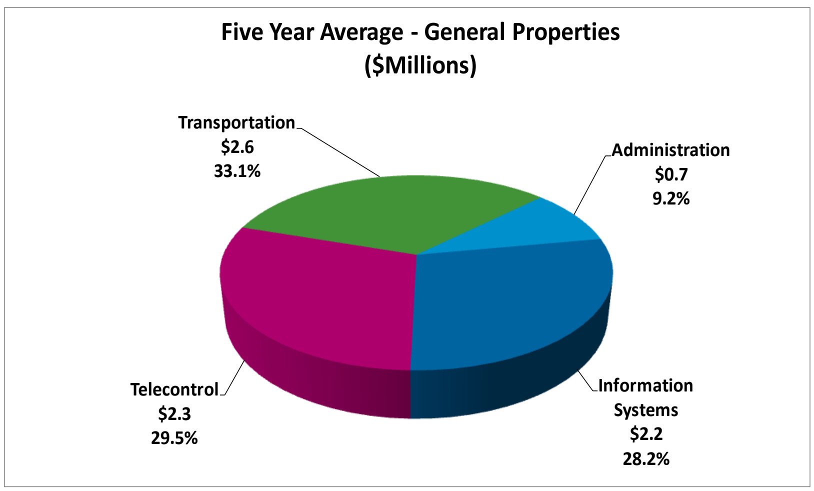

Figure 7: Five-Year Average Capital Expenditures for General Properties (2014–2018)

4.3.1 Transportation

Hydro operates a fleet of approximately 335 pieces of light- and heavy-duty equipment distributed across the service areas. Using established replacement criteria that consider the operating regime of each asset, Hydro replaces vehicles within the fleet to ensure availability as and when required. The 2020 CBA includes a project to replace 39 pieces of light- and heavy-duty equipment that will meet the replacement criteria in 2020.

4.3.2 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, as well as the Replace Personal Computers and Peripheral Infrastructure projects. Expenditures have trended down primarily due to completion of a few more material projects over the past several years, including upgrading Microsoft Office, storage capacity, and server technology.

4.3.3 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 2020 CBA proposals in this area include infrastructure replacements and upgrades, ongoing replacement or refurbishment programs for such items as microwave antenna radomes, network communications equipment, and other equipment that is part of the communications infrastructure.

5.0 General

5.1 Project Prioritization and Ranking

An overall ranking of 2020 projects is included in this Overview as Appendix A.

5.2 Projects by Definition and Classification

Table 1 and Table 2 list the 2020 proposed projects by definition and classification, respectively. The total proposed expenditure of $234,156,200 includes the total overall project estimate for all projects with proposed expenditure in 2020 (single-year and multi-year), including the expenditures in previous years for previously approved projects and expenditures in 2020 and future years for previously approved and new proposals.

Table 1: Projects by Definition

Type	Number	($000)
Clustered	0	0.0
Pooled	40	167,977.6
Other	27	66,178.6
Total	**67**	**234,156.2**

Table 2: Projects by Classification

Type	Number	($000)
Normal	66	233,811.0
Justifiable	1	345.2
Mandatory	0	0.0
Total	**67**	**234,156.2**

5.3 Phase 1 Engineering Costs

Hydro has tracked the FEED costs specific to each project and these costs form part of the 2020 CBA. Therefore, Hydro's 2020 capital projects include Phase 1 engineering costs that were incurred in association with the related 2020 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 2020 capital budget submission is approximately $443,000.

Appendix A

2020 Project Prioritization

Prioritization Explanations

Table A-1 shows the ranking of Hydro's 2020 capital projects. Rank 1 indicates the projects of the highest importance with no projects with a ranking of more than 29 included in the CBA. Projects that received the same score through the prioritization process have the same ranking. The three projects that are classified as Rank 1 are considered high-priority projects that are mandatory or are required to address safety or system load issues. Please note that the non-prioritized projects marked with an "*" in the table are the continuation of multi-year projects.

Table A-1: 2020 Project Prioritization

Project Description	Cost ($000)	Rank	Cumulative Project Cost ($000)
Multi-Year Projects (2020 is 2nd or 3rd Year)	59,390.4	******	59,390.4
TRO Service Extensions and Upgrades	7,479.0	******	66,869.4
Transportation	2,720.0	******	69,589.4
Tools & Equipment	900.6	******	70,490.0
Allowance for Unforeseen Items	1,000.0	1	71,490.0
Additions for Load - Isolated Generation Systems (2020–2021) - Makkovik	846.1	1	72,336.1
Remove Safety Hazards - Various	198.6	1	72,534.7
Upgrade Fuel Storage Tanks - Charlottetown	467.2	2	73,001.9
Diesel Plant Fire Protection (2020–2021)	176.5	3	73,178.4
Rewind Unit 3 Stator – Holyrood TGS	1,281.4	4	74,459.8
Generator Assessment - Happy Valley Gas Turbine	1,097.6	5	75,557.4
Wood Pole Line Management Program - Various	2,792.7	6	78,350.1
Hydraulic Generation Refurbishment and Modernization (2020–2021)	6,580.2	7	84,930.3
Terminal Station Refurbishment and Modernization (2020–2021)	3,712.0	8	88,642.3
Install Recloser Remote Control (2020–2021) - Hampden and Upper Salmon	71.3	9	88,713.6
Distribution System Upgrades (2020–2021) - Various	102.7	10	88,816.3
Hydraulic In-Service Failures	1,250.0	11	90,066.3
Terminal Station In-Service Failures	1,500.0	11	91,566.3
Thermal In-Service Failures	2,000.0	11	93,566.3
Upgrade Fire Suppression System - Bishop's Falls	91.6	12	93,657.9
Overhaul Diesel Units - Various	2,310.9	13	95,968.8
Replace Fire Suppression System - Happy Valley Gas Turbine	264.6	14	96,233.4
Purchase New Mobile Substation - Bishop's Falls	734.7	15	96,968.1

Project Description	Cost ($000)	Rank	Cumulative Project Cost ($000)
Perform Combustor Inspection - Holyrood Gas Turbine	546.1	16	97,514.2
Replace Automation Equipment - Rigolet	363.8	17	97,878.0
Replace Transformer T7 – Holyrood Terminal Station	2,678.1	18	100,556.1
Purchase SF_6 Multi Analyzer - Various	207.1	19	100,763.2
Upgrade Uninterruptable Power Supply 3 & 4 – Holyrood TGS	348.7	20	101,111.9
Upgrade Line Depots - Various	648.3	21	101,760.2
Replace Elevator Motors and Controls Equipment – Hydro Place	89.1	22	101,849.3
Diesel Genset Replacements – Mary's Harbour	3,900.7	23	105,750.0
Diesel Plant Ventilation Upgrade - Nain	162.7	24	105,912.7
Install Partial Discharge Monitoring – Holyrood Gas Turbine	37.8	25	105,950.5
Replace Powerhouse Roofing System – L'Anse Au Loup and St. Anthony	125.3	26	106,075.8
Replace Sewage Lift System - Rigolet	127.9	27	106,203.7
Computer Technology System Support	1,313.7	28	107,517.4
Network Services Infrastructure System Support	969.8	29	108,487.2

Table A-2 presents the prioritization criteria and the assigned weights used for the 2020 CBA.

Table A-2: Prioritization Criteria and Weight Factors

Criteria		Factors	Factor Weights
1	Work Classification	Normal	5
	(maximum weight = 85)	Justifiable: Payback (70)	15
		Justifiable: Payback (40)	45
		Justifiable: Payback (10)	85
2	Net Present Value[9]	NPV ($0)	0
	(maximum weight = 85)	NPV (<$100,000)	5
		NPV (<$500,000)	15
		NPV (<$1,000,000)	45
		NPV (>$1,000,000)	85
3	Goal 1: Safety	Minor	10
	(maximum weight = 100)	Treatment	50
		Lost Time	80
		Disability	100

[9] Net Present Value ("NPV").

Criteria		Factors	Factor Weights
4	Goal 2: Environment	None	10
	(maximum weight = 100)	Minor	50
		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
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 …	No type	5
	(maximum weight = 90)	Equipment	40
		Facility	50
		Production	70
		Customer delivery	90
12	Loss mitigation	Redundant unit	30
	(maximum weight = 90)	Backup option	60
		Nothing	90

Criteria		Factors	Factor Weights
13	Percent Improvement in Five-Year Average SAIDI[10] or SAIFI[11] (maximum weight = 50)	% SAIDI or SAIFI (0)	0
		% SAIDI or SAIFI (<1)	10
		% SAIDI or SAIFI (<2)	15
		% SAIDI or SAIFI (<3)	30
		% SAIDI or SAIFI (>3)	50
14	Estimated Project Cost Range (maximum weight = 50)	N.R.P.[12]	0
		Cost (>$1,000,000)	5
		Cost ($500,000 to $1,000,000)	15
		Cost ($200,000 to $500,000)	30
		Cost (<$200,000)	50

Level 1

Immediate HIGH Priority Projects

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.

Mandatory

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.

Level 2

Work Classification

Normal

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

[10] System Average Interruption Duration Index ("SAIDI").
[11] System Average Interruption Frequency Index ("SAIFI").
[12] Non-Reliability Project ("N.R.P")

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.

Net Present Value

NPV ($0)

The capital proposal generates $0 cost savings to Hydro.

NPV (<$100,000)

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $100,000 for Hydro.

NPV (<$500,000)

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $500,000 for Hydro.

NPV (<$1,000,000)

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of less than $1,000,000 for Hydro.

NPV (>$1,000,000)

A cost-benefit analysis indicates that the capital proposal generates a positive cost savings of more than $1,000,000 for Hydro.

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.

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 kilometre 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 kilometre 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.

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.

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.

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.

Customers Impacted

<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.

System Impact: Critical to...

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.

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 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 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 MAD of 830 MWh of unsupplied energy or 2 days (whichever is comes first).

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).

Loss Mitigation

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.

Percent Improvement in Five-Year Average SAIDI or SAIFI

% SAIDI or SAIFI (0)

This project will have no effect on SAIDI or 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 1%.

% SAIDI or SAIFI (<2)

This project is expected to improve the SAIDI or SAIFI factor by less than 2% but greater than 5% is implied.

% SAIDI or SAIFI (<3)

This project is expected to improve the SAIDI or SAIFI factor by less than 3% but greater than 10%is implied.

% SAIDI or SAIFI (>3)

This project is expected to improve the SAIDI or SAIFI factor by at least 3%.

Estimated Project Cost Range

Non-Reliability Project

This project is a N.R.P.

Cost (>$1,000,000)

The cost of the project is estimated to be more than $1,000,000.

Cost ($500,000–$1,000,000)

The cost of the project is estimated to be between $500,000–$1,000,000.

Cost ($200,000–$500,000)

The cost of the project is estimated to be between $200,000–$500,000.

Cost (<$200,000)

The cost of the project is estimated to be less than $200,000.

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 will not measurably change the assessment. The project risks are well defined and well controlled.

2020 Capital Budget Application
2020–2024 Capital Plan

July 2019

A report to the Board of Commissioners of Public Utilities

newfoundland labrador
hydro
a nalcor energy company

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Appendix A: Five-Year Capital Plan

List of Attachments

Attachment 1: TL 267 Project – 230 kV Transmission Line – Bay d'Espoir to Western Avalon – Annual Report

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") is focused on providing safe, reliable, and least-cost service to 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 Board Order No. P.U. 30(2007), Hydro was directed to file a five-year capital expenditure plan. The Board of Commissioners of Public Utilities ("Board") indicated the plan should focus on strategic spending priorities beginning with the current year of the Capital Budget Application ("CBA"). 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. Details regarding the proposed projects for 2020 and historical shifts are included in the 2020 Capital Projects Overview report. The Board also directed Hydro to provide specific focus on the Holyrood Thermal Generating Station ("Holyrood TGS"), 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 TGS was established. The Holyrood TGS is addressed in this report and in more detail in the Holyrood Overview and the Plan of Projected Operating Maintenance Expenditures 2020–2029 For Holyrood Generating Station reports in the 2020 CBA.

As of December 2018, Hydro maintains an asset base of approximately $2.1 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, or systems have or are about to do so. This includes components of major facilities such as the Bay d'Espoir Hydroelectric Generating Facility ("Bay d'Espoir"), the Holyrood TGS, 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's five-year capital plan 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, asset management strategies evolve, and 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 customers.

2.0 Five-Year Plan Overview

Hydro plans to invest approximately $536 million in plant and equipment over the 2020 to 2024 period, resulting in an average annual capital expenditure of approximately $107 million. Individual year expenditures will range from a high of $111.9 million in 2020 to a low of $101.9 million in 2024.

Over the period 2014 to 2018, the average annual capital expenditure was $206 million. Between 2014 and 2018, Hydro invested approximately $445 million in the installation of the Holyrood Gas Turbine and the construction of TL 267 and TL 266. Excluding these large projects, the average annual spend was approximately $117 million. The reduction in forecasted capital expenditures in the current plan reflects no forecasted material asset base additions for growth as was seen in recent years, but contains projects that are materially a sustaining capital plan. In addition, as described in the Capital Projects Overview, Section 3.1, in an effort to further reduce the cost impact for customers, while maintaining reliable service, Hydro has additionally adjusted down its capital budget plans. As a result of this analysis, Hydro has reduced the forecasted average capital budget for the four year period between 2020 and 2023; from $129.0 million as presented in the 2019 CBA to $108.5 million for the same period in the 2020 CBA. Through its review of the five-year plan, Hydro realigned projects based on condition of assets, enabling Hydro to adjust the time frames associated with project execution such that the projects are included at later times than previously assessed, thus better balancing capital investment with customer expectations for cost management and reliability. To ensure the right cost and reliability balance, Hydro had a goal of further reducing capital where prudent and where Hydro would not be placing the system at inappropriate risk. No priority work activities or projects were deferred.

Overall capital expenditures in the five-year plan reflect the requirement for projects related to the replacement and upgrade of deteriorating facilities, ensuring compliance with legislation, but ensuring a balance between capital investment and customer expectations for cost management and reliability.

3.0 Strategic Spending Priorities

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

- Achieving cost efficiencies while maintaining system reliability;
- Addressing 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; and
- 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.

Hydro's detailed five-year capital plan is presented in Appendix A. Over this period, the level of capital expenditure is primarily driven by the age and condition of current infrastructure and assets.

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 some 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 2020–2024 Capital Plan includes the continuation of the Hydraulic Generation

Refurbishment and Modernization project, which consolidates program-based projects into single projects, ensuring that equipment is replaced or refurbished in a planned approach.

Since 2016, Hydro has executed several unplanned supplemental and allowance for unforeseen items capital projects to refurbish the three penstocks serving Bay d'Espoir Powerhouse 1. Bay d'Espoir Penstock 1 experienced three ruptures between 2016 and 2017, and all three penstocks have had weld refurbishment and plate re-enforcement projects completed since the first rupture in May 2016. Hydro filed reports with the Board on the two refurbishment projects for Penstock 1 and the refurbishment of Penstock 2. On May 18, 2018, Hydro filed a report on the results of the Bay d'Espoir penstock stress analysis. A recommendation in the stress analysis report was to complete a detailed condition assessment of the penstocks, including the refurbishment areas completed in 2016 and 2017. Hydro completed condition assessments on Bay d'Espoir Penstocks 1 to 3 during the summer 2018 unit outages. The inspections confirmed the refurbishment work completed in 2016 and 2017 was effective with no defects identified in the refurbished welds. These assets are performing reliably. Hydro filed reports on Bay d'Espoir Penstocks 1 to 3 on December 12, 2018, March 29, 2019, and July 31, 2019. The July 31, 2019 report recommends several alternatives for managing the future reliability of the Bay d'Espoir penstocks. Based on this recommendation, Hydro is developing updated plans for this refurbishment work, which will be proposed in Hydro's 2021 CBA.

Hydro has updated its asset maintenance plan for the penstocks on its major generators,[1] with scheduled PM9 (six-year frequency, comprehensive internal inspection), PM6 (annual frequency, external inspection), and PM4 (monthly frequency, external inspection) inspections. Level 2 condition assessments, similar to the recent project executed for Bay d'Espoir Penstocks 1 to 3, will be executed based on the results of the PM9 inspections. The results of the inspections will form the basis of any capital refurbishment requirements in the capital plan for the other major generating facilities.

4.2 Thermal

On December 17, 2012, the Government of Newfoundland and Labrador announced official sanction of the Muskrat Falls project, which includes the Labrador-Island Link ("LIL"). The Holyrood TGS will be required for power production until the LIL is reliably in service and it is currently intended that the

[1] At this time, Roddickton, Venams Bight, and Snook's Arm penstock maintenance plans have not been adjusted to this more intensive inspection philosophy.

Holyrood TGS facility will remain fully available for generation in stand-by mode until March 31, 2021 (post-winter 2021) timeframe. Post-winter 2021, Units 1 and 2 and the steam components of Unit 3 at the Holyrood TGS will be decommissioned and Unit 3 will continue to operate in synchronous condenser mode, with no generation capability.

Holyrood TGS Units 1 and 2 were commissioned in 1970 and 1971, respectively, and Unit 3 in 1979. Holyrood TGS remains critical to the reliable power supply on the Island Interconnected System. The capital work contained in this plan is necessary to replace or refurbish assets that are necessary to contribute to reliable generation in the near term and other work that is required for reliable operation as a synchronous condenser facility.

Please refer to the Holyrood Overview section of this 2020 CBA for further discussion pertaining to the five-year plan for the Holyrood TGS and the Plan of Projected Operating Maintenance Expenditures 2020–2029 For Holyrood Thermal 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 to function as synchronous condensers (with the exception of the Holyrood Gas Turbine) to help support voltage control 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 system peaks, to support reliability and to and provide voltage support, especially when operating as synchronous condensers.

The 123.5 MW gas turbine located at the Holyrood TGS site has been in service since February 2015. 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 expected. Once the LIL is in service, running frequency for the Holyrood Gas Turbine is expected to be reduced and therefore there are no material projects in the five-year plan beyond the 2020 CBA, with the exception of a hot gas path inspection starting in 2024. The hot gas path inspection will depend on the number of starts accumulated up to that date, with an execution date to be determined.

The 50 MW Hardwoods and Stephenville Gas Turbines have required relatively minimal capital expenditure until recent years. There are no capital proposals in the 2020 CBA, or in the five-year plan for these facilities. These facilities will continue to be evaluated as part of the Reliability and Resource Adequacy Study.

Hydro's Happy Valley Gas Turbine was constructed in 1992. This plant has required only minor upgrades since that time and an overhaul in 2017. In addition to the projects proposed in the 2020 CBA, there are planned expenditures of $2 million in the remainder of the five-year capital plan for the Happy Valley Gas Turbine to maintain this facility.

5.0 Transmission and Rural Operations

The total planned investment of capital in transmission and rural operations facilities for the Island Interconnected System decreases in the five-year plan as result of the completion of major transmission projects between 2014 and 2018, namely TL 267 and TL 266. Approved and planned transmission investment for the Labrador Interconnected System continues until 2022. The Muskrat Falls to Happy Valley Interconnection project is scheduled for full completion in 2020, with the transmission interconnection portion started in 2019 and Happy Valley Terminal Station modifications in 2020. A project included in the 2020 Capital Plan is the Additions for Load – Increase Capacity for Labrador West. Hydro is developing a supplemental application to the 2019 Capital Budget to address the base load forecast for Labrador West; however, the technical analysis is not yet complete. This will include terminal station and distribution substation upgrades to meet load growth in Labrador West. The 2020 CBA does not seek approval of the funding for this project;[2] however, it has been included for completeness. Additional details on this project will be included in the Supplemental Capital Budget Application when filed. It is anticipated that this project, if approved, will be executed between 2019 and 2022.

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 included in Transmission and Rural Operations address assets that their condition dictate

[2] The 2020 Capital Budget Application financial schedules include a planned total value of $111,947,300; however, the 2020 CBA only seeks approval of $108,487,300, and excludes the planned 2019-2022 Additions for Load – Increase Capacity Labrador West project ($3,460,000 in 2020).

refurbishment is required, as well as projects that address assets that are at, or near the end of, their service lives and upgrades will improve reliability or performance. There are also projects that improve safety, or implement more efficient technology.

5.1 Terminal Stations

Maintaining reliability is the principal driver for terminal station expenditures over the next five years. Condition and equipment age are considered when reviewing short- and long-term plans. Hydro continues to implement and propose the Terminal Station Refurbishment and Modernization projects, which consolidate Hydro’s asset maintenance philosophies for terminal stations and will guide expenditures over the next five years. The five-year plan also contains expenditures such as projects to replace power transformers and the replacement of aging circuit breakers. As noted in the 2019 CBA, the approved scope and budget for the Upgrade Circuit Breakers – Various Sites (2016–2020) project was adjusted to reduce the number of circuit breaker replacements within the program by 10 and schedule their replacement to a timeframe after 2020 to balance investment and schedule over the five-year capital plan. The previous five-year program of circuit breaker replacement addressed the high volume of breakers to be replaced on an accelerated basis. Hydro is now transitioning to more steady state, condition based circuit breaker replacement. Therefore, the continued replacement of these and other circuit breakers have been included in the five-year plan as several two-year projects, starting in 2021. Hydro intends to consider adding circuit breaker replacement into its Terminal Station Refurbishment and Modernization Program for the 2021 CBA, as opposed to separate two-year projects. There is also a plan to replace power transformers starting in 2022, but this is subject to reassessment of the condition of the transformers as the project gets closer.

5.2 Transmission

Transmission investment in the five-year capital plan reflects the completion of several major projects, followed by a focus on improving reliability and sustaining the transmission asset base.

The major project to construct the transmission line between Bay d’Espoir and Western Avalon (TL 267) is in service as of December 6, 2017. Hydro received approval for the construction of TL 267 in Board Order No. P.U. 53(2014). As part of that approval, Hydro is required to file a report on the construction of TL 267 addressing the work progress, the expenditure and budget status, and an explanation for any deviations from the project scope and budget. The report is to be provided with each CBA filed until the completion of the project. Final completion of environmental rehabilitation has been carried over to 2019. The TL 267 update is presented as Attachment 1 of this 2020–2024 Capital Plan.

The Wood Pole Line Management ("WPLM") Program forms the backbone of Hydro's asset management strategy for its wooden transmission poles, with this strategy in place since 2005. Its effectiveness and value have been tested and demonstrated, as shown in the report "Review of Current WPLM Program, Interim Report,"[3] enabling Hydro to realize the maximum useful life from these transmission systems. An update to the 2013 CBA report on the WPLM Program was included in the 2019 CBA[4] (2019 CBA, 2019-2023 Capital Plan, Appendix C). The WPLM Program is based on structured, periodic assessment of the wood transmission poles and facilitates their replacement before failure, while extracting the maximum possible reliable life from each pole.

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 line replacement focused on worst performing feeders, and installation of recloser remote control on two lines in Hampden and Upper Salmon.

5.4 Rural Generation

The replacement of aging infrastructure is required to ensure reliability for Hydro's 20 isolated electrical systems, which are primarily supplied with electricity by diesel generating sets ("gensets"). At each isolated system, Hydro has a typical installation of between 3 and 5 individual gensets. Hydro's diesel gensets have the shortest lives of all its generating assets, requiring overhaul after 20,000 hours for 1800 rpm units and 30,000 hours for 1200 RPM units. Replacement of the gensets occurs after approximately 100,000 hours of operation for 1800 RPM units and 120,000 hours for 1200 RPM units. The 2020 CBA includes a project entitled Overhaul Diesel Units - Various, which discusses the philosophy regarding the change in timing for overhauls and replacement of 1200 RPM diesel engines versus the 1800 RPM units that formed the bulk of Hydro's diesel engines. Figure 1 provides the age distribution of the diesel engines in Hydro's rural generating plants. During the next five years, Hydro plans to replace

[3] Hydro's "2013 Capital Budget Application," August 2012, vol. II, tab 17, app. B.
[4] Hydro's "2019 Capital Budget Application," July 31, 2018, vol. I, "2019–2023 Capital Plan," app. C.

Gensets in various isolated diesel plants, with a planned project to replace units in Hopedale and St. Brendan's starting in 2021. These replacements 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, including annual proposals to install diesel plant fire protection, where appropriate. Projects for the replacement and upgrade of diesel plant infrastructure and auxiliary systems are included over the coming five years.

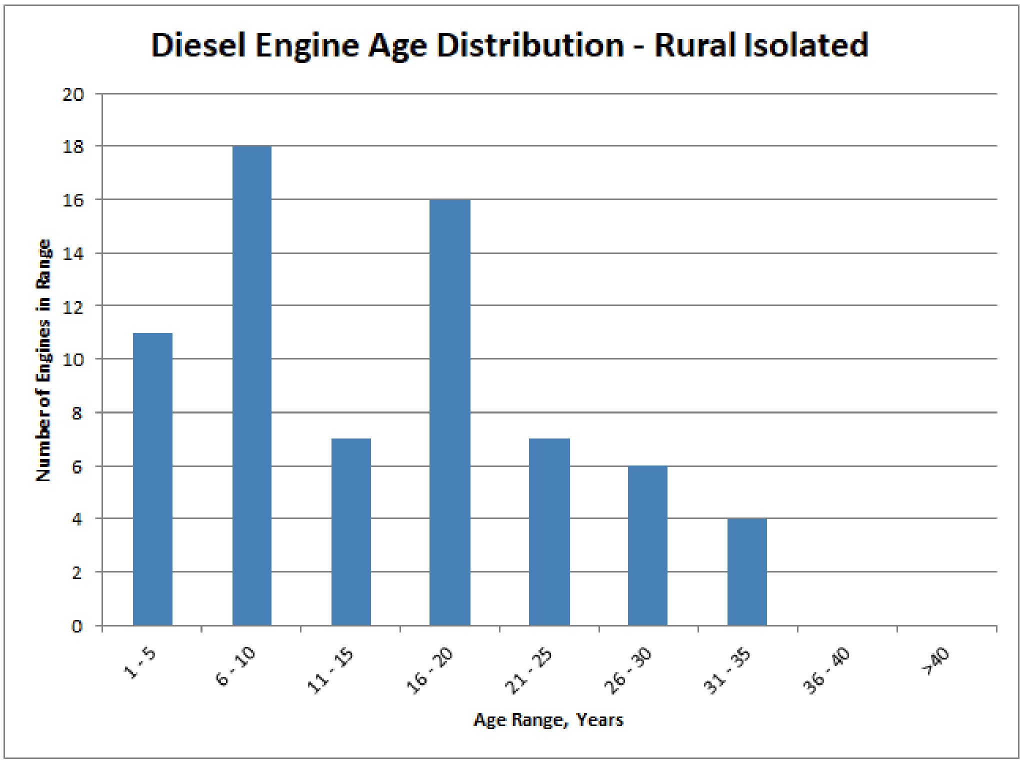

Figure 1: Diesel Engine Age Distribution for Rural Isolated Systems

6.0 General Property

Hydro's category of General Properties is a broad ranging group of assets and inicludes vehicles, facilities, 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. These types of replacements, similar to previous years, are planned 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, refurbish microwave sites, replace radomes, and replace obsolete radio equipment. The plan also includes site-specific projects to replace backup generation at microwave sites.

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 sometimes challenging and harsh physical environments. Hydro selects, operates, and maintains this equipment in a manner designed to achieve the least lifecycle 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 plans to continue annual expenditures over the next five years on items such as office equipment, building auxiliary systems, and building infrastructure.

Appendix A

Five-Year Capital Plan

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Five-Year Capital Plan
($000)

	Expended to 2019	2020	2021	2022	2023	2024	Total
Generation	12,301.7	20,702.9	40,292.8	35,792.6	31,370.9	35,860.8	176,321.7
Transmission and Rural Operations	97,862.3	84,720.9	60,885.4	65,962.8	63,414.5	58,074.3	430,920.1
General Properties	1,344.4	5,523.5	9,238.3	5,906.7	6,356.7	6,948.6	35,318.2
Allowance for Unforeseen	-	1,000.0	1,000.0	1,000.0	1,000.0	1,000.0	5,000.0
Total Capital Budget	**111,508.4**	**111,947.3**	**111,416.5**	**108,662.1**	**102,142.1**	**101,883.7**	**647,560.0**

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Five-Year Capital Plan
($000)

	Expended to 2019	2020	2021	2022	2023	2024	Total
Generation							
Hydraulic Plant	12,231.0	14,746.3	19,943.2	24,944.0	25,905.0	24,243.0	122,012.5
Thermal Plant	-	3,630.1	11,105.1	9,733.2	4,899.2	3,400.0	32,767.6
Gas Turbines	70.7	2,263.8	9,180.3	1,050.0	500.0	8,150.0	21,214.8
Tools and Equipment	-	62.7	64.2	65.4	66.7	67.8	326.8
Total Generation	**12,301.7**	**20,702.9**	**40,292.8**	**35,792.6**	**31,370.9**	**35,860.8**	**176,321.7**
Transmission and Rural Operations							
Terminal Stations	77,239.4	42,873.2	33,848.2	34,493.8	36,496.2	25,424.9	250,375.7
Transmission	12,586.4	10,184.8	2,888.6	2,745.5	2,289.1	2,884.4	33,578.8
Distribution	456.9	14,309.1	12,696.9	13,669.7	13,993.7	14,032.2	69,158.4
Rural Generation	7,356.6	15,308.5	8,488.4	11,975.0	7,555.0	13,600.0	64,283.5
Properties	223.0	862.1	1,427.0	1,352.5	1,239.5	1,078.6	6,182.7
Metering	-	244.2	196.8	194.8	193.9	195.0	1,024.7
Tools and Equipment	-	939.0	1,339.5	1,531.5	1,647.1	859.2	6,316.3
Total Transmission and Rural Operations	**97,862.3**	**84,720.9**	**60,885.4**	**65,962.8**	**63,414.5**	**58,074.3**	**430,920.1**
General Properties							
Information Systems	-	1,313.7	1,297.0	1,320.0	1,484.0	1,519.0	6,933.7
Telecontrol	96.3	1,640.8	3,907.2	1,253.4	1,496.0	2,027.9	10,421.6
Transportation	1,248.1	2,220.4	2,904.8	2,049.7	2,091.9	2,115.5	12,630.4
Administration	-	348.6	1,129.3	1,283.6	1,284.8	1,286.2	5,332.5
Total General Properties	**1,344.4**	**5,523.5**	**9,238.3**	**5,906.7**	**6,356.7**	**6,948.6**	**35,318.2**
Allowance for Unforeseen	**-**	**1,000.0**	**1,000.0**	**1,000.0**	**1,000.0**	**1,000.0**	**5,000.0**
Total Capital Budget	**111,508.4**	**111,947.3**	**111,416.5**	**108,662.1**	**102,142.1**	**101,883.7**	**647,560.0**

Newfoundland and Labrador Hydro
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($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Hydraulic Plant							
Hydraulic Generation Refurbishment and Modernization (2019–2020)	10,313.6	5,486.5	-	-	-	-	15,800.1
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	1,917.4	1,429.6	-	-	-	-	3,347.0
Hydraulic Generation Refurbishment and Modernization (2020–2021)	-	6,580.2	10,249.8	-	-	-	16,830.0
Hydraulic In-Service Failures (2020)	-	1,250.0	-	-	-	-	1,250.0
Hydraulic Generation Refurbishment and Modernization (2021–2022)	-	-	8,443.4	8,280.0	-	-	16,723.4
Hydraulic In-Service Failures (2021)	-	-	1,250.0	-	-	-	1,250.0
Hydraulic Generation Refurbishment and Modernization (2022–2023)	-	-	-	14,664.0	3,000.0	-	17,664.0
Burnt Dam Spillway and Victoria Control Structure Automation (2022–2023)	-	-	-	750.0	1,750.0	-	2,500.0
Hydraulic In-Service Failures (2022)	-	-	-	1,250.0	-	-	1,250.0
Hydraulic Generation Refurbishment and Modernization (2023–2024)	-	-	-	-	19,905.0	5,420.0	25,325.0
Hydraulic In-Service Failures (2023)	-	-	-	-	1,250.0	-	1,250.0
Hydraulic Generation Refurbishment and Modernization (2024–2025)	-	-	-	-	-	17,573.0	17,573.0
Hydraulic In-Service Failures (2024)	-	-	-	-	-	1,250.0	1,250.0
Total Hydraulic Plant	**12,231.0**	**14,746.3**	**19,943.2**	**24,944.0**	**25,905.0**	**24,243.0**	**122,012.5**

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($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Thermal Plant							
Rewind Unit 3 Stator - Holyrood	-	1,281.4	5,664.2	-	-	-	6,945.6
Thermal In-Service Failures (2020)	-	2,000.0	-	-	-	-	2,000.0
Replace Uninterruptible Power Supply 3 & 4 - Holyrood	-	348.7	-	-	-	-	348.7
Replace Stage II Electrical Distribution Equipment - Holyrood	-	-	2,513.2	2,269.6	-	-	4,782.8
Upgrade Waste Water Basin Building - Holyrood	-	-	116.7	1,362.7	-	-	1,479.4
Replace One of North or South Instrument Air Receiver System Unit 3 - Holyrood	-	-	753.0	-	-	-	753.0
Thermal In-Service Failures (2021)	-	-	750.0	-	-	-	750.0
Inspect and Overhaul Stacks - Holyrood	-	-	500.0	-	-	-	500.0
Upgrade DCS Controllers/Hardware	-	-	250.0	250.0	-	-	500.0
Replace One of North or South Service Air Receivers Unit 3 - Holyrood	-	-	308.0	-	-	-	308.0
Water Treatment Plant - Acid/Caustic Tank Upgrades - Holyrood	-	-	200.0	-	-	-	200.0
Upgrade Property Fencing - Holyrood	-	-	50.0	50.0	-	-	100.0
Replace Unit 3 Generator (slip rings, bushings, bearings, etc.) - Holyrood	-	-	-	1,000.0	1,000.0	1,000.0	3,000.0
Overhaul Unit 3 Generator - Holyrood	-	-	-	1,300.0	-	-	1,300.0
Install Lube Oil / Seal Oil Systems Unit 3 - Holyrood	-	-	-	260.0	770.0	-	1,030.0
Inspect and Upgrade Light Oil System - Holyrood	-	-	-	100.0	900.0	-	1,000.0
Replace Stage 1 4160 Vac Breakers - Holyrood	-	-	-	750.0	-	-	750.0
Thermal In-Service Failures (2022)	-	-	-	750.0	-	-	750.0
Replace High Bay Lighting with LED - Holyrood	-	-	-	15.9	609.2	-	625.1
Replace Unit 3 Protective Relaying - Holyrood	-	-	-	500.0	-	-	500.0
Upgrade On Site Roads - Holyrood	-	-	-	500.0	-	-	500.0
Upgrade Fire Suppression System - Holyrood	-	-	-	275.0	-	-	275.0
Upgrade WWTP 600 V Variable Frequency Drives - Holyrood	-	-	-	250.0	-	-	250.0
Upgrade Bio-Green/Sewage Treatment System - Holyrood	-	-	-	100.0	-	-	100.0
Thermal In-Service Failures (2023)	-	-	-	-	750.0	-	750.0
Refurbish Stage 2 Cooling Water Pumphouse - Holyrood	-	-	-	-	350.0	400.0	750.0
Upgrade Cooling Water System Wet Well Stop Log Unit 3 - Holyrood	-	-	-	-	320.0	-	320.0
Upgrade Holyrood Training Centre - Holyrood	-	-	-	-	200.0	-	200.0
Upgrade Water Treatment Plant - Holyrood (if required for H2 electrolyzer)	-	-	-	-	-	1,000.0	1,000.0
Thermal In-Service Failures (2024)	-	-	-	-	-	750.0	750.0
Upgrade Ambient Monitoring Stations - Holyrood	-	-	-	-	-	250.0	250.0
Total Thermal Plant	**-**	**3,630.1**	**11,105.1**	**9,733.2**	**4,899.2**	**3,400.0**	**32,767.6**

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2020 Capital Budget Application
Five-Year Capital Plan
($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Gas Turbines							
Upgrade Compressed Air System - Holyrood Gas Turbine	70.7	317.7	-	-	-	-	388.4
Perform Combustor Inspection - Holyrood Gas Turbine	-	546.1	4,927.4	-	-	-	5,473.5
Replace Fire Supression System - Happy Valley Gas Turbine	-	264.6	2,377.9	-	-	-	2,642.5
Generator Assessment - Happy Valley Gas Turbine	-	1,097.6	-	-	-	-	1,097.6
Install Partial Discharge Monitoring - Holyrood Gas Turbine	-	37.8	575.0	-	-	-	612.8
Replace Lube Oil and Glycol Pumps - Happy Valley Gas Turbine	-	-	100.0	300.0	-	-	400.0
Replace Snow Doors - Happy Valley Gas Turbine	-	-	350.0	-	-	-	350.0
Purchase Capital Spares - Gas Turbines (2021)	-	-	300.0	-	-	-	300.0
Replace Voltage Regulator - Happy Valley Gas Turbine	-	-	50.0	250.0	-	-	300.0
Install Infrared Scanning Ports - Happy Valley Gas Turbine	-	-	250.0	-	-	-	250.0
Construct Cooler Hoods - Holyrood Gas Turbine	-	-	200.0	-	-	-	200.0
Upgrade Compressed Air System - Happy Valley Gas Turbine	-	-	50.0	150.0	-	-	200.0
Purchase Capital Spares - Gas Turbines (2022)	-	-	-	300.0	-	-	300.0
Replace Shell and Tube Heat Exchanger Coil - Happy Valley Gas Turbine	-	-	-	50.0	150.0	-	200.0
Purchase Capital Spares - Gas Turbines (2023)	-	-	-	-	300.0	-	300.0
Replace Glycol Cooler Coil - Happy Valley Gas Turbine	-	-	-	-	50.0	250.0	300.0
Inspect Gas Turbine - Holyrood Gas Turbine	-	-	-	-	-	7,500.0	7,500.0
Purchase Capital Spares - Gas Turbines (2024)	-	-	-	-	-	300.0	300.0
Inspect Fuel Tanks - Holyrood Gas Turbine	-	-	-	-	-	100.0	100.0
Total Gas Turbines	**70.7**	**2,263.8**	**9,180.3**	**1,050.0**	**500.0**	**8,150.0**	**21,214.8**

Newfoundland and Labrador Hydro
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Five-Year Capital Plan
($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Tools and Equipment							
Purchase Tools and Equipment Less than $50,000 (2020) - Gas Turbine	-	26.0	-	-	-	-	26.0
Purchase Tools and Equipment Less than $50,000 (2020) - Hydraulic Plants	-	21.0	-	-	-	-	21.0
Purchase Tools and Equipment Less than $50,000 (2020) - Thermal Plants	-	15.7	-	-	-	-	15.7
Purchase Tools and Equipment Less than $50,000 (2021) - Gas Turbine	-	-	26.5	-	-	-	26.5
Purchase Tools and Equipment Less than $50,000 (2021) - Hydraulic Plants	-	-	21.6	-	-	-	21.6
Purchase Tools and Equipment Less than $50,000 (2021) - Thermal Plants	-	-	16.1	-	-	-	16.1
Purchase Tools and Equipment Less than $50,000 (2022) - Gas Turbine	-	-	-	27.0	-	-	27.0
Purchase Tools and Equipment Less than $50,000 (2022) - Hydraulic Plants	-	-	-	22.0	-	-	22.0
Purchase Tools and Equipment Less than $50,000 (2022) - Thermal Plants	-	-	-	16.4	-	-	16.4
Purchase Tools and Equipment Less than $50,000 (2023) - Gas Turbine	-	-	-	-	27.5	-	27.5
Purchase Tools and Equipment Less than $50,000 (2023) - Hydraulic Plants	-	-	-	-	22.4	-	22.4
Purchase Tools and Equipment Less than $50,000 (2023) - Thermal Plants	-	-	-	-	16.8	-	16.8
Purchase Tools and Equipment Less than $50,000 (2024) - Gas Turbine	-	-	-	-	-	28.0	28.0
Purchase Tools and Equipment Less than $50,000 (2024) - Hydraulic Plants	-	-	-	-	-	22.8	22.8
Purchase Tools and Equipment Less than $50,000 (2024) - Thermal Plants	-	-	-	-	-	17.0	17.0
Total Tools and Equipment	**-**	**62.7**	**64.2**	**65.4**	**66.7**	**67.8**	**326.8**
Total Generation	**12,301.7**	**20,702.9**	**40,292.8**	**35,792.6**	**31,370.9**	**35,860.8**	**176,321.7**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Terminal Stations							
Upgrade Circuit Breakers (2016–2020) - Various	39,783.7	11,116.8	-	-	-	-	50,900.5
Upgrade Terminal Station for Mobile Substation (2019–2020) - St. Anthony	89.3	402.7	-	-	-	-	492.0
Terminal Station Refurbishment and Modernization (2019–2020)	10,891.1	19,061.8	-	-	-	-	29,952.9
Additions for Load - Increase Capacity Labrador West	26,475.3	3,460.0	13,632.0	9,539.9	-	-	53,107.2
Terminal Station Refurbishment and Modernization (2020–2021)	-	3,712.0	6,067.8	-	-	-	9,779.8
Purchase Mobile Substation - Bishop's Falls	-	734.7	2,701.8	-	-	-	3,436.5
Replace Transformer T7 - Holyrood Terminal Station	-	2,678.1	-	-	-	-	2,678.1
Terminal Station In-Service Failures (2020)	-	1,500.0	-	-	-	-	1,500.0
Purchase SF_6 Multi Analyzer - Various	-	207.1	-	-	-	-	207.1
Terminal Station Refurbishment and Modernization (2021–2022)	-	-	7,589.6	13,382.8	-	-	20,972.4
Upgrade Circuit Breakers (2021–2022) - Various	-	-	1,730.0	2,550.0	-	-	4,280.0
Terminal Station In-Service Failures (2021)	-	-	1,500.0	-	-	-	1,500.0
Install Fire Barriers Between T10 & T12 and T10 & T11 - Bay d'Espoir	-	-	162.0	1,208.0	-	-	1,370.0
Install Fire Barriers between T1, T2, T3, & the Substation - Massey Drive	-	-	100.0	400.0	-	-	500.0
Construct Fire Separation Wall between Transformers - Happy Valley	-	-	300.0	-	-	-	300.0
Upgrade Transformer Paralleling T1, T2, and T3 (2021) - Massey Drive	-	-	65.0	-	-	-	65.0
Terminal Station Refurbishment and Modernization (2022–2023)	-	-	-	5,101.7	9,348.0	-	14,449.7
Replace Transformers T3 and T2 (2022-2023) - Wabush and Cat Arm	-	-	-	200.0	9,000.0	-	9,200.0
Upgrade Circuit Breakers (2022–2023) - Various	-	-	-	200.0	6,800.0	-	7,000.0
Terminal Station In Service Failures (2022)	-	-	-	1,500.0	-	-	1,500.0
Upgrade Drainage to Stop Frost Heaving - Various	-	-	-	200.0	400.0	400.0	1,000.0
Install Firewall Between Transformer and Gas Turbine - Stephenville	-	-	-	154.4	683.9	-	838.3
Replace Telecontrol Building and Upgrade Equipment - Peters Barren	-	-	-	57.0	764.0	-	821.0
Terminal Station Refurbishment and Modernization (2023–2024)	-	-	-	-	7,700.3	12,296.1	19,996.4
Upgrade Circuit Breakers (2023–2024) - Various	-	-	-	-	300.0	5,500.0	5,800.0
Terminal Station In-Service Failures (2023)	-	-	-	-	1,500.0	-	1,500.0
Terminal Station Refurbishment and Modernization (2024–2025)	-	-	-	-	-	4,500.0	4,500.0
Terminal Station In-Service Failures (2024)	-	-	-	-	-	1,500.0	1,500.0
Replace Capacitor Bank C1 (2024) - Oxen Pond	-	-	-	-	-	378.8	378.8
Upgrade Circuit Breakers (2024–2025) - Various	-	-	-	-	-	300.0	300.0
Upgrade Station Access Road (2024) - Various	-	-	-	-	-	250.0	250.0
Replace Switchgear - Various	-	-	-	-	-	200.0	200.0
Replace Transformers - Bay d'Espoir T3 (2024–2025)	-	-	-	-	-	100.0	100.0
Total Terminal Stations	**77,239.4**	**42,873.2**	**33,848.2**	**34,493.8**	**36,496.2**	**25,424.9**	**250,375.7**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Transmission							
Muskrat Falls to Happy Valley Interconnection	12,586.4	7,392.1	-	-	-	-	19,978.5
Perform Wood Pole Line Management Program - Various (2020)	-	2,792.7	-	-	-	-	2,792.7
Perform Wood Pole Line Management Program - Various (2021)	-	-	2,888.6	-	-	-	2,888.6
Perform Wood Pole Line Management Program - Various (2022)	-	-	-	2,745.5	-	-	2,745.5
Perform Wood Pole Line Management Program - Various (2023)	-	-	-	-	2,289.1	-	2,289.1
Perform Wood Pole Line Management Program - Various (2024)	-	-	-	-	-	2,884.4	2,884.4
Total Transmission	**12,586.4**	**10,184.8**	**2,888.6**	**2,745.5**	**2,289.1**	**2,884.4**	**33,578.8**

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Newfoundland and Labrador Hydro
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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Distribution							
Distribution System Upgrades (2019–2020) - Various	390.8	5,490.1	-	-	-	-	5,880.9
Install Recloser Remote Control (2019–2020) - Rocky Harbour	66.1	319.9	-	-	-	-	386.0
Provide Service Extensions - All Regions (2020)	-	4,284.0	-	-	-	-	4,284.0
Distribution System Upgrades (2020–2021)	-	102.7	3,154.4	-	-	-	3,257.1
Upgrade Distribution Systems - All Regions (2020)	-	3,195.0	-	-	-	-	3,195.0
Additions for Load Growth - Makkovik and Hopedale	-	846.1	-	-	-	-	846.1
Install Recloser Remote Control (2020–2021) - Hampden and Upper Salmon	-	71.3	185.3	-	-	-	256.6
Distribution System Upgrades (2021–2022)	-	-	348.1	4,022.7	-	-	4,370.8
Provide Service Extensions - All Regions (2021)	-	-	4,365.0	-	-	-	4,365.0
Upgrade Distribution Systems - All Regions (2021)	-	-	3,258.0	-	-	-	3,258.0
Additions for Load - Distribution System (2021)	-	-	678.9	-	-	-	678.9
Install Recloser Remote Control (2021–2022)- Various	-	-	50.0	513.3	-	-	563.3
Replace Insulators, L2 - Main Brook	-	-	300.0	-	-	-	300.0
Install Sectionalizing for Cold Load Pickup - Port Hope Simpson	-	-	257.2	-	-	-	257.2
Implement Geographical Information System - Various	-	-	100.0	100.0	-	-	200.0
Provide Service Extensions - All Regions (2022)	-	-	-	4,455.0	-	-	4,455.0
Distribution System Upgrades (2022–2023)	-	-	-	662.5	3,776.6	-	4,439.1
Upgrade Distribution Systems - All Regions (2022)	-	-	-	3,330.0	-	-	3,330.0
Install Recloser Remote Control (2022–2023)- Various	-	-	-	50.0	526.0	-	576.0
Additions for Load (2022)	-	-	-	500.0	-	-	500.0
Convert La Scie L7 to 25 kV - Bottom Waters	-	-	-	36.2	328.5	-	364.7
Distribution System Upgrades (2023–2024)	-	-	-	-	908.6	4,216.6	5,125.2
Provide Service Extensions - All Regions (2023)	-	-	-	-	4,536.0	-	4,536.0
Upgrade Distribution Systems - All Regions (2023)	-	-	-	-	3,393.0	-	3,393.0
Additions for Load (2023)	-	-	-	-	500.0	-	500.0
Install Recloser Remote Control (2023–2024) - Various	-	-	-	-	25.0	270.0	295.0
Provide Service Extensions - All Regions (2024)	-	-	-	-	-	4,626.0	4,626.0
Upgrade Distribution Systems - All Regions (2024)	-	-	-	-	-	3,465.0	3,465.0
Additions for Load (2024)	-	-	-	-	-	500.0	500.0
Distribution System Upgrades (2024–2025)	-	-	-	-	-	468.5	468.5
Convert Section of Line to 14.4 kV - King's Point	-	-	-	-	-	461.0	461.0
Install Recloser Remote Control (2024–2025) - Various	-	-	-	-	-	25.0	25.0
Total Distribution	**456.9**	**14,309.1**	**12,696.9**	**13,669.7**	**13,993.7**	**14,032.2**	**69,158.4**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Rural Generation							
Diesel Genset Replacements (2018–2020) - Makkovik	5,307.4	3,592.8	-	-	-	-	8,900.2
Diesel Genset Replacements (2019–2020) - Cartwright	525.6	3,421.8	-	-	-	-	3,947.4
Additions for Load - Isolated Generation Systems (2019–2020) - Makkovik	1,523.6	658.9	-	-	-	-	2,182.5
Diesel Genset Replacements - Mary's Harbour	-	3,900.7	-	-	-	-	3,900.7
Overhaul Diesel Units (2020) - Various	-	2,310.9	-	-	-	-	2,310.9
Diesel Plant Fire Protection (2020–2021) - Charlottetown	-	176.5	1,691.4	-	-	-	1,867.9
Replace Powerhouse Roofing System - L'Anse Au Loup and St. Anthony Diesel Plant	-	125.3	1,195.8	-	-	-	1,321.1
Diesel Plant Ventilation Upgrade - Nain	-	162.7	690.4	-	-	-	853.1
Inspect Fuel Storage Tanks (2020) - Charlottetown	-	467.2	-	-	-	-	467.2
Replace Automation Equipment - Rigolet	-	363.8	-	-	-	-	363.8
Replace Sewage Lift System - Rigolet	-	127.9	-	-	-	-	127.9
Diesel Genset Replacements (2021–2022) - Hopedale and St.Brendan's	-	-	600.0	3,500.0	-	-	4,100.0
Overhaul Diesel Units (2021) - Various	-	-	2,424.2	-	-	-	2,424.2
Install Fire Protection in Diesel Plants (2021–2022) - Port Hope Simpson	-	-	500.0	1,000.0	-	-	1,500.0
Upgrade Building Exterior - Postville	-	-	111.6	500.0	-	-	611.6
Additions for Load Growth - Isolated Generation Stations (2021) - Various	-	-	500.0	-	-	-	500.0
Inspect Fuel Storage Tanks (2021) - Postville	-	-	400.0	-	-	-	400.0
Replace Bulk Storage Piping - Black Tickle	-	-	300.0	-	-	-	300.0
Install Electric Trolly on Jib Crane - Various	-	-	75.0	75.0	-	-	150.0
Replace Diesel Engine - Various	-	-	-	3,300.0	2,200.0	-	5,500.0
Overhaul Diesel Units (2022) - Various	-	-	-	2,500.0	-	-	2,500.0
Install Fire Protection in Diesel Plants (2022–2023) - Mary's Harbour	-	-	-	500.0	1,055.0	-	1,555.0
Additions for Load Growth - Isolated Generation Stations (2022) - Various	-	-	-	500.0	-	-	500.0
Inspect Fuel Storage Tanks (2022) - Mary's Harbour	-	-	-	100.0	-	-	100.0
Replace Unit 2085 - Nain	-	-	-	-	500.0	4,000.0	4,500.0
Overhaul Diesel Units (2023) - Various	-	-	-	-	2,500.0	-	2,500.0
Install Fire Protection in Diesel Plants (2023–2024) - St. Lewis	-	-	-	-	500.0	1,000.0	1,500.0
Replace Unit 2058 - Little Bay Islands	-	-	-	-	100.0	1,000.0	1,100.0
Replace Unit 577 - Postville	-	-	-	-	100.0	1,000.0	1,100.0
Additions for Load Growth - Isolated Generation Stations (2023) - Various	-	-	-	-	500.0	-	500.0
Inspect Fuel Storage Tanks (2023) - Various	-	-	-	-	100.0	-	100.0
Overhaul Diesel Units (2024) - Various	-	-	-	-	-	2,500.0	2,500.0
Replace Diesel Gensets	-	-	-	-	-	2,400.0	2,400.0
Inspect Fuel Storage Tanks (2024) - Various	-	-	-	-	-	600.0	600.0
Install Fire Protection in Diesel Plants (2024–2025)	-	-	-	-	-	500.0	500.0
Additions for Load Growth - Isolated Generation Stations (2024) - Various	-	-	-	-	-	500.0	500.0
Automate Diesel Plant - Postville	-	-	-	-	-	100.0	100.0
Total Rural Generation	**7,356.6**	**15,308.5**	**8,488.4**	**11,975.0**	**7,555.0**	**13,600.0**	**64,283.5**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Properties							
Install Energy Efficiency Lighting in Diesel Plants - Various	223.0	122.2	-	-	-	-	345.2
Upgrade Line Depots (2020) - Various	-	648.3	-	-	-	-	648.3
Upgrade Fire Suppression System - Bishop's Falls	-	91.6	292.6	-	-	-	384.2
Upgrade Line Depots (2021–2022) - Various	-	-	387.7	624.2	-	-	1,011.9
Replace In-Floor Drains and Sanitary Lines - Bishop's Falls	-	-	746.7	-	-	-	746.7
Upgrade Line Depots (2022–2023) - Various	-	-	-	398.5	640.9	-	1,039.4
Upgrade Outside Property - Happy Valley	-	-	-	120.0	-	-	120.0
Replace Roof on Garage - Bishop's Falls	-	-	-	105.4	-	-	105.4
Upgrade HVAC System - Stephenville	-	-	-	104.4	-	-	104.4
Upgrade Line Depots (2023–2024) - Various	-	-	-	-	409.4	658.6	1,068.0
Upgrade Classroom and Boardroom in Main Office - Bishop's Falls	-	-	-	-	189.2	-	189.2
Upgrade Line Depots (2024–2025) - Various	-	-	-	-	-	420.0	420.0
Total Properties	**223.0**	**862.1**	**1,427.0**	**1,352.5**	**1,239.5**	**1,078.6**	**6,182.7**
Metering							
Purchase Meters and Metering Equipment (2020) - Various	-	244.2	-	-	-	-	244.2
Purchase Meters and Metering Equipment (2021) - Various	-	-	196.8	-	-	-	196.8
Purchase Meters and Metering Equipment (2022) - Various	-	-	-	194.8	-	-	194.8
Purchase Meters and Metering Equipment (2023) - Various	-	-	-	-	193.9	-	193.9
Purchase Meters and Metering Equipment (2024) - Various	-	-	-	-	-	195.0	195.0
Total Metering	**-**	**244.2**	**196.8**	**194.8**	**193.9**	**195.0**	**1,024.7**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Tools and Equipment							
Replace Light-Duty Mobile Equipment (2020) - Various	-	499.6	-	-	-	-	499.6
Purchase Tools and Equipment Less than $ 50,000 (2020) - Central Region	-	242.1	-	-	-	-	242.1
Purchase Tools and Equipment Less than $ 50,000 (2020) - Labrador Region	-	102.4	-	-	-	-	102.4
Purchase Tools and Equipment Less than $ 50,000 (2020) - Northern Region	-	94.9	-	-	-	-	94.9
Replace Light-Duty Mobile Equipment (2021) - Various	-	-	620.6	-	-	-	620.6
Replace Off Road Track Vehicle Unit No. 7565 - Stephenville	-	-	15.0	445.0	-	-	460.0
Replace Off-Road Track Vehicle No. V7601	-	-	300.0	-	-	-	300.0
Replace Back Hoe Unit No. 9813 - Holyrood	-	-	158.2	-	-	-	158.2
Purchase Tools and Equipment Less than $ 50,000 (2021) - Central Region	-	-	141.1	-	-	-	141.1
Purchase Tools and Equipment Less than $ 50,000 (2021) - Northern Region	-	-	77.6	-	-	-	77.6
Purchase Tools and Equipment Less than $ 50,000 (2021) - Labrador Region	-	-	27.0	-	-	-	27.0
Replace Light-Duty Mobile Equipment (2022) - Various	-	-	-	625.0	-	-	625.0
Replace Off Road Track Vehicle Unit No. 7698 - Stephenville	-	-	-	10.0	460.0	-	470.0
Replace Off Road Track Vehicle Unit No. 7799 - Stephenville	-	-	-	200.0	-	-	200.0
Purchase Tools and Equipment Less than $ 50,000 (2022) - Central Region	-	-	-	144.5	-	-	144.5
Purchase Tools and Equipment Less than $ 50,000 (2022) - Northern Region	-	-	-	79.4	-	-	79.4
Purchase Tools and Equipment Less than $ 50,000 (2022) - Labrador Region	-	-	-	27.6	-	-	27.6
Replace Light-Duty Mobile Equipment (2023) - Various	-	-	-	-	630.0	-	630.0
Replace Off-Road Track Vehicles No. V9829	-	-	-	-	300.0	-	300.0
Purchase Tools and Equipment Less than $ 50,000 (2023) - Central Region	-	-	-	-	147.8	-	147.8
Purchase Tools and Equipment Less than $ 50,000 (2023) - Northern Region	-	-	-	-	81.1	-	81.1
Purchase Tools and Equipment Less than $ 50,000 (2023) - Labrador Region	-	-	-	-	28.2	-	28.2
Replace Light-Duty Mobile Equipment (2024) - Various	-	-	-	-	-	635.0	635.0
Purchase Tools and Equipment Less than $ 50,000 (2024) - Central Region	-	-	-	-	-	102.6	102.6
Purchase Tools and Equipment Less than $ 50,000 (2024) - Northern Region	-	-	-	-	-	82.8	82.8
Purchase Tools and Equipment Less than $ 50,000 (2024) - Labrador Region	-	-	-	-	-	28.8	28.8
Replace Off Road Track Vehicle Unit No. 7974 - Stephenville	-	-	-	-	-	10.0	10.0
Total Tools and Equipment	**-**	**939.0**	**1,339.5**	**1,531.5**	**1,647.1**	**859.2**	**6,316.3**
Total Transmission and Rural Operations	**97,862.3**	**84,720.9**	**60,885.4**	**65,962.8**	**63,414.5**	**58,074.3**	**430,531.2**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Information Systems							
Software Applications							
Refresh Security Software (2020) - Hydro Place	-	110.2	-	-	-	-	110.2
Upgrade Software Applications (2020) - Hydro Place	-	65.4	-	-	-	-	65.4
Perform Minor Enhancements (2020) - Hydro Place	-	49.0	-	-	-	-	49.0
Upgrade Energy Management System (2021) - Hydro Place	-	-	381.5	-	-	-	381.5
Upgrade Software Applications (2021) - Hydro Place	-	-	100.0	-	-	-	100.0
Refresh Security Software (2021) - Hydro Place	-	-	60.0	-	-	-	60.0
Perform Minor Enhancements (2021) - Hydro Place	-	-	49.0	-	-	-	49.0
Upgrade Energy Management System (2022) - Hydro Place	-	-	-	391.0	-	-	391.0
Upgrade Software Applications (2022) - Hydro Place	-	-	-	100.0	-	-	100.0
Refresh Security Software (2022) - Hydro Place	-	-	-	60.0	-	-	60.0
Perform Minor Enhancements (2022) - Hydro Place	-	-	-	49.0	-	-	49.0
Upgrade Energy Management System (2023) - Hydro Place	-	-	-	-	400.0	-	400.0
Upgrade Software Applications (2023) - Hydro Place	-	-	-	-	100.0	-	100.0
Refresh Security Software (2023) - Hydro Place	-	-	-	-	60.0	-	60.0
Perform Minor Enhancements (2023) - Hydro Place	-	-	-	-	49.0	-	49.0
Upgrade Energy Management System (2024) - Hydro Place	-	-	-	-	-	410.0	410.0
Upgrade Software Applications (2024) - Hydro Place	-	-	-	-	-	100.0	100.0
Perform Minor Enhancements (2024) - Hydro Place	-	-	-	-	-	49.0	49.0
Refresh Security Software (2024) - Hydro Place	-	-	-	-	-	60.0	60.0
Total Software Applications	**-**	**224.6**	**590.5**	**600.0**	**609.0**	**619.0**	**1,415.1**

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Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Computer Operations							
Replace Personal Computers (2020) - Hydro Place	-	673.3	-	-	-	-	673.3
Replace Peripheral Infrastructure (2020) - Hydro Place	-	222.1	-	-	-	-	222.1
Upgrade Core OT Infrastructure (2020) - Hydro Place	-	193.7	-	-	-	-	193.7
Replace Personal Computers (2021) - Hydro Place	-	-	371.2	-	-	-	371.2
Replace Peripheral Infrastructure (2021) - Hydro Place	-	-	210.3	-	-	-	210.3
Upgrade Core IT Infrastructure (2021) - Hydro Place	-	-	125.0	-	-	-	125.0
Replace Personal Computers (2022) - Hydro Place	-	-	-	380.0	-	-	380.0
Replace Peripheral Infrastructure (2022) - Hydro Place	-	-	-	215.0	-	-	215.0
Upgrade Core IT Infrastructure (2022) - Hydro Place	-	-	-	125.0	-	-	125.0
Replace Personal Computers (2023) - Hydro Place	-	-	-	-	490.0	-	490.0
Replace Peripheral Infrastructure (2023) - Hydro Place	-	-	-	-	260.0	-	260.0
Upgrade Core IT Infrastructure (2023) - Hydro Place	-	-	-	-	125.0	-	125.0
Replace Personal Computers (2024) - Hydro Place	-	-	-	-	-	500.0	500.0
Replace Peripheral Infrastructure (2024) - Hydro Place	-	-	-	-	-	275.0	275.0
Upgrade Core IT Infrastructure (2024) - Hydro Place	-	-	-	-	-	125.0	125.0
Total Computer Operations	**-**	**1,089.1**	**706.5**	**720.0**	**875.0**	**900.0**	**4,290.6**
Total Information Systems	**-**	**1,313.7**	**1,297.0**	**1,320.0**	**1,484.0**	**1,519.0**	**6,933.7**

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Five-Year Capital Plan
($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Telecontrol							
Network Services							
Upgrade Telecontrol Facilities (2019–2020) - Gull Pond Hill and Bay d'Espoir Hill	96.3	577.6	-	-	-	-	673.9
Replace Radomes (2020) - Various	-	384.5	-	-	-	-	384.5
Replace Battery Banks and Chargers - Various (2020)	-	195.9	-	-	-	-	195.9
Replace Network Communications Equipment (2020) - Various	-	186.8	-	-	-	-	186.8
Replace RTUs (2020) - Various	-	157.1	-	-	-	-	157.1
Purchase Tools and Equipment Less than $50,000 (2020)	-	93.4	-	-	-	-	93.4
Upgrade Site Facilities (2020) - Various	-	45.5	-	-	-	-	45.5
Replace VHF Mobile Radio System - Various	-	-	2,000.0	-	-	-	2,000.0
Replace SCADA Communications Equipment - TL221	-	-	666.0	-	-	-	666.0
Replace Battery Banks and Chargers - Various (2021)	-	-	485.7	-	-	-	485.7
Replace Back-up Generator - Microwave Sites - Blue Grass Hill	-	-	200.0	200.0	-	-	400.0
Replace Network Communications Equipment (2021) - Various	-	-	180.0	-	-	-	180.0
Replace Radomes (2021) - Various	-	-	180.0	-	-	-	180.0
Replace RTUs (2021) - Various	-	-	100.0	-	-	-	100.0
Upgrade Site Facilities (2021) - Various	-	-	48.0	-	-	-	48.0
Purchase Tools and Equipment Less than $50,000 (2021)	-	-	47.5	-	-	-	47.5
Replace Battery Banks and Chargers - Various (2022)	-	-	-	496.8	-	-	496.8
Replace Network Communications Equipment (2022) - Various	-	-	-	180.0	-	-	180.0
Replace Radomes (2022) - Various	-	-	-	180.0	-	-	180.0
Replace RTUs (2022) - Various	-	-	-	100.0	-	-	100.0
Purchase Tools and Equipment Less than $50,000 (2022)	-	-	-	48.6	-	-	48.6
Upgrade Site Facilities (2022) - Various	-	-	-	48.0	-	-	48.0
Replace Power Line Carrier - (2023-2024)	-	-	-	-	90.0	950.0	1,040.0
Replace Battery Banks and Chargers - Various (2023)	-	-	-	-	508.3	-	508.3
Replace Back-up Generator - Microwave Sites (Bay d'Espoir Hill)	-	-	-	-	200.0	-	200.0
Replace Network Communications Equipment (2023) - Various	-	-	-	-	180.0	-	180.0
Replace Radomes (2023) - Various	-	-	-	-	180.0	-	180.0
Replace Network Management Tools - Various	-	-	-	-	140.0	-	140.0
Replace RTUs (2023) - Various	-	-	-	-	100.0	-	100.0
Purchase Tools and Equipment Less than $50,000 (2023)	-	-	-	-	49.7	-	49.7
Upgrade Site Facilities (2023) - Various	-	-	-	-	48.0	-	48.0
Replace Battery Banks and Chargers - Various (2024)	-	-	-	-	-	520.0	520.0
Replace Network Communications Equipment (2024) - Various	-	-	-	-	-	180.0	180.0
Replace Radomes (2024) - Various	-	-	-	-	-	180.0	180.0
Replace RTUs (2024) - Various	-	-	-	-	-	100.0	100.0
Purchase Tools and Equipment Less than $50,000 (2024)	-	-	-	-	-	49.9	49.9
Upgrade Site Facilities (2024) - Various	-	-	-	-	-	48.0	48.0
Total Telecontrol	**96.3**	**1,640.8**	**3,907.2**	**1,253.4**	**1,496.0**	**2,027.9**	**10,421.6**

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Five-Year Capital Plan
($000)

Project Description	Expended to 2019	2020	2021	2022	2023	2024	Total
Transportation							
Replace Vehicles and Aerial Devices (2019-2020) - Various	1,248.1	594.9	-	-	-	-	1,843.0
Replace Light- and Heavy-Duty Vehicles - Various (2020–2021)	-	1,625.5	1,583.5	-	-	-	3,209.0
Replace Light- and Heavy-Duty Vehicles - Various (2021–2022)	-	-	1,321.3	724.7	-	-	2,046.0
Replace Light- and Heavy-Duty Vehicles - Various (2022–2023)	-	-	-	1,325.0	741.9	-	2,066.9
Replace Light- and Heavy-Duty Vehicles - Various (2023–2024)	-	-	-	-	1,350.0	760.5	2,110.5
Replace Light- and Heavy-Duty Vehicles - Various (2024–2025)	-	-	-	-	-	1,355.0	1,355.0
Total Transportation	**1,248.1**	**2,220.4**	**2,904.8**	**2,049.7**	**2,091.9**	**2,115.5**	**12,630.4**
Administration							
Remove Safety Hazards (2020) - Various	-	198.6	-	-	-	-	198.6
Replace Elevator Motors and Controls Equipment - Hydro Place	-	89.1	647.6	-	-	-	736.7
Purchase Office Equipment Less than $50,000 (2020)	-	60.9	-	-	-	-	60.9
Refurbish Office Buildings (2021-2022) - Various	-	-	200.0	500.0	-	-	700.0
Remove Safety Hazards (2021) - Various	-	-	219.6	-	-	-	219.6
Purchase Office Equipment Less than $50,000 (2021)	-	-	62.1	-	-	-	62.1
Refurbish Office Buildings (2022-2023) - Various	-	-	-	500.0	500.0	-	1,000.0
Remove Safety Hazards (2022) - Various	-	-	-	220.0	-	-	220.0
Purchase Office Equipment Less than $50,000 (2022)	-	-	-	63.6	-	-	63.6
Refurbish Office Buildings (2023-2024) - Various	-	-	-	-	500.0	500.0	1,000.0
Remove Safety Hazards (2023) - Various	-	-	-	-	220.0	-	220.0
Purchase Office Equipment Less than $50,000 (2023)	-	-	-	-	64.8	-	64.8
Refurbish Office Buildings (2024-2025) - Various	-	-	-	-	-	500.0	500.0
Remove Safety Hazards (2024) - Various	-	-	-	-	-	220.0	220.0
Purchase Office Equipment Less than $50,000 (2024)	-	-	-	-	-	66.2	66.2
Total Administration	**-**	**348.6**	**1,129.3**	**1,283.6**	**1,284.8**	**1,286.2**	**5,332.5**
Total General Properties	**1,344.4**	**5,523.5**	**9,238.3**	**5,906.7**	**6,356.7**	**6,948.6**	**32,315.2**
Total (Including Allowance for Unforeseen Items)	**111,508.4**	**111,947.3**	**111,416.5**	**108,662.1**	**102,142.1**	**101,883.7**	**647,560.0**

Attachment 1

TL 267 Project
230 kV Transmission Line Bay d'Espoir to Western Avalon
Annual Report

TL 267 Project
230 kV Transmission Line
Bay d'Espoir to Western Avalon
Annual Report

July 2019

A report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
a nalcor energy company

Executive Summary

The Board of Commissioners of Public Utilities ("Board") approved the Newfoundland and Labrador Hydro ("Hydro") Upgrade of Transmission Line Corridor ("Project") on December 12, 2014, with a total capital expenditure of approximately $292 million and an in-service date of May 1, 2018. As TL 267 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 before the winter of 2017.

The project includes expansion of the Bay d'Espoir Terminal Station 2 ("Bay d'Espoir TS2"), expansion of the Western Avalon Terminal Station ("Western Avalon TS") located in Chapel Arm, and construction of 188 km of 230 kV transmission line.

The Project is substantially complete, and the line was successfully energized and placed in service on December 6, 2017.

Work completed in 2018 includes: re-termination of the TL 208 line at Western Avalon TS to the new station equipment; environmental reclamation work along the right of way and addressing any final deficiencies along the line; environmental monitoring; material reconciliation; establishing spare parts inventory; and preparation of as-built drawings.

The final line reclamation task, which is an Environmental Assessment requirement, involves removing bridges near the Bay du Nord Wilderness Reserve ("Reserve") and was originally scheduled to be completed in November/December 2018. However, significant amounts of precipitation in October and November resulted in high water levels at the bridge locations that did not recede enough to allow the bridge removals to safely proceed in 2018. As such, this work was deferred until conditions permit in the summer of 2019.

Cost expenditure is tracking as planned and under budget, with expenditures to date of approximately $286 million.

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4.0 Environmental Assessment 2
5.0 Procurement 3
6.0 Construction 3
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1.0 Introduction

The Board approved the Project on December 12, 2014. The Project, known as TL 267, involves the design and construction of 188 kilometres of 230 kV steel tower transmission line, as well as station expansions at Bay d'Espoir TS2 and Western Avalon TS. The approved capital expenditure is $291,658,000. As directed by the Board as part of the approval of the Project, an annual report shall be filed with each capital budget application until completion of the Project.[1]

2.0 Project Description

On April 30, 2014, Hydro filed an application for approval to construct a 230 kV transmission line between the Bay d'Espoir Hydroelectric Generation Station, in particular Bay d'Espoir TS2 and Western Avalon TS, 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 provides additional capacity, enhances resiliency to system faults, and relieves 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 No. 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 TS2, including:
    a. Two circuit breakers and associated disconnect switches; and
    b. Electrical and protection and control equipment.
2) The addition of gas-insulated switchgear ring bus in Western Avalon TS; and
3) A new 230 kV transmission line, 188 km in length, linking the two stations.

[1] Board Order No. P.U. 53(2014), December 12, 2014, at p. 5/8–11.

The two sub-projects are:

1) Modifications to Bay d'Espoir 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 Western Avalon TS to connect TL 208, which currently services the Vale site, to the new station equipment.

The Project is substantially complete and the line was successfully energized and placed in service on December 6, 2017. Work completed in 2018 included the re-termination of the TL 208 line at Western Avalon TS to the new station equipment; environmental reclamation work along the right-of-way and addressing any final deficiencies along the line; environmental monitoring; material reconciliation and establishing spare parts inventory; and preparation of as-built drawings.

The final reclamation task, which is an Environmental Assessment requirement, involves removing bridges near the Reserve and was originally scheduled to be completed in November/December 2018. However, significant amounts of precipitation in October and November resulted in high water levels at the bridge locations, which did not recede enough to allow the bridge removals to safely proceed in 2018. As such, this work was deferred until conditions permit in the summer of 2019.

3.0 Engineering

The Project, including all station modifications and line designs, utilizes all of the latest industry standards, practices, operational experience, and design criteria currently in use by Hydro. Modifications to the terminal stations include the latest electrical and protection and control equipment. Detailed design for the Project is complete.

4.0 Environmental Assessment

Given the size and nature of the Project, registration for environmental assessment under the *Environmental Protection Act* was required. The environmental assessment registration document for the Project was an enhanced registration document that 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.

As consultation is a cornerstone of the environmental assessment 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. The release from further Environmental Assessment was subsequently issued by the Department of Environment and Conservation on June 15, 2016.

The preparation of a Decommissioning Plan was a requirement of the Project's environmental assessment Release. The Decommissioning Plan addresses concerns specific to Hydro's operations and assets constructed adjacent to the Reserve. The plan details what assets are to be decommissioned as well as plans for limiting and discouraging illegal public access to the Reserve. The Decommissioning Plan also details the proposed methods for rehabilitating quarries, borrow areas, roads, and trails following the completion of construction on the Project.

The environmental reclamation work outlined in the Decommissioning Plan was completed in 2018 with exception of the bridge removal near the Reserve. This final reclamation task is scheduled to be completed once conditions permit in the summer of 2019.

5.0 Procurement

Procurement activities are complete.

6.0 Construction

Construction started with the commencement of the transmission line clearing in June 2016. Transmission line construction subsequently began in August 2016, followed closely by construction in the Bay d'Espoir TS2 and Western Avalon TS in September 2016.

The Project is substantially complete, and the line was successfully energized and placed in service on December 6, 2017.

The final reclamation task involves removing bridges near the Reserve and is scheduled to be completed once conditions permit in the summer of 2019.

7.0 Cost

The bulk of the project expenditure occurred in 2016 and 2017, with a smaller fraction of spend in 2018 and 2019 for the scope described in Section 2.0. The expenditures are summarized as follows: $2.1 million (2015), $59.3 million (2016), $213.6 million (2017), $10.1 million (2018), and $2.5 million (2019). Expenditures over the last 12 months covered by this annual report primarily include construction-related costs.

The project S-Curve (Figure 1) reflects expenditures to the end of May 2019. Overall, $286 million has been expended on the project to date and the project is forecasted to be completed under budget at $288 million (original budget $291.7 million).

All of the major construction contracts have been closed out, with the only open contract being for the remaining reclamation work described above.

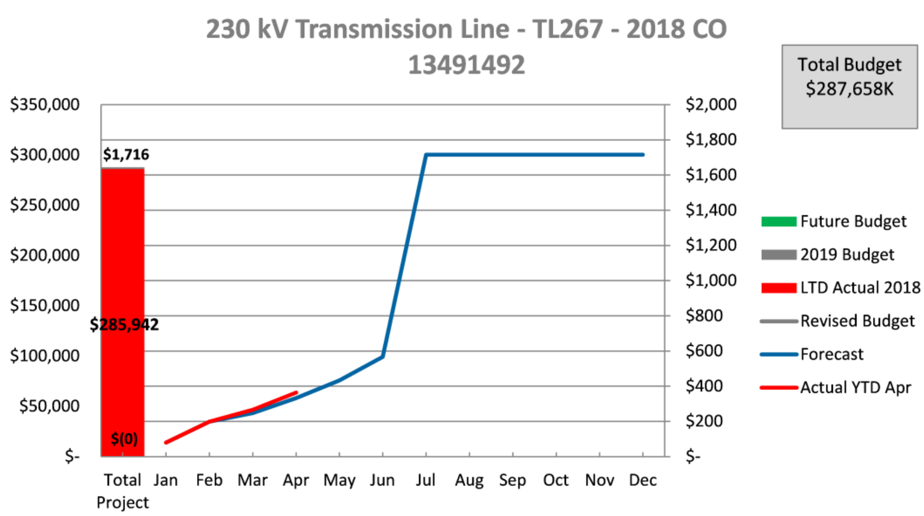

Figure 1: Project S-Curve

8.0 Schedule

All work is complete except for the remaining environmental reclamation work described above, which will take place when conditions permit in the summer of 2019.

2020 Capital Budget Application
Holyrood Thermal Generating Station Overview Future Operation and Capital Expenditure Requirements

July 2019

A report to the Board of Commissioners of Public Utilities

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1.0 Background

In Board Order No.s P.U. 5(2012) and P.U. 4(2013), the Board of Commissioners of Public Utilities ("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 TGS"). The Board required the overview to include the following: [1]

- An updated outlook regarding anticipated changes in the role of the Holyrood TGS on the system;
- An updated schedule of anticipated changes in the Holyrood TGS operations that may reasonably be expected to have an impact on capital expenditure requirements;
- A summary description of all proposed Holyrood TGS 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 the Holyrood TGS's role on the system;
- A summary guide to all internal and external reports filed in support of the capital expenditure proposals, summarizing alternatives considered and recommendations made; and
- An explanation of the necessity of all proposed capital expenditures in the context of the anticipated changes in the Holyrood TGS operations.

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

[1] Board Order No. P.U. 5(2012), p. 14

2.0 Introduction

The Holyrood TGS is a critical part of the Island Interconnected System. With three oil-fired generating units providing an installed capacity of 490 MW, the plant represents approximately one third of Hydro's Island Interconnected System generating capacity and approximately one quarter of the total Island Interconnected System 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 each and 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 Island Interconnected System 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 Island Interconnected System. The generator itself is pressurized and cooled by hydrogen gas to provide maximum efficiency both in heat transfer and reduced windage losses.[2]

The Holyrood TGS is necessary to reliably meet both winter peak demand and annual energy requirements. The Holyrood TGS supplies the balance of customer load that cannot currently be met by Hydro's hydroelectric generating facilities, purchases from non-utility generators and customer owned generation. Annual production at the Holyrood TGS will vary depending on hydroelectric reservoir storage and inflows. In the existing system configuration, the Holyrood TGS units also provide voltage support to 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.

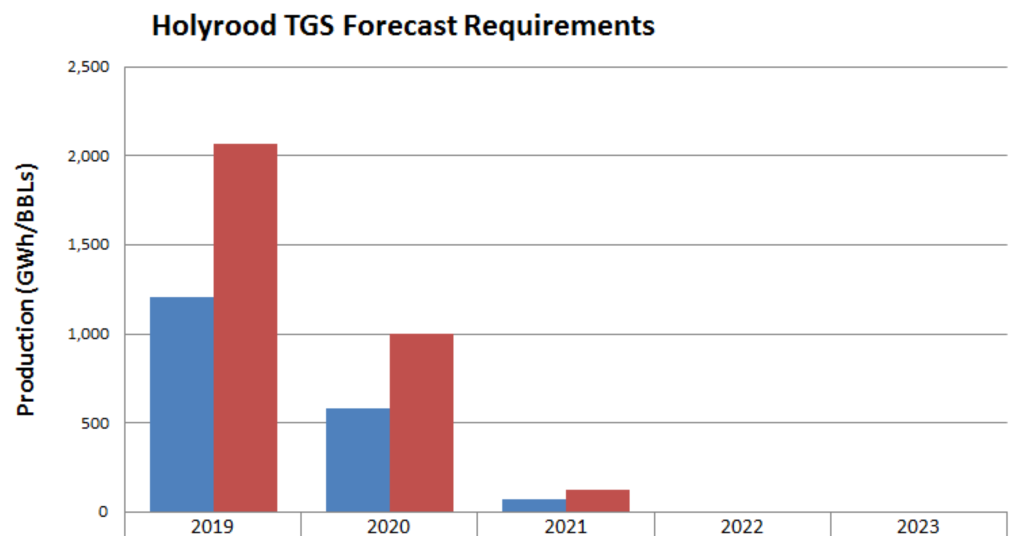
Figure 1: Holyrood Thermal Generating Station

3.0 Current Operational Outlook and Schedule

Work remains underway on the construction and integration of the Muskrat Falls Project Assets. The Muskrat Falls hydroelectric generating facility and the HVdc Labrador-Island Link ("LIL") will transmit power from Muskrat Falls to the Soldiers Pond Facility on the Avalon Peninsula. The LIL will provide the Island Interconnected System with a second interconnection to the North American Grid, with the Maritime Link being the first. The LIL is expected to be in-service in bipole configuration in early 2020.

Through 2019, Hydro was able to reduce required production from Holyrood through use of both the LIL and the Maritime Link. Hydro expects to continue importing energy from off-island supply to reduce production at the Holyrood TGS when technically and economically feasible. Hydro will continue to use the Holyrood TGS to provide reliable service to customers, and as satisfactory operating experience is obtained over the LIL, the Holyrood TGS 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 from off-island supply, including Muskrat Falls, and sustained reliable operation of the interconnections.

While in standby mode, the plant will remain fully available for generation and will be operated as required to ensure availability until Hydro is satisfied with the reliability of the Muskrat Falls assets. At that time, 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.



	2019	2020	2021	2022	2023
Holyrood TGS Production (GWh)	1,209	587	75	0	0
Production (BBLs)	2,066	1,005	129	0	0

Figure 2: Holyrood TGS Annual Production Requirements 2019 to 2023

Figure 2 indicates the Holyrood TGS's forecasted annual production requirements for the five-year period from 2019 to 2023. Forecasts are based on average hydrologic inflow conditions. The LIL is expected to supplement the supply to the Island Interconnected System by delivering power from the Muskrat Falls Generating Station and Recapture Energy[3] in excess of Labrador Interconnected System requirements.

[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 Churchill Falls 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.

The production at the Holyrood TGS may vary from the forecast depending on customer requirements, the timing of in-service of the Muskrat Falls 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 early 2020): 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 (Early 2020 through to the end of the winter 2021): All three units are available for prime power generation with Unit 3 also available for synchronous condenser operation, as required. Units will be placed in Standby Mode as reliable Muskrat Falls assets are proven, Unit 3 will be operated in synchronous condenser mode, as required; and
- **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. The Holyrood TGS Units 1 and 2 have been placed in Standby Mode, until decommissioning is appropriate. The Holyrood TGS Unit 3 continues to operate as a synchronous condenser. There will be no power production from the Holyrood TGS after remaining excess fuel has been consumed.

The systems to be decommissioned once generation is no longer required include:

- 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 TGS Operating Requirements 2019-2023

Year	Holyrood TGS Production (GWh)	Total Unit Operating Hours	Annual Required Hydro Generation (GWh)	Holyrood TGS Production as Percentage of Total Load
2019	1,209	13,410	7,261	17%
2020	587	8,666	7,342	8%
2021	75	1,498	7,251	1%
2022	N/A	N/A	N/A	N/A
2023	N/A	N/A	N/A	N/A

There are two active factors that may influence the current planned phases and schedule for Holyrood's contribution to the Island Interconnected System. First, the final timing of the reliable in-service of the Muskrat Falls assets, and second, the outcome of the Reliability and Resource Adequacy Study review with the Board. Either factor, or both, could result in Holyrood continued operation beyond the current schedule contained in this plan. Through fall 2019, Hydro is expecting to have further information on Muskrat Falls assets and schedule expectations that could impact Holyrood schedule. The Reliability and Resource Adequacy Study review process with the Board is expected to extend in 2020.

4.0 Maintenance Strategy through the Operational Phases

Phase 1 will continue through early 2020. Scheduled overhauls of plant equipment continue during this phase to ensure plant reliability. The upgrade of equipment at or near the end of its useful service life and replacement of obsolete equipment that could no longer be maintained was also continued with serious consideration given to the short service life.

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, allowing Hydro to reduce cost while maintaining reliability.

In Phase 3, assets with operational synchronous condenser requirements beyond the winter 2020-2021 timeframe will continue to be optimally maintained with investment reflecting that continued requirement.

5.0 Holyrood 2020 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 2020 capital project proposals (Tables 2, 3, and 4) were 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 2020 capital projects for the Holyrood TGS. 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 Muskrat Falls Project assets.

Hydro is managing several deteriorating pieces of infrastructure, notably the waste water basins building, concrete exhaust stacks, and fuel oil storage tanks, with the intention of reaching end-of-generation life with minimal refurbishment costs. Condition assessments have been completed recently and will continue for these assets and other assets as required. Minor interventions have been 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 projects to Replace Uninterruptable Power Supplies ("UPS") 3 and UPS 4 and to Rewind the Unit 3 Generator Stator will replace and upgrade important assets that are required for Phase 3, Synchronous Condenser Operation. This work will ensure long-term reliable operation of these assets during synchronous condenser 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 the Holyrood TGS.

Table 2: Holyrood TGS Projects Included in the 2020 Capital Plan

Project	Scope Summary	Proposal Location
Rewind Unit 3 Generator Stator	This project proposes to rewind the Unit 3 generator stator. The existing stator windings are original and have been in operation since 1980. Generator winding insulation breaks down over time and, because of the age of these windings, there is an elevated risk of a catastrophic failure. This project will rewind the stator to ensure reliable synchronous condenser operation in Phase 3. The generator rotor was already rewound in 2016.	>$500k Projects Report in Volume II, Tab 2
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 to reduce downtime and increase availability should a failure of a key component occur.	>$500k Projects in Summary, Tab C
Replace UPS 3 & 4	There are four UPS at Holyrood, all of which are obsolete. This project proposes the replacement of UPS 3 and UPS 4, which are the UPS assets required for Phase 3 operation. This will ensure long-term reliable operation of these assets during synchronous condenser operation.	>$200k and <$500k Projects in Summary, Tab D

Table 3: Reports Filed in Support of the 2020 Project Proposals

Project	Reports filed	Alternatives Considered	Recommendation
Rewind Unit 3 Generator Stator	-	There are no alternatives	Rewind the stator
Thermal In-Service Failures	-	There are no alternatives	Complete refurbishments/ replacements as required
Replace UPS 3 & 4	-	There are no alternatives	Replace UPS 3 & 4

Table 4: 2020 Project Necessity in the Context of Changing Role of the Holyrood TGS

		Necessity by Operational Phase		
Major System or Subsystem	**Project**	**Phase 1**[4]	**Phase 2**[5]	**Phase 3**[6]
Fuel Storage & Delivery	No projects included	-	-	-
Feedwater & Condensate	No projects included	-	-	-
Boiler	No projects included	-	-	-
Turbine Generator	Rewind Unit 3 Generator Stator	-	Required	Required
Cooling Water Systems	No Projects Included	-	-	-
Buildings & Grounds	No projects included	-	-	-
Common Systems	Replace UPS 3 & 4	-	Required	Required

6.0 Holyrood TGS 2020-2024 Capital Expenditures Outlook

Capital investment will be necessary throughout the period of 2020 to 2024 to ensure continued security of supply and maintenance of the level of service required in generation and synchronous condenser operations. Various types of investments and expenditures for the Holyrood TGS are anticipated, including refurbishment, upgrade or replacement of failed or obsolete equipment, and general plant infrastructure work. In reviewing future capital projects for the Holyrood TGS, Hydro has considered the three phases of operations and will submit for approval only those projects it deems

[4] Phase 1: 2016 to early 2020 – normal production.
[5] Phase 2: Early 2020 to end of winter 2021 – stand-by production.
[6] Phase 3: Post-winter 2021 – synchronous condenser operation.

necessary for the safe and reliable operation of the plant as a generator up to the time of decommissioning.[7]

Capital projects proposed are reviewed in light of the future plant requirements and considered essential to fulfill Hydro’s mandate to serve its customers and meet safety and environmental requirements.

The maintenance strategy for the Holyrood TGS to its end-of-life as a generating station is to extend the life of the existing assets at minimum cost through continued preventive 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. Phase 1 will be complete in early 2020.[8] Phase 2 entails minimal changes in the 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 deteriorate 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 used to determine the optimal work plan for the assets in light of the changing role of Holyrood.

Figure 3 provides the planned level of expenditure for the Holyrood TGS over the 2020 to 2024 period. The annual average expenditure is $6.1 million, ranging from a high of $11.1 million in 2021 to a low of $3.4 million in 2024. Details regarding the planned capital expenditures are in the “2020-2024 Capital Plan Report,” Appendix A, Thermal Plant, p. A-4.

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[7] In the event Hydro is required to apply for a supplemental application for a Holyrood capital addition it could result in a significant increase to depreciation under the accelerated depreciation approach. As a result, under this scenario Hydro may also apply for a deferral account to amortize the asset over a longer period of time.

[8] Hydro continues to track progress of the Muskrat Falls Project, which could impact the timing of the transitional phases.

All of the projects in the plan are required for the Phase 3 operation. Planned expenditures for the five-year period total $32.8 million.

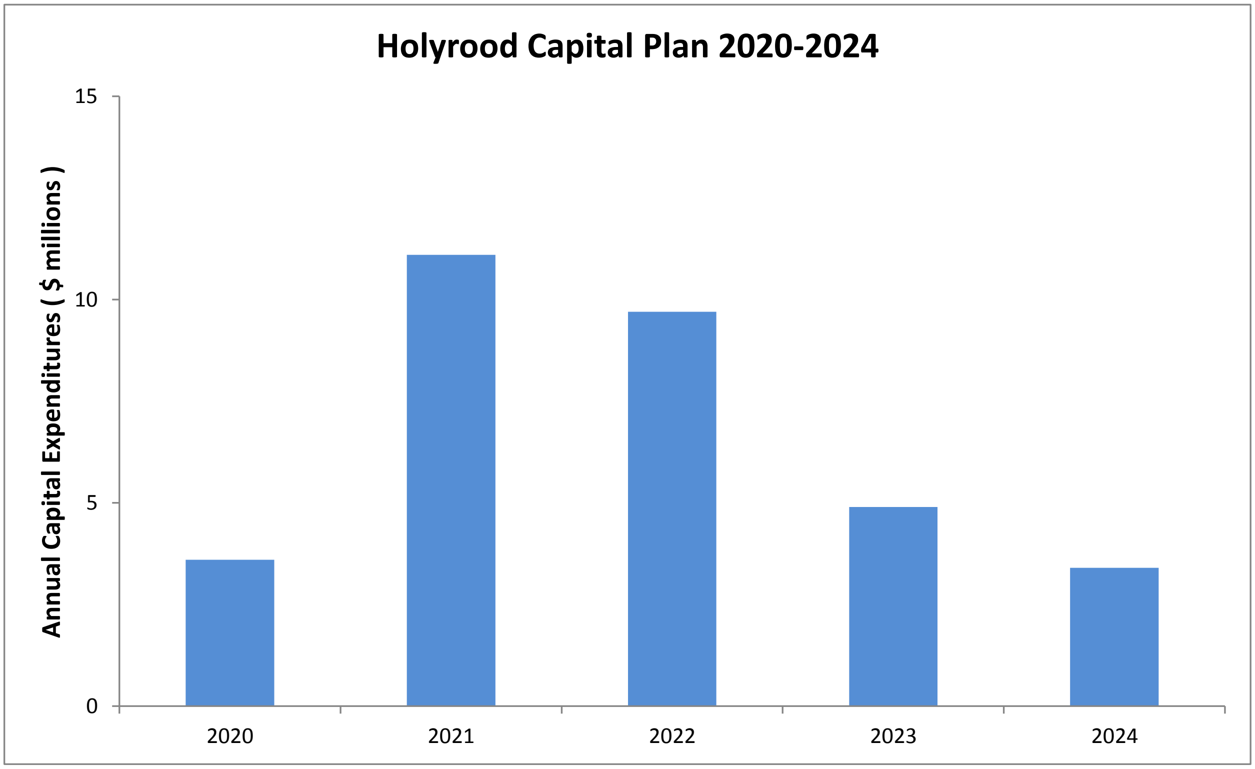

Figure 3: Holyrood TGS Capital Expenditures 2020 to 2024

Holyrood Project Operating and Maintenance Expenditures

2020 Capital Budget Application
Plan of Projected Holyrood Operating Maintenance Expenditures 2020–2029

July 2019

A report to the Board of Commissioners of Public Utilities

newfoundland labrador hydro
a nalcor energy company

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Appendix C: 10-Year SEM Expenditures for Ancillary Equipment

1.0 Introduction

In Order No. P. U. 14(2004), the Board of Commissioners of Public Utilities ("Board"), directed Newfoundland and Labrador Hydro ("Hydro") to **"**file a ten year plan of maintenance expenditures for the Holyrood Generating Station 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 this report. Capital expenditures for the Holyrood Thermal Generating Station ("Holyrood TGS") are submitted annually to the Board with other Hydro capital proposals as part of the annual Capital Budget Application ("CBA"), and are discussed in the Holyrood Overview.

This report addresses the identified and expected maintenance expenditures for the years 2020 to 2029 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 49 years and that Unit 3 and its associated equipment have been in service for 39 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 ten-year plan of SEM is difficult to complete. The harsh operating environment, evolving production requirements, Muskrat Falls asset in-service schedule, Reliability and Resource Adequacy Study review outcomes, the shift to synchronous condensing operation, and the age of units may trigger revision of the maintenance plan to address unforeseen events. The plan currently reflects the operational phases provided in the Holyrood Overview, with no power production after March 31, 2021, and the continuation of synchronous condenser function for Unit 3 into the future. 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 the Holyrood TGS.[2]

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[1] Board Order No. P.U. 14(2004), at p.166.
[2] Hydro continues to track progress of the Muskrat Falls Project, which could impact the timing of the transitional phases, as well as the SEM expenditures.

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."[3]

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 its impact on safe, reliable service when applying maintenance strategies and tactics. There are four main types or categories of maintenance undertaken at Holyrood: 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 when it is less costly to do so rather than repairing or refurbishing them.

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

[3] Board Order No. P.U. 14(2004), at p. 64.

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. Boiler 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, and 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 boiler overhaul. In some cases the nature of defined work meets the criteria for capitalization; in such cases it 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 usually 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 the Holyrood TGS 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 through C set out the ten-year maintenance plan for Holyrood. Appendix A is a summary that outlines the expected expenditures in each of the major equipment groupings containing SEM costs for the years 2020 to 2029. Appendices B and C 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 2020 to 2029 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, all boiler overhauls are expected to be on a reduced scope. No boiler overhauls are expected beyond 2020; and
- **Operating Projects**: Non-capitalized projects justified on the basis of safety, environment, reliability, or cost benefit analysis.

Appendix C provides a listing of the remaining ancillary equipment groupings, including Common Equipment, Building and Grounds, Water Treatment Plant, Waste Water Treatment Plant, and Environmental Monitoring and detail only Preventive, Corrective, and Operating Projects.

It should be noted that this ten-year plan spans the period during which the role of the Holyrood TGS will change as a result of the in-service of the Muskrat Falls assets and the interconnection between Labrador and the Island. These events significantly impact cost and activity levels for the standby period and for the synchronous condenser period, as reflected in this plan. Generation from the Holyrood TGS has already begun to reduce as a result of the availability of the Labrador Island Transmission Link and the Maritime Link. The units will start to be placed in standby mode as these systems are fully proven to be ready for reliable service, and units at Muskrat Falls are brought on-line. The timing of the final shut down and repurposing of the Holyrood TGS will be made once commissioning of the infrastructure related to the Muskrat Falls Project is complete in 2020 and reliable service has been demonstrated. This is currently planned 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 2020 and continues into 2021. Delivery of power and energy via the Labrador Island Transmission Link started in 2018, but remains limited to available recall power from Churchill Falls as the Muskrat Falls powerhouse is not yet in service.

In the attached ten-year maintenance plan, a single escalation factor of 2.5% per year has been used for 2020 to 2029 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 1,500 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

As the 2020 operating budget has not yet been prepared, this plan is based on the 2019 budget for system equipment. It is adjusted for future years forecasted plant role on the Island Interconnected System 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 TGS. The 2019 budget was also used as the baseline for the report that was generated last year. 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

Total Holyrood 10-Year SEM Expenditures

Table 1: Total Holyrood 10-Year SEM Expenditures ($000)

	Base Year 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Unit 1 Total SEM	996	199	-	-	-	-	-	-	-	-
Unit 2 Total SEM	1,092	199	-	-	-	-	-	-	-	-
Unit 3 Total SEM	1,003	262	268	275	282	289	296	303	311	319
Common Equipment Total SEM	1,399	673	690	707	725	743	762	781	800	820
Buildings & Grounds Total SEM	290	297	305	312	320	328	336	345	353	362
WT Plant Total SEM	59	20	21	21	22	22	23	23	24	24
WWT Plant Total SEM	8	8	8	8	8	9	9	9	9	10
Environmental Monitoring Total SEM	115	118	121	124	127	130	133	137	140	144
Total Operating Projects	118	55	-	34	150	35	-	37	-	39
Total Holyrood SEM	**5,080**	**1,830**	**1,412**	**1,481**	**1,633**	**1,556**	**1,559**	**1,635**	**1,637**	**1,717**

Appendix B

10-Year SEM Expenditures for Generating Units

Table 1: Total Holyrood 10-Year SEM Expenditures ($000)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Unit No. 1										
Preventive	296	106	-	-	-	-	-	-	-	-
Corrective	258	93	-	-	-	-	-	-	-	-
Boiler O/H	442	-	-	-	-	-	-	-	-	-
Subtotal	996	199	-	-	-	-	-	-	-	-
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 1	-	-	-	-	-	-	-	-	-	-
Total - Unit No. 1	**996**	**199**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unit No. 2										
Preventive	296	106	-	-	-	-	-	-	-	-
Corrective	258	93	-	-	-	-	-	-	-	-
Boiler O/H	538	-	-	-	-	-	-	-	-	-
Subtotal	1,092	199	-	-	-	-	-	-	-	-
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 2	-	-	-	-	-	-	-	-	-	-
Total - Unit No. 2	**1,092**	**199**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Unit No. 3										
Preventive	300	140	143	147	150	154	158	162	166	170
Corrective	261	122	125	128	131	135	138	141	145	149
Boiler O/H	442	-	-	-	-	-	-	-	-	-
Subtotal	1,003	262	268	275	282	289	296	303	311	319
Operating Projects										
Boiler Chemical Clean										
Total Op Projects - Unit 3	-	-	-	-	-	-	-	-	-	-
Total - Unit No. 3	**1,003**	**262**	**268**	**275**	**282**	**289**	**296**	**303**	**311**	**319**

Appendix C

10-Year SEM Expenditures for Ancillary Equipment

Table 1: 10-Year SEM Expenditures for Ancillary Equipment ($000)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Common Equipment										
Preventive	1,257	597	608	623	639	655	671	688	705	723
Corrective	142	76	82	84	86	88	91	93	95	97
Subtotal	1,399	673	690	707	725	743	762	781	800	820
Operating Projects										
Total Op Projects - Common	-	-	-	-	-	-	-	-	-	-
Total - Common Equipment	**1,399**	**673**	**690**	**707**	**725**	**743**	**762**	**781**	**800**	**820**
Buildings & Grounds										
Preventive	267	274	281	288	295	302	310	317	325	333
Corrective	23	24	24	25	25	26	27	27	28	29
Subtotal	290	297	305	312	320	328	336	345	353	362
Operating Projects										
Total Op Projects - Bldgs & Grounds	-	-	-	-	-	-	-	-	-	-
Total - Bldgs & Grounds	**290**	**297**	**305**	**312**	**320**	**328**	**336**	**345**	**353**	**362**
Water Treatment Plant										
Preventive	33	11	11	12	12	12	12	13	13	13
Corrective	26	9	9	9	10	10	10	10	11	11
Subtotal	59	20	21	21	22	22	23	23	24	24
Operating Projects										
Resin Replacement	63	23	-	-	-	-	-	-	-	-
Total Op Projects - WTP	63	23	-	-	-	-	-	-	-	-
Total - Water Treatment Plant	**122**	**43**	**21**	**21**	**22**	**22**	**23**	**23**	**24**	**24**

Table 2: 10-Year SEM Expenditures for Ancillary Units ($000)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Environmental Monitoring										
Preventive	16	16	17	17	18	18	19	19	19	20
Corrective	99	101	104	107	109	112	115	118	121	124
Subtotal	115	118	121	124	127	130	133	137	140	144
Operating Projects										
Thermal Plant	55	0	0	0	0	0	0	0	0	0
GT and Diesel Plant	0	32		34		35		37		39
Total Op Projects - Environment	55	32	0	34	0	35	0	37	0	39
Total - Environmental Monitoring	**170**	**150**	**121**	**157**	**127**	**165**	**133**	**174**	**140**	**183**
Waste Water Treatment Plant										
Preventive	4	4	4	4	4	4	4	5	5	5
Corrective	4	4	4	4	4	4	4	5	5	5
Subtotal	8	8	8	8	8	9	9	9	9	10
Operating Projects										
WWTP Periodic Basin Cleaning					150					
WWTP Continuous Basin Clean-Out	0									
Total Op Projects - WWTP	0	0	0	0	150	0	0	0	0	0
Total - Waste Water Treatment	**8**	**8**	**8**	**8**	**158**	**9**	**9**	**9**	**9**	**10**

2020 Capital Budget Application
2020 Capital Budget

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Overview
($000)

	Expended to 2019	2020	Future Years	Total
Generation	12,301.7	20,702.9	23,794.3	56,798.9
Transmission and Rural Operations	97,862.3	84,720.9	39,151.4	221,734.6
General Properties	1,344.4	5,523.5	2,231.1	9,099.0
Allowance for Unforeseen Items	0.0	1,000.0	0.0	1,000.0
Total Capital Budget	**111,508.4**	**111,947.3**	**65,176.8**	**288,632.5**

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Summary by Category
($000)

	Expended to 2019	2020	Future Years	Total
Generation				
Hydraulic Plant	12,231.0	14,746.3	10,249.8	37,227.1
Thermal Plant	0.0	3,630.1	5,664.2	9,294.3
Gas Turbines	70.7	2,263.8	7,880.3	10,214.8
Tools and Equipment	0.0	62.7	0.0	62.7
Total Generation	**12,301.7**	**20,702.9**	**23,794.3**	**56,798.9**
Transmission and Rural Operations				
Terminal Stations	77,239.4	42,873.2	31,941.5	152,054.1
Transmission	12,586.4	10,184.8	0.0	22,771.2
Distribution	456.9	14,309.1	3,339.7	18,105.7
Generation	7,356.6	15,308.5	3,577.6	26,242.7
Properties	223.0	862.1	292.6	1,377.7
Metering	0.0	244.2	0.0	244.2
Tools and Equipment	0.0	939.0	0.0	939.0
Total Transmission and Rural Operations	**97,862.3**	**84,720.9**	**39,151.4**	**221,734.6**
General Properties				
Information Systems	0.0	1,313.7	0.0	1,313.7
Telecontrol	96.3	1,640.8	0.0	1,737.1
Transportation	1,248.1	2,220.4	1,583.5	5,052.0
Administration	0.0	348.6	647.6	996.2
Total General Properties	**1,344.4**	**5,523.5**	**2,231.1**	**9,099.0**
Allowance for Unforeseen Items	**0.0**	**1,000.0**	**0.0**	**1,000.0**
Total Capital Budget	**111,508.4**	**111,947.3**	**65,176.8**	**288,632.5**

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
Hydraulic Plant					
Hydraulic Generation Refurbishment and Modernization (2019-2020)	10,313.6	5,486.5	0.0	15,800.1	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	1,917.4	1,429.6	0.0	3,347.0	
Hydraulic Generation Refurbishment and Modernization (2020-2021)	0.0	6,580.2	10,249.8	16,830.0	C-4
Hydraulic In-Service Failures	0.0	1,250.0	0.0	1,250.0	C-25
Total Hydraulic Plant	**12,231.0**	**14,746.3**	**10,249.8**	**37,227.1**	
Thermal Plant					
Rewind Unit 3 Stator - Holyrood	0.0	1,281.4	5,664.2	6,945.6	C-7
Thermal In-Service Failures	0.0	2,000.0	0.0	2,000.0	C-13
Upgrade Uninterruptible Power Supply 3 & 4 - Holyrood	0.0	348.7	0.0	348.7	D-2
Total Thermal Plant	**0.0**	**3,630.1**	**5,664.2**	**9,294.3**	

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
Gas Turbines					
Upgrade Compressed Air System - Holyrood Gas Turbine	70.7	317.7	0.0	388.4	
Perform Combustor Inspection - Holyrood Gas Turbine	0.0	546.1	4,927.4	5,473.5	C-9
Replace Fire Suppression System - Happy Valley Gas Turbine	0.0	264.6	2,377.9	2,642.5	C-11
Generator Assessment - Happy Valley Gas Turbine	0.0	1,097.6	0.0	1,097.6	C-32
Install Partial Discharge Monitoring - Holyrood Gas Turbine	0.0	37.8	575.0	612.8	C-34
Total Gas Turbines	**70.7**	**2,263.8**	**7,880.3**	**10,214.8**	
Tools and Equipment					
Purchase Tools and Equipment Less than $50,000	0.0	62.7	0.0	62.7	
Total Tools and Equipment	**0.0**	**62.7**	**0.0**	**62.7**	
Total Generation	**12,301.7**	**20,702.9**	**23,794.3**	**56,798.9**	
Terminal Stations					
Upgrade Circuit Breakers (2016-2020) - Various	39,783.7	11,116.8	0.0	50,900.5	
Terminal Station Refurbishment and Modernization (2019-2020)	10,891.1	19,061.8	0.0	29,952.9	
Upgrade Terminal Station for Mobile Substation (2019-2020) - St. Anthony	89.3	402.7	0.0	492.0	
Additions for Load - Increase Capacity Labrador West	26,475.3	3,460.0	23,171.9	53,107.2	
Terminal Station Refurbishment and Modernization (2020-2021)	0.0	3,712.0	6,067.8	9,779.8	C-36
Purchase New Mobile Substation - Bishop's Falls	0.0	734.7	2,701.8	3,436.5	C-43
Replace Transformer T7 - Holyrood Terminal Station	0.0	2,678.1	0.0	2,678.1	C-51
Terminal Station In-Service Failures	0.0	1,500.0	0.0	1,500.0	C-58
Purchase SF_6 Multi Analyzer - Various	0.0	207.1	0.0	207.1	D-35
Total Terminal Stations	**77,239.4**	**42,873.2**	**31,941.5**	**152,054.1**	
Transmission					
Muskrat Falls To Happy Valley Interconnection	12,586.4	7,392.1	0.0	19,978.5	
Wood Pole Line Management Program - Various	0.0	2,792.7	0.0	2,792.7	C-49
Total Transmission	**12,586.4**	**10,184.8**	**0.0**	**22,771.2**	

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
Distribution					
Distribution System Upgrades (2019-2020) - Various	390.8	5,490.1	0.0	5,880.9	
Install Recloser Remote Control (2019-2020) - Rocky Harbour	66.1	319.9	0.0	386.0	
Provide Service Extensions - Various	0.0	4,284.0	0.0	4,284.0	C-39
Distribution System Upgrades (2020-2021) - Various	0.0	102.7	3,154.4	3,257.1	C-45
Upgrade Distribution Systems - Various	0.0	3,195.0	0.0	3,195.0	C-47
Additions for Load - Distribution System - Makkovik and Hopedale	0.0	846.1	0.0	846.1	C-72
Install Recloser Remote Control (2020-2021) - Hampden and Upper Salmon	0.0	71.3	185.3	256.6	D-23
Total Distribution	**456.9**	**14,309.1**	**3,339.7**	**18,105.7**	
Generation					
Diesel Genset Replacements (2018-2020) - Makkovik	5,307.4	3,592.8	0.0	8,900.2	
Diesel Genset Replacements (2019-2020) - Cartwright	525.6	3,421.8	0.0	3,947.4	
Additions for Load - Isolated Generation Systems (2019-2020) - Makkovik	1,523.6	658.9	0.0	2,182.5	
Diesel Genset Replacements - Mary's Harbour	0.0	3,900.7	0.0	3,900.7	C-41
Overhaul Diesel Units - Various	0.0	2,310.9	0.0	2,310.9	C-53
Diesel Plant Fire Protection (2020-2021)	0.0	176.5	1,691.4	1,867.9	C-56
Replace Powerhouse Roofing System - L'Anse Au Loup and St. Anthony	0.0	125.3	1,195.8	1,321.1	C-68
Diesel Plant Ventilation Upgrade - Nain	0.0	162.7	690.4	853.1	C-70
Upgrade Fuel Storage Tanks - Charlottetown	0.0	467.2	0.0	467.2	D-10
Replace Automation Equipment - Rigolet	0.0	363.8	0.0	363.8	D-19
Replace Sewage Lift System - Rigolet	0.0	127.9	0.0	127.9	E-2
Total Generation	**7,356.6**	**15,308.5**	**3,577.6**	**26,242.7**	

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
Properties					
Install Energy Efficiency Lighting in Diesel Plants - Various	223.0	122.2	0.0	345.2	
Upgrade Line Depots - Various	0.0	648.3	0.0	648.3	C-74
Upgrade Fire Suppression System - Bishop's Falls	0.0	91.6	292.6	384.2	D-15
Total Properties	**223.0**	**862.1**	**292.6**	**1,377.7**	
Metering					
Purchase Meters and Metering Equipment - Various	0.0	244.2	0.0	244.2	D-33
Total Metering	**0.0**	**244.2**	**0.0**	**244.2**	
Tools and Equipment					
Replace Light Duty Mobile Equipment - Various	0.0	499.6	0.0	499.6	D-5
Purchase Tools & Equipment Less than $50,000 - Central	0.0	242.1	0.0	242.1	
Purchase Tools & Equipment Less than $50,000 - Labrador	0.0	102.4	0.0	102.4	
Purchase Tools & Equipment Less than $50,000 - Northern	0.0	94.9	0.0	94.9	
Total Tools and Equipment	**0.0**	**939.0**	**0.0**	**939.0**	
Total Transmission and Rural Operations	**97,862.3**	**84,720.9**	**39,151.4**	**221,734.6**	

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
General Properties					
Information Systems					
Software Applications					
Refresh Security Software - Hydro Place	0.0	110.2	0.0	110.2	E-20
Upgrade Software Applications - Hydro Place	0.0	65.4	0.0	65.4	E-23
Perform Minor Enhancements - Hydro Place	0.0	49.0	0.0	49.0	
Total Software Applications	**0.0**	**224.6**	**0.0**	**224.6**	
Computer Operations					
Replace Personal Computers - Hydro Place	0.0	673.3	0.0	673.3	C-80
Replace Peripheral Infrastructure - Hydro Place	0.0	222.1	0.0	222.1	D-51
Upgrade Core IT Infrastructure - Hydro Place	0.0	193.7	0.0	193.7	E-12
Total Computer Operations	**0.0**	**1,089.1**	**0.0**	**1,089.1**	
Total Information Systems	**0.0**	**1,313.7**	**0.0**	**1,313.7**	

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2020 Capital Budget: Detailed Breakdown
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Page Ref.
Telecontrol					
Network Services					
Upgrade Telecontrol Facilities (2019-2020) - Gull Pond Hill and Bay d'Espoir Hill	96.3	577.6	0.0	673.9	
Replace Radomes - Various	0.0	384.5	0.0	384.5	D-38
Replace Battery Banks and Chargers - Various	0.0	195.9	0.0	195.9	E-9
Replace Network Communications Equipment - Various	0.0	186.8	0.0	186.8	E-15
Replace Remote Terminal Units - Various	0.0	157.1	0.0	157.1	E-17
Purchase Tools and Equipment Less than $50,000 Telecontrol	0.0	93.4	0.0	93.4	
Upgrade Site Facilities - Various	0.0	45.5	0.0	45.5	
Total Telecontrol	**96.3**	**1,640.8**	**0.0**	**1,737.1**	
Transportation					
Replace Vehicles and Aerial Devices (2019-2020) - Various	1,248.1	594.9	0.0	1,843.0	
Replace Light and Heavy Duty Vehicles (2020-2021) - Various	0.0	1,625.5	1,583.5	3,209.0	C-76
Total Transportation	**1,248.1**	**2,220.4**	**1,583.5**	**5,052.0**	
Administration					
Replace Elevator Motors and Control Equipment - Hydro Place	0.0	89.1	647.6	736.7	C-78
Remove Safety Hazards - Various	0.0	198.6	0.0	198.6	E-6
Purchase Office Equipment Less than $50,000	0.0	60.9	0.0	60.9	
Total Administration	**0.0**	**348.6**	**647.6**	**996.2**	
Total General Properties	**1,344.4**	**5,523.5**	**2,231.1**	**9,099.0**	

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B. Capital Budget Summary with Multi-Year Projects Separated

2020 Capital Budget Application
2020 Capital Budget Summary with Multi-Year Projects Separated

Newfoundland and Labrador Hydro
2020 Capital Budget: Multi-Year Projects Separated
($000)

Single-Year Projects	2020
Generation	4,759.0
Transmission and Rural Operations	24,505.0
General Properties	2,541.9
Allowance for Unforeseen	1,000.0
Total Projects Under $50,000	94.5
Multi-Year Projects (2020 Expenditures)	
Multi-Year Projects Commencing in 2020	15,601.5
Multi-Year Projects Commencing in 2019	47,184.0
Multi-Year Projects Commencing prior to 2019	
Upgrade Circuit Breakers (2016–2020) - Various	11,116.8
Install Energy Efficiency Lighting in Diesel Plants - Various	122.2
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	1,429.6
Diesel Genset Replacements (2018–2020) - Makkovik	3,592.8
Total Multi-Year Projects Commencing Prior to 2019	**16,261.4**
Total Capital Budget	**111,947.3**

Newfoundland and Labrador Hydro
2020 Capital Budget
Single-Year Projects Over $50,000
($000)

Project Description	
Generation	
Hydraulic Plant	
Hydraulic In-Service Failures	1,250.0
Thermal Plant	
Thermal In-Service Failures	2,000.0
Upgrade Uninterruptible Power Supply 3 & 4 - Holyrood	348.7
Gas Turbine	
Generator Assessment - Happy Valley Gas Turbine	1,097.6
Tools and Equipment	
Purchase Tools and Equipment Less than $50,000	62.7
Total Generation	**4,759.0**

Newfoundland and Labrador Hydro
2020 Capital Budget
Single-Year Projects Over $50,000
($000)

Project Description	
Transmission and Rural Operations	
Terminal Stations	
Replace Transformer T7 - Holyrood Terminal Station	2,678.1
Terminal Station In-Service Failures	1,500.0
Purchase SF6 Multi Analyzer - Various	207.1
Transmission	
Wood Pole Line Management Program - Various	2,792.7
Distribution	
Provide Service Extensions - Various	4,284.0
Upgrade Distribution Systems - Various	3,195.0
Additions for Load - Distribution System - Makkovik and Hopedale	846.1
Generation	
Diesel Genset Replacements - Mary's Harbour	3,900.7
Overhaul Diesel Units - Various	2,310.9
Upgrade Fuel Storage Tanks - Charlottetown	467.2
Replace Automation Equipment - Rigolet	363.8
Replace Sewage Lift System - Rigolet	127.9
Properties	
Upgrade Line Depots - Various	648.3
Metering	
Purchase Meters and Metering Equipment - Various	244.2
Tools and Equipment	
Replace Light Duty Mobile Equipment - Various	499.6
Purchase Tools & Equipment Less than $50,000 - Central	242.1
Purchase Tools & Equipment Less than $50,000 - Labrador	102.4
Purchase Tools & Equipment Less than $50,000 - Northern	94.9
Total Transmission and Rural Operations	**24,505.0**

Newfoundland and Labrador Hydro
2020 Capital Budget
Single-Year Projects Over $50,000
($000)

Project Description	
General Properties	
Information Systems	
Software Applications	
Refresh Security Software - Hydro Place	110.2
Upgrade Software Applications - Hydro Place	65.4
Computer Operations	
Replace Personal Computers - Hydro Place	673.3
Replace Peripheral Infrastructure - Hydro Place	222.1
Upgrade Core IT Infrastructure - Hydro Place	193.7
Telecontrol	
Network Services	
Replace Radomes - Various	384.5
Replace Battery Banks and Chargers - Various	195.9
Replace Network Communications Equipment - Various	186.8
Replace Remote Terminal Units - Various	157.1
Purchase Tools and Equipment Less than $50,000 Telecontrol	93.4
Administration	
Remove Safety Hazards - Various	198.6
Purchase Office Equipment Less than $50,000	60.9
Total General Properties	**2,541.9**
Total Single-Year Projects Over $50,000	**31,805.9**

Newfoundland and Labrador Hydro
2020 Capital Budget
Multi-Year Projects Over $50,000
($000)

Multi-Year Projects Commencing in 2020

Project Description	2020	2021	2022	2022	2023	Total
Hydraulic Generation Refurbishment and Modernization (2020–2021)	6,580.2	10,250.0	-	-	-	16,830.2
Terminal Station Refurbishment and Modernization (2020–2021)	3,712.0	5,698.5	-	-	-	9,410.5
Rewind Unit 3 Stator - Holyrood	1,281.4	5,664.2	-	-	-	6,945.6
Perform Combustor Inspection - Holyrood Gas Turbine	546.1	4,927.4	-	-	-	5,473.5
Purchase New Mobile Substation - Bishop's Falls	734.7	2,701.8	-	-	-	3,436.5
Distribution System Upgrades (2020–2021) - Various	102.7	3,154.4	-	-	-	3,257.1
Replace Light and Heavy Duty Vehicles (2020–2021) - Various	1,625.5	1,583.5	-	-	-	3,209.0
Replace Fire Supression System - Happy Valley Gas Turbine	264.6	2,377.9	-	-	-	2,642.5
Diesel Plant Fire Protection (2020–2021)	176.5	1,691.4	-	-	-	1,867.9
Replace Powerhouse Roofing System - L'Anse Au Loup and St. Anthony	125.3	1,195.8	-	-	-	1,321.1
Diesel Plant Ventilation Upgrade - Nain	162.7	690.4	-	-	-	853.1
Replace Elevator Motors and Control Equipment - Hydro Place	89.1	647.6	-	-	-	736.7
Install Partial Discharge Monitoring - Holyrood Gas Turbine	37.8	575.0	-	-	-	612.8
Upgrade Fire Suppression System - Bishop's Falls	91.6	292.6	-	-	-	384.2
Install Recloser Remote Control (2020–2021) - Hampden and Upper Salmon	71.3	185.3	-	-	-	256.6
Total Multi-Year Projects Over $50,000 commencing in 2020	**15,601.5**	**41,635.8**	**-**	**-**	**-**	**57,237.3**

Newfoundland and Labrador Hydro
2020 Capital Budget
Multi-Year Projects Over $50,000
($000)

Multi-Year Projects Commencing in 2019

Project Description	Expended to 2019	2020	2021	2022	2022	2023	Total
Additions for Load - Increase Capacity Labrador West	26,475.3	3,460.0	13,632.0	9,539.9	-	-	53,107.2
Terminal Station Refurbishment and Modernization (2019-2020)	10,891.1	19,061.8	-	-	-	-	29,952.9
Muskrat Falls To Happy Valley Interconnection	12,586.4	7,392.1	-	-	-	-	19,978.5
Hydraulic Generation Refurbishment and Modernization (2019-2020)	10,313.6	5,486.5	-	-	-	-	15,800.1
Distribution System Upgrades (2019-2020) - Various	390.8	5,490.1	-	-	-	-	5,880.9
Diesel Genset Replacements (2019-2020) - Cartwright	525.6	3,421.8	-	-	-	-	3,947.4
Additions for Load - Isolated Generation Systems (2019-2020) - Makkovik	1,523.6	658.9	-	-	-	-	2,182.5
Replace Vehicles and Aerial Devices (2019-2020) - Various	1,248.1	594.9	-	-	-	-	1,843.0
Upgrade Telecontrol Facilities (2019-2020) - Gull Pond Hill and Bay d'Espoir Hill	96.3	577.6	-	-	-	-	673.9
Upgrade Terminal Station for Mobile Substation (2019-2020) - St. Anthony	89.3	402.7	-	-	-	-	492.0
Upgrade Compressed Air System - Holyrood Gas Turbine	70.7	317.7	-	-	-	-	388.4
Install Recloser Remote Control (2019-2020) - Rocky Harbour	66.1	319.9	-	-	-	-	386.0
Total Multi-Year Projects Over $50,000 commencing in 2019	**64,276.9**	**47,184.0**	**-**	**-**	**-**	**-**	**134,632.8**

Newfoundland and Labrador Hydro
2020 Capital Budget
Multi-Year Projects Over $50,000
($000)

Multi-Year Projects Commencing before 2019

Project Description	Expended to 2019	2020	2021	2022	2022	2023	Total
Upgrade Circuit Breakers (2016-2020) - Various	39,783.7	11,116.8	-	-	-	-	50,900.5
Diesel Genset Replacements (2018-2020) - Makkovik	5,307.4	3,592.8	-	-	-	-	8,900.2
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	1,917.4	1,429.6	-	-	-	-	3,347.0
Install Energy Efficiency Lighting in Diesel Plants - Various	223.0	122.2	-	-	-	-	345.2
Total Multi-Year Projects Over $50,000 commencing before 2019	**47,231.5**	**16,261.4**	**-**	**-**	**-**	**-**	**63,492.9**

C. Capital Projects Over $500,000

2020 Capital Budget Application
Capital Projects Over $500,000

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Projects Over $500,000
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Definition	Classification	Page Ref.
Generation							
Hydraulic Generation Refurbishment and Modernization (2019–2020)	10,313.6	5,486.5	-	15,800.1	Pooled	Normal	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	1,917.4	1,429.6	-	3,347.0	Pooled	Normal	
Hydraulic Generation Refurbishment and Modernization (2020–2021)	-	6,580.2	10,249.8	16,830.0	Pooled	Normal	C-4
Rewind Unit 3 Stator - Holyrood	-	1,281.4	5,664.2	6,945.6	Other	Normal	C-7
Perform Combustor Inspection - Holyrood Gas Turbine	-	546.1	4,927.4	5,473.5	Other	Normal	C-9
Replace Fire Suppression System - Happy Valley Gas Turbine	-	264.6	2,377.9	2,642.5	Other	Normal	C-11
Thermal In-Service Failures	-	2,000.0	-	2,000.0	Other	Normal	C-13
Hydraulic In-Service Failures	-	1,250.0	-	1,250.0	Other	Normal	C-25
Generator Assessment - Happy Valley Gas Turbine	-	1,097.6	-	1,097.6	Other	Normal	C-32
Install Partial Discharge Monitoring - Holyrood Gas Turbine	-	37.8	575.0	612.8	Other	Normal	C-34
Total Generation	**12,231.0**	**19,973.8**	**23,794.3**	**55,999.1**			

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Projects Over $500,000
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Definition	Classification	Page Ref.
Transmission and Rural Operations							
Upgrade Circuit Breakers (2016–2020) - Various	39,783.7	11,116.8	-	50,900.5	Pooled	Normal	
Terminal Station Refurbishment and Modernization (2019–2020)	10,891.1	19,061.8	-	29,952.9	Pooled	Normal	
Muskrat Falls To Happy Valley Interconnection	12,586.4	7,392.1	-	19,978.5	Other	Normal	
Diesel Genset Replacements (2018–2020) - Makkovik	5,307.4	3,592.8	-	8,900.2	Other	Normal	
Distribution System Upgrades (2019–2020) - Various	390.8	5,490.1	-	5,880.9	Pooled	Normal	
Diesel Genset Replacements (2019–2020) - Cartwright	525.6	3,421.8	-	3,947.4	Pooled	Normal	
Additions for Load - Isolated Generation Systems (2019–2020) - Makkovik	1,523.6	658.9	-	2,182.5	Pooled	Normal	
Additions for Load - Increase Capacity Labrador West	26,475.3	3,460.0	23,171.9	53,107.2	Pooled	Normal	
Terminal Station Refurbishment and Modernization (2020–2021)	-	3,712.0	6,067.8	9,779.8	Pooled	Normal	C-36
Provide Service Extensions - Various	-	4,284.0	-	4,284.0	Pooled	Normal	C-39
Diesel Genset Replacements - Mary's Harbour	-	3,900.7	-	3,900.7	Pooled	Normal	C-41
Purchase New Mobile Substation - Bishop's Falls	-	734.7	2,701.8	3,436.5	Other	Normal	C-43
Distribution System Upgrades (2020–2021) - Various	-	102.7	3,154.4	3,257.1	Pooled	Normal	C-45
Upgrade Distribution Systems - Various	-	3,195.0	-	3,195.0	Pooled	Normal	C-47
Wood Pole Line Management Program - Various	-	2,792.7	-	2,792.7	Other	Normal	C-49
Replace Transformer T7 - Holyrood Terminal Station	-	2,678.1	-	2,678.1	Other	Normal	C-51
Overhaul Diesel Units - Various	-	2,310.9	-	2,310.9	Pooled	Normal	C-53
Diesel Plant Fire Protection (2020–2021)	-	176.5	1,691.4	1,867.9	Other	Normal	C-56
Terminal Station In-Service Failures	-	1,500.0	-	1,500.0	Other	Normal	C-58
Replace Powerhouse Roofing System - L'Anse Au Loup and St. Anthony	-	125.3	1,195.8	1,321.1	Pooled	Normal	C-68
Diesel Plant Ventilation Upgrade - Nain	-	162.7	690.4	853.1	Other	Normal	C-70
Additions for Load - Distribution System - Makkovik and Hopedale	-	846.1	-	846.1	Pooled	Normal	C-72
Upgrade Line Depots - Various	-	648.3	-	648.3	Pooled	Normal	C-74
Total Transmission and Rural Operations	**97,483.9**	**81,364.0**	**38,673.5**	**217,521.4**			

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Projects Over $500,000
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Definition	Classification	Page Ref.
General Properties							
Replace Vehicles and Aerial Devices (2019–2020) - Various	1,248.1	594.9	-	1,843.0	Pooled	Normal	
Upgrade Telecontrol Facilities (2019–2020) - Gull Pond Hill and Bay d'Espoir Hill	96.3	577.6	-	673.9	Pooled	Normal	
Replace Light and Heavy Duty Vehicles (2020–2021) - Various	-	1,625.5	1,583.5	3,209.0	Pooled	Normal	C-76
Replace Elevator Motors and Control Equipment - Hydro Place	-	89.1	647.6	736.7	Other	Normal	C-78
Replace Personal Computers - Hydro Place	-	673.3	-	673.3	Pooled	Normal	C-80
Total General Properties	**1,344.4**	**3,560.4**	**2,231.1**	**7,135.9**			
Total Projects Over $500,000	**111,059.3**	**104,898.2**	**64,698.9**	**280,656.4**			

Project Title: Hydraulic Generation Refurbishment and Modernization (2020–2021)

Location: Various

Category: Generation - Hydraulic

Definition: Pooled

Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") has consolidated much of its hydraulic generation capital work into the Hydraulic Generation Refurbishment and Modernization Project. Hydro's philosophies for the assessment of equipment and the selection of capital work for the Hydraulic Generation Refurbishment and Modernization Project are outlined in the "Hydraulic Generation Asset Management Overview" (Volume II, Tab 1). Hydro has subdivided all the hydraulic generation assets and created programs for refurbishment and modernization within each division. The programs include:

- Hydraulic Generating Units Program;
- Hydraulic Structures Program;
- Reservoirs Program;
- Site Buildings and Services Program; and
- Common Auxiliary Equipment Program.

Hydro continues to develop activities within each program and has submitted a report titled Hydraulic Generation Refurbishment and Modernization in the 2020 Capital Budget Application, as well as an updated Hydraulic Generation Refurbishment and Modernization Overview – Version 3 document.

2.0 Project Description

Hydro proposes the following program-based activities under the Hydraulic Generation Refurbishment and Modernization Project:

- Hydraulic Generating Units Program:
  - Turbine and Generator Six-Year Overhauls;
  - Refurbish Generator Stator; and
  - Replace/Improve Unit Metering, Monitoring, Protection, and Control Assets including:

    - Replace Turbine-Generator Control and Vibration Monitoring Systems;
    - Replace Control Cables; and
    - Install Partial Discharge Continuous Monitors;
- Hydraulic Structures Program:
  - Control Structures Refurbishments; and
  - Penstock Level II Condition Assessment.
- Reservoirs Program:
  - Upgrade Public Safety Around Dams; and
  - Install Emergency Detection Response System.
- Site Buildings and Services Program:
  - Refurbish Access Road; and
  - Upgrade Bear Brook Crossing.
- Common Auxiliary Equipment Program:
  - Replace Sump Pump;
  - Replace Diesel Genset; and
  - Refurbish Sump Level System.

The project estimate for all activities for the 2020 Hydraulic Generation Refurbishment and Modernization Project are in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	584.7	697.1	0.0	**1,281.8**
Labour	1,783.3	2,056.4	0.0	**3,839.7**
Consultant	425.8	184.2	0.0	**610.0**
Contract Work	2,657.1	5,187.1	0.0	**7,844.2**
Other Direct Costs	211.6	221.7	0.0	**433.3**
Interest and Escalation	342.1	933.9	0.0	**1,276.0**
Contingency	575.6	969.4	0.0	**1,545.0**
Total	**6,580.2**	**10,249.8**	**0.0**	**16,830.0**

3.0 Project Justification

Hydro executes a robust capital program to ensure the generation of safe, reliable, least-cost electricity in an environmentally responsible manner. Hydro's capital program sees the replacement and refurbishment of equipment based on Hydro's long term asset management strategy.

4.0 Attachments

The reports entitled "Hydraulic Generation Refurbishment and Modernization (2020–2021)" and "Hydraulic Generation Asset Management Overview" (Volume ll, Tab 1) contain further project details.

Project Title: Rewind Unit 3 Stator
Location: Holyrood Thermal Generating Station
Category: Generation
Definition: Other
Classification: Normal

1.0 Introduction

Holyrood Thermal Generating Station ("Holyrood TGS") Unit 3 Generator is used to generate electricity or as a synchronous condenser. The generator stator armature windings have reached the end of their design life, but the useful life of the generator could be extended by rewinding the stator armature windings.

Unit 3 is anticipated to continue generating electricity until April 2021 when the Holyrood TGS will transition to post-steam operation with Unit 3 remaining as a synchronous condenser. The generator will operate a further 20 years as a synchronous condenser, until approximately 2041.

As preparation for operation as a synchronous condenser and extension of the machine's useful life, the rotor was rewound in 2016. The rewinding of the stator will complete the generator refurbishment.

2.0 Project Description

The scope of the project includes procurement of materials and execution of the rewind. The rewind will be completed by a contractor during the Unit 3 annual maintenance outage and will include:

- Disassembly;
- Removal and storage of generator rotor;
- Refurbishment work, as required;
- Installation of new stator coils and insulation system;
- Reassembly of components; and
- Commissioning activities and electrical testing.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	60.0	0.0	**60.0**
Labour	111.5	720.0	0.0	**831.5**
Consultant	22.6	22.6	0.0	**45.2**
Contract Work	970.0	3,880.0	0.0	**4,850.0**
Other Direct Costs	0.0	3.9	0.0	**3.9**
Interest and Escalation	73.6	544.7	0.0	**618.3**
Contingency	103.7	433.0	0.0	**536.7**
Total	**1,281.4**	**5,664.2**	**0.0**	**6,945.6**

3.0 Project Justification

This project is proposed to enable the continued reliable operation of the Holyrood TGS Unit 3 Generator.

4.0 Attachment

The report entitled "Rewind Unit 3 Stator – Holyrood" (Volume II, Tab 2) contains further project details.

Project Title: Perform Combustor Inspection
Location: Holyrood Gas Turbine
Category: Generation - Thermal
Definition: Other
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") owns and operates a 123.5 MW gas turbine plant at the Holyrood Thermal Generating Station. The plant was constructed in 2014 and commissioned early in 2015.

Hydro has incorporated on-going combustor inspections and overhauls into its long term asset management plan according to recommendations by the combustion turbine unit manufacturer to maintain reliable operations of the Holyrood Gas Turbine. The first combustor inspection and overhaul was completed in 2016 when the total equivalent starts on the combustion turbine unit reached 400. The second combustor inspection and overhaul was completed in 2018 as a part of the hot gas path inspection and overhaul project when the total equivalent starts on the combustion turbine unit reached 800. The third combustor inspection and overhaul is required when the total equivalent starts on the combustion turbine unit reaches 1200. Hydro anticipates that the Holyrood Gas Turbine will reach this operational milestone in 2021.

In addition, the manufacturer recommends completion of a generator medium inspection after 53,000 equivalent operating hours or six calendar years, whichever occurs first. The generator at the Holyrood Gas Turbine will be in operation for six years in 2021.

This proposed project will complete the third combustor inspection and overhaul on the Holyrood Gas Turbine unit. It will also complete the first generator medium inspection at the Holyrood Gas Turbine.

2.0 Project Description

This is a two-year project to complete the following scope of work at the Holyrood Gas Turbine:

- Completion of combustor inspection and overhaul; and

- Completion of generator medium inspection.

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

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	30.0	0.0	**30.0**
Labour	26.7	473.1	0.0	**499.8**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	440.0	3,550.0	0.0	**3,990.0**
Other Direct Costs	0.0	29.1	0.0	**29.1**
Interest and Escalation	32.7	437.0	0.0	**469.7**
Contingency	46.7	408.2	0.0	**454.9**
Total	**546.1**	**4,927.4**	**0.0**	**5,473.5**

3.0 Project Justification

This project is required to execute manufacturer recommended asset management activities that will contribute to maintaining the reliable operation of the Holyrood Gas Turbine plant.

4.0 Attachment

The report entitled “Perform Combustor Inspection - Holyrood Gas Turbine” (Volume II, Tab 3) contains further project details.

Project Title: Replace Fire Suppression System
Location: Happy Valley Gas Turbine
Category: Generation
Definition: Other
Classification: Normal

1.0 Introduction

Gas Turbines are combustion-based equipment that use flammable fuel and, as such, if a fire occurred, the equipment and building could be damaged or destroyed. Such damage could have an extended impact on the reliable provision of electricity to Newfoundland and Labrador Hydro's ("Hydro") customers. To mitigate this risk, Hydro installs fire suppression systems in its gas turbine buildings. The Happy Valley Gas Turbine provides backup generation and voltage support to the eastern region of Hydro's Labrador Interconnected System.

The existing Carbon Dioxide ("CO_2") system was installed when the plant was constructed in 1992 and now requires recertification. Due to safety concerns CO_2 systems are no longer used by Hydro for normally occupied spaces when an acceptable alternate exists. An alternative fire suppression system does exist for Happy Valley Gas Turbine and is being proposed in this project.

2.0 Project Description

The project scope of work will include the following:

- Removal and disposal of the existing CO_2 fire suppression system.
- Installation of an INERGEN®[1] fire suppression system for the turbine enclosure, generator enclosure, and battery room.
- Installation of either a water mist or hybrid nitrogen-water fire suppression system in the Turbine Hall.

The estimate for this project is shown in Table 1.

[1] INERGEN® is a mixture of 52% Nitrogen, 40% Argon and 8% CO_2. However, in the event of a fire, when INERGEN® is discharged, it mixes with the air present in the room to create a mixture that comprises of 67.3% Nitrogen, 12.5% Oxygen, 17% Argon, and 3.2% CO_2.

Table 1: Project Estimate ($000)

Project Cost	**2020**	**2021**	**Beyond**	**Total**
Material Supply	0.0	10.0	0.0	10.0
Labour	71.8	225.7	0.0	297.5
Consultant	140.0	60.0	0.0	200.0
Contract Work	0.0	1,611.0	0.0	1,611.0
Other Direct Costs	6.3	16.8	0.0	23.1
Interest and Escalation	13.7	165.9	0.0	179.6
Contingency	32.8	288.5	0.0	321.3
Total	**264.6**	**2,377.9**	**0.0**	**2,642.5**

3.0 Project Justification

This project will replace the CO_2 fire suppression system at the Happy Valley Gas Turbine to ensure that a reliable fire suppression system is in service. It will ensure that minimum damage is incurred by the plant in the event of a fire and thereby minimize any disruption of electricity supply to customers.

4.0 Attachment

The report entitled "Replace Fire Suppression System – Happy Valley Gas Turbine" (Volume II, Tab 4) contains further project details.

Project Title: Thermal In-Service Failures
Location: Holyrood
Category: Generation – Thermal
Definition: Other
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("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 approval by the Board of Commissioners of Public Utilities in time to be included in its annual Capital Budget Application. The identification is done through the preventative maintenance program using various condition based assessments and 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 the occurrence of an actual failure, the identification of an incipient failure, or determination of faster than anticipated equipment deterioration. These situations can be caused by events such as:

- Storm damage;
- Accidental damage;
- Abnormal system operations;
- Age-related failures including:
    - Breakdown of electrical insulation;
    - Wear of mechanical components; and
    - Corrosion mechanisms including:
        - Cavitation;
        - Flow-accelerated corrosion;

- Creep; and
- Fatigue.

Hydro is proposing that, within this project, it undertake the immediate capital refurbishment and replacement work[1] required for its Holyrood Thermal Generating Station ("Holyrood TGS") to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares[2] required to support such work. Examples of the activities which may be undertaken in this project are outlined in Appendix A.

Hydro uses historical data and asset management personnel judgement to predict the magnitude of the budget for this project.

2.0 Background

2.1 Operating Experience

The 2018 Thermal In-Service Failures project consisted of 14 corrective actions with a total expenditure of $2,699,900. The corrective actions are detailed in Appendix A.

3.0 Project Justification

Due to the nature of the Holyrood TGS systems and equipment, unanticipated failures and deterioration will occur. This project provides an effective and timely means to undertake the immediate capital refurbishment and replacement work required for the Holyrood TGS to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work

4.0 Project Description

Hydro is proposing to undertake the immediate capital refurbishment and replacement work required for its Holyrood TGS to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work. At this

[1] This work will not include actions which more appropriately can be executed as Unforeseen or Capital Budget Supplemental projects.

[2] Capital spares are major spare parts that meet the definition of capital assets that are kept on hand to be used in the event of an unexpected breakdown or failure of equipment, thereby expediting the return of the equipment to service. Capital spares are important in reducing periods of interruption in the generation and transmission of electricity.

time, Hydro does not have any planned capital spare acquisitions; however, throughout 2020, Hydro may purchase capital spares which are identified by asset management personnel as requiring immediate procurement to offset deficiencies in its capital spares.

The estimate for this project is shown in Table 1. Based on the expenditures noted in Appendix A and current expenditures under the 2019 Thermal In-Service Failures project, Hydro has reassessed the approved amount in the 2019 Thermal In-Service Failures project[3] and proposes a new value shown in Table 1 for the 2020 Thermal In-Service Failures project.

Table 1: Project Estimate ($000)

Project Cost	**2020**	**2021**	**Beyond**	**Total**
Material Supply	170.0	0.0	0.0	**170.0**
Labour	95.4	0.0	0.0	**95.4**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	1,682.0	0.0	0.0	**1,682.0**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	52.6	0.0	0.0	**52.6**
Contingency	0.0	0.0	0.0	**0.0**
Total	**2,000.0**	**0.0**	**0.0**	**2,000.0**

As there is no planned refurbishment work, replacement work, or capital spares acquisitions, no project schedule is provided for those activities.

[3] The 2019 Thermal Generation In-Service Failures project was approved at $1,250,000 as per Board Order No. P.U. 46(2018) on December 10, 2018.

Appendix A

2018 In-Service Failure Activities

Table A-1: 2018 In-Service Failure Activities

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Hydraulic System, Holyrood TGS Unit 1	597.7	Unit 1 tripped offline on November 3, 2018 as a result of turbine steam control valves closing without receiving the command from the control system to do so. An investigation concluded that hydraulic system contamination was the cause of the unit trip. Hydro proceeded to refurbish the hydraulic system on Unit 1.	The hydraulic system for the Unit 1 control valves was refurbished. This included: replacement of servo valves; cleaning or replacement of hydraulic actuators; replacement of actuator seals; replacement of filters; cleaning of hydraulic fluid coolers; flushing of the entire system; and replacement of the hydraulic fluid.
Hydraulic System, Holyrood TGS Unit 2	218.9	The Unit 2 hydraulic system is identical to that for Unit 1 and, while no failures had occurred, Hydro determined it was reasonable to expect that the system for Unit 2 was in the same contaminated condition as for Unit 1. The following issues supported the conclusion that the system was contaminated: (i) the control valve actuator was showing signs of seal deterioration, with smearing deposits noted on the shaft, and (ii) the right hand intercept valve did not fully stroke during online testing. Refurbishment was required to prevent a failure, which was likely to occur prior to or during the next winter operating season.	The hydraulic system for the Unit 2 control valves was refurbished. This included: replacement of servo valves; cleaning or replacement of hydraulic actuators; replacement of actuator seals; replacement of filters; cleaning of hydraulic fluid coolers; flushing of the entire system; and replacement of the hydraulic fluid. The Unit 2 refurbishment is lower cost than the Unit 1 refurbishment because it was completed in a planned manner rather than emergency manner.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Boiler Stop Valve and Hydraulic Ram, Holyrood TGS Unit 1	703.0	Unit 1 turbine control valves began operating erratically on January 3, 2018. On January 5 to 6, 2018, an outage was taken to replace the servo and clean the hydraulic fluid and filters. This did not solve the problem and, on January 20, 2018, erratic operation of the control valves became severe to the point where the unit was taken offline on a forced outage to address the issue. Further investigation revealed that the hydraulic ram for one of the control valves was deteriorated and required refurbishment. For the boiler stop valve, a technical representative for the original equipment manufacturer ("OEM") identified that the internal seating surface was damaged, with excessive clearance between the body and the pressure seal ring. Upon review, and with consideration for the remaining life of the Holyrood TGS boilers, it was determined that the boiler stop valve could be eliminated from the system and replaced with a welded pipe spool.	The hydraulic ram for the turbine control valve was refurbished using parts from an available spare ram and the spare ram was reconditioned and returned to inventory. The boiler stop valve was replaced with a welded pipe spool.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Boiler Observation Ports, Vestibule Refractory, and Steam Coil Air Heaters, Holyrood TGS	341.2	Units 1 and 2 observation ports in the boiler casing, consisting of: special glass; metal frames; and refractory seals, were inspected and found to have refractory damage and, therefore, at an elevated risk of sudden failure. There are two ports for each unit. Unit 2 header vestibule refractory seals around the boiler tube penetrations were inspected and one of the five seals was found to have refractory damage. When this refractory fails, hot gas will enter the vestibules and can cause boiler gas leaks from the vestibule to the powerhouse, which is at a lower pressure. This could lead to health and safety concerns and could lead to a forced outage for repair. Two of the eight steam coil air heaters on Unit 3, which preheat the combustion air prior to the air entering the main air heaters, were found to be leaking steam and had to be isolated in the fall of 2017. All of the coils were inspected in 2018 and found to be in poor condition with damaged and fouled fins, affecting fan performance by increasing the pressure drop across them. Failures of additional loops were reasonably expected.	The observation ports on Units 1 and 2 were replaced. The header vestibule refractory seals were replaced on Unit 2. The eight steam coil air heaters were replaced.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Fuel Oil Return Line, Holyrood Marine Terminal	296.9	The Holyrood Marine Terminal has an 18-inch fuel oil line used to off-load tankers and a separate 4-inch line to empty fuel oil from the 18-inch line following a tanker off-loading. There are approximately 157 barrels of fuel oil that would be released into the environment if a failure was to occur on the 18-inch line due to arctic sea ice in Holyrood Bay or tanker impact during fuel delivery at this location following a fuel delivery. A visual inspection of the Holyrood Marine Terminal revealed that the 4-inch return line had lifted vertically off its pipe supports and moved axially towards the ocean by approximately 12 inches. A subsequent assessment of the line indicated that it had significant corrosion underneath the pipe insulation and measured wall thicknesses below the pipe original minimum wall thickness. In addition, the line was no longer resting on its supports and permanent damage was expected from excessive movement. Due to the urgent requirement to mitigate the risk of failure, Hydro decided to replace the line.	The 4-inch fuel oil return line was replaced including: piping; supports; heat tracing; and insulation.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Variable Frequency Drive Fan Motor and Boiler Feed Pump Motor, Holyrood TGS	84.2	The Unit 1 West variable frequency drive fan motor exhibited high winding temperatures resulting in an alarm. Load on the unit was reduced to control the motor temperature, but the temperature continued to increase over time, indicating an imminent failure. The unit was removed from service for immediate replacement of the motor using an available spare motor. The Unit 2 West boiler feed pump motor had to be removed from service when the motor bearing failed. As a result, Unit 2 was derated to approximately 70 MW until the motor was replaced with the available spare motor.	The Unit 1 West variable frequency drive motor and the Unit 2 West boiler feed pump motor were replaced with available spares. The motors removed from service were refurbished and added to inventory as critical spares.
East Cooling Water Pump Motor, Holyrood TGS Unit 3	73.3	The drive-end bearing on the Unit 3 East cooling water pump ("CWP") motor was found to be exhibiting high vibration during the 2017–2018 winter operating season and was running hotter than normal. These observed conditions indicated that failure was imminent and that intervention was required before returning the unit to service for the winter season.	The Unit 3 East CWP motor was removed, refurbished, and returned to service.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
West Cooling Water Pump Motor, Holyrood TGS Unit 2	56.7	The Unit 2 West CWP motor was tested on May 30, 2018 for winding resistance as part of routine maintenance. The test results indicated that the winding insulation had deteriorated to the point where online failure could be expected during the next operating season. To restore the motor from this incipient failure condition, and ensure reliable operation going forward, it was necessary to have the windings restored.	The motor was replaced with an available spare motor. The motor removed from service was refurbished and added to inventory as a critical spare.
West Forced Draft (“FD”) Fan Motor, Holyrood TGS Unit 2	53.2	The Unit 2 West FD fan motor was tested on May 29, 2018 for winding resistance as part of routine maintenance. The test results indicated that the winding insulation has deteriorated to the point where online failure could be expected during the next operating season. To restore the motor from this incipient failure condition and ensure reliable operation going forward, it is necessary to have the windings restored.	The motor was replaced with an available spare motor. The motor removed from service was refurbished and added to inventory as a critical spare.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Variable Frequency Drive (“VFD”), Holyrood Units 1 and 2	104.7	On March 5, 2018, a Unit 2 West VFD power cell failed and was replaced. The drive bypassed the failed cell and the unit did not trip in this instance. On March 19, 2018, the West VFD tripped on Unit 1. Another power cell had failed and was replaced with an available spare and two cell control fuses had blown and were replaced with available spares. The fault log was downloaded from the VFD and sent it to the OEM for review and technical assistance. The OEM confirmed that the actions taken by the plant were appropriate. On March 26, 2018, the East VFD tripped on Unit 1, with a failure similar to that which occurred on March 19, 2018. Power cells and fuses were replaced with available spares.	Failed VFD power cells and fuses were replaced with available spares.
Forced Draft Fan Bearing, Holyrood Unit 1	49.8	On June 17, 2018, the Unit 1 East FD fan inboard bearing liner failed, which led to a forced outage on Unit 1.	The inboard bearing liner was replaced with an available spare and the journal (the bearing surface section of the fan shaft) was refurbished.
Turbine Control System (Mark V), Holyrood Unit 1	75.0	Online testing of the reheat valves for Units 1 and 2 revealed that components in the turbine control system has failed and required replacement. Upon completion of the replacement of the failed components, the reheat valves on both units tested successfully.	Failed components of the turbine control system were replaced, including: two solenoids; fuses; circuit boards; and ribbon cables on Unit 1 and the servomotors on both of the reheat valves on Unit 2.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Distributed Control System ("DCS"), Holyrood TGS	32.7	Hydro received a Schneider Electric Customer Advisory detailing a manufacturing defect with the Schneider Electric FCP270 Control Processors ("FCP"). As outlined in the advisory, there was an incipient failure that needed to be corrected before entering into the 2018–2019 winter season to maintain reliability of this critical system. There were three options presented in Schneider Electric's advisory. The option to receive pre-programmed, upgraded FCPs, was the most cost-effective and least-impactful to Holyrood TGS' operation.	All FCPs were replaced with factory-updated FCPs. This includes eight FCPs installed in Holyrood TGS' distributed control system and one in inventory.
DCS Operator Station, Holyrood TGS Unit 3	12.6	One of the Unit 3 DCS Operator Stations failed on May 4, 2018. The Basic Input/Output System ("BIOS") of the machine was not identifying any hard drive; therefore, the operating system was not booting. This may have been caused by a critical failure of the hard drive itself, the motherboard's connection to it, or the power supply connection to the hard drive. The computer that failed is one of the oldest operator stations with obsolete hardware and a motherboard problem would require full replacement of the operator station. For safe and reliable operation through the 2018–2019 winter operating season, all stations are required to be in service. Therefore the replacement of the failed operator station was required. This operator station will be required post steam.	The Unit 3 DCS Operator Station was replaced.

Project Title: Hydraulic In-Service Failures

Location: Hydro Generation

Category: Generation - Hydraulic

Definition: Other

Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("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 approval by the Board of Commissioners of Public Utilities in time to be included in its annual Capital Budget Application. The identification is done through the preventative maintenance program using various condition based assessments and 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 the occurrence of an actual failure, the identification of an incipient failure, or determination of faster than anticipated equipment deterioration. These situations can be caused by events such as vandalism, storm damage, lightning, accidental damage, abnormal system operations, cavitation, existing installation deficiencies, etc. Hydro is proposing that within this project it will undertake the immediate capital refurbishment and replacement work[1] required for its hydraulic generating stations and water reservoirs to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares[2] required to support such work. These activities will be undertaken in accordance with the philosophies outlined throughout the "Hydraulic Generation Asset Management Overview" (see Volume II, Tab 1) document. Examples of the activities which may be undertaken in this project are outlined in Appendix A. Hydro uses historical data and asset management personnel judgement to predict the magnitude of Hydraulic Generation In-Service Failures project budget.

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[1] This work will not include actions which more appropriately can be executed as Unforeseen or Capital Budget Supplement projects.

[2] Capital spares are major spare parts that meet the definition of capital assets that are kept on hand to be used in the event of an unexpected breakdown or failure of equipment thereby expediting the return of the equipment to service. Capital spares are important in reducing periods of interruption in the generation and transmission of electricity.

2.0 Operating Experience

The 2018 Hydraulic Generation In-Service Failures project consisted of nine corrective actions with a total expenditure of $452,300. The corrective actions are detailed in Appendix A.

3.0 Project Description

Hydro is proposing to undertake the immediate capital refurbishment and replacement work required for its hydraulic generating stations and water reservoirs to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work.

In 2020, Hydro is proposing to acquire the capital spares listed below:

- Upper Salmon Intake Transformer, 3 phase overhead type rated for 14.4 kV;
- Granite Canal Excitation Transformer, 3 phase dry type rated for 13.8 kV; and
- Hinds Lake Station Service Breaker 52 SST, 3 phase rated for 600 V.

Also, throughout 2020, Hydro may purchase capital spares which are identified by asset management personnel as requiring immediate procurement to offset deficiencies in its capital spares.

Hydro's estimated project cost of the Hydraulic Generation In-Service Failures project is presented in Table 1. Based on the expenditures noted in Appendix A and current expenditures under the 2019 Hydraulic Generation In-Service Failures project, Hydro has retained the same amount as proposed in the 2019 Hydraulic Generation In-Service Failures project.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	797.3	0.0	0.0	**797.3**
Labour	311.7	0.0	0.0	**311.7**
Consultant	77.9	0.0	0.0	**77.9**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	22.1	0.0	0.0	**22.1**
Contingency	41.0	0.0	0.0	**41.0**
Total	**1,250**	**0.0**	**0.0**	**1,250**

As there are no planned activities for refurbishment or replacement work, no schedule is provided for those activities. The project schedule for acquiring listed capital spares is presented in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning: Open work order, plan and develop detailed schedules	January 2020	March 2020
Procurement: Procure consultant to develop equipment spec for tender.	January 2020	February 2020
Equipment Procurement: Based on Consultant spec and tender results, purchase equipment.	February 2020	March 2020
Equipment Delivery and Closeout: Equipment on site and Close work order, complete all documentation and complete lessons learned	December 2020	December 2020

4.0 Project Justification

Due to the nature of Hydro's hydraulic generating stations and water reservoirs systems and equipment, unanticipated failures and deterioration will occur. This project provides an effective and timely means to undertake the immediate capital refurbishment and replacement work required for hydraulic generating stations and water reservoirs to maintain the integrity and reliability for the generation of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work.

Appendix A

2018 In-Service Failure Activities

Table A-1: 2018 In-Service Failure Activities

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Replace Guide Bearing Assembly, Bay d'Espoir Unit 2	138.4	The existing generator guide bearing assembly was installed in 2015. It was designed and fabricated by the original equipment manufacturer in order to reduce the misting issues experienced through the top oil pot housing covers and was of a modified design as compared to the original. During the overhaul and refurbishment of Unit 2, inspection damage was found on the journal, bearing, and other rotating components likely caused by the new bearing design. To eliminate the possibility of further damage to the journal, bearing, and other rotating components such as the thrust bearing, rotating ring, and spring beds, it was determined that the generator bearing should be converted back to original design. The original design is time proven and has operated successfully for decades. The misting issue that the new bearing design was installed to address will not affect unit performance since a capital program to add new seals to reduce misting is included within Hydro's five-year capital plan.	The guide bearing was returned to original design using available spare parts.
Circuit Breaker Capital Spare, Hinds Lake	110.4	The planned scope for this project included the procurement of a spare circuit breaker for Hinds Lake to allow responsive action to failures.	The spare circuit breaker was procured.
Replace Thrust Bearing Assembly, Bay d'Espoir Unit 2	99.8	Upon inspection of the generator main bracket stationary parts, it was observed that the thrust bearing had undergone severe damage to the babbitt on two thrust pads as well as signs of damage on all other pads including perpendicular cracks and heat damage to the babbitt. The bearing was deemed unusable and required immediate replacement. As well, the damage to the thrust bearing scarred the rotating ring bearing surface, a surface that is required to be machine finished to ensure a low coefficient of friction while the unit is rotating. The spring beds were in use for over 20 years, and were found to be heavily contaminated with babbitt, and have exhibited changes in	The thrust bearing assembly, including pads, spring beds and the rotating ring, were replaced.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
		length from the original equipment manufacturer's drawings. These springs required replacement with the thrust pads and rotating ring to ensure this bearing surface is free from any contaminants and operating as intended as per original equipment manufacturer design.	
Replace Sump Pump 1, Bay d'Espoir Powerhouse 1	42.8	The sump pump was observed to not be operating as intended with the level in the sump not decreasing when it was in operation. There was risk of powerhouse flooding, with the pump unable to move water at a rate equal to the potential inflow of water into the sump.	The sump pump was replaced.
Refurbish Culverts, Bear Brook, Bay d'Espoir	24.8	The road at the Bear Brook crossing, on the access road to the Bay d'Espoir Generating Station, deteriorated and was in an unacceptable condition for vehicular traffic. Material between the 1200 mm culverts had eroded away and no longer adequately supported the surface of the road.	The material around the culverts, including the bedding material, was replaced. Blast rock was installed to reduce erosion and berms were constructed to redirect water flows.
Procure a Replacement HVAC unit for the Control Room, Cat Arm	14.2	The control room air conditioning unit failed due to the loss of refrigerant. Copper tubing and fittings were corroded, which increased the possibility of accidental release when completing maintenance.	A replacement HVAC unit was procured. Installation will occur in 2019 when road conditions allow for a contractor to access site to install. Installation costs will be reported under the 2019 Hydraulic In-Service Failures project.
Purchase Station Service Transformer Capital Spare, Hinds Lake	12.9	The planned scope for this project included the procurement of a spare station service transformer for Hinds Lake to allow responsive action to failures.	A spare station service transformer was ordered and will be received in 2019. Material costs will be reported under the 2019 Hydraulic In-Service Failures project.
Replace High Pressure Pump, Hinds Lake	5.5	During start-up of the generating unit at Hinds Lake, it was discovered that the high pressure pump was unable to meet required pressure and thus the unit controls would not allow the unit to start.	An available spare pump was installed and a new spare was procured.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Purchase Excitation Transformer Capital Spare, Cat Arm	3.5	The planned scope for this project included the procurement of a spare excitation transformer for Cat Arm to allow responsive action to failures.	A spare excitation transformer was ordered and will be received in 2019. Material costs will be reported under the 2019 Hydraulic In-Service Failures project.

Project Title: Generator Assessment
Location: Happy Valley Gas Turbine
Category: Generation - Gas Turbines
Definition: Other
Classification: Normal

1.0 Introduction

The Happy Valley Gas Turbine provides back up electrical generation and synchronous condense support to the Labrador Interconnected System. The generator has over 120,000 hours of operation and as a result the Original Equipment Manufacturer (“OEM”)[1] recommends a Level II Assessment be conducted. The Level II Assessment requires the gas turbine generator to be disassembled and the rotor removed. The Happy Valley Gas Turbine was placed in service in 1992 and provides 25 MW of back up electrical generation and reactive power ranging from -10 to +23.8 MVAR as a synchronous condenser for the Labrador Interconnected System. The OEM, which also specializes in generator inspection and maintenance, recommends a Level II Assessment be conducted after the unit has 100,000 operating hours or after the unit has been in service for 10 to 12 years. Hydro would use the assessment to determine if corrective action is required to facilitate the continuation of the reliable operation of the Happy Valley Gas Turbine.

2.0 Project Description

This proposed project includes the dismantling of the generator to inspect, test, and clean the generator rotor and the generator stator. From the information obtained through this work, the OEM will provide a Level II Assessment report.

This proposed project will be completed during the planned unit outage in 2020 at an estimated cost of $1,097,600, as shown in Table 1.

[1] The OEM for the Happy Valley Gas Turbine generator is Brush.

Table 1: Project Estimate ($000s)

Project Cost	2020	2021	Beyond	Total
Material Supply	62.9	0	0	**62.9**
Labour	328.1	0	0	**328.1**
Consultant	0.0	0	0	**0.0**
Contract Work	536.7	0	0	**536.7**
Other Direct Costs	27.2	0	0	**27.2**
Interest and Escalation	9.2	0	0	**9.2**
Contingency	133.5	0	0	**133.5**
Total	**1097.6**	**0**	**0**	**1097.6**

3.0 Project Justification

The project is required to assess the Happy Valley Gas Turbine generator to determine if corrective action is required to facilitate the continuation of the reliable operation of the Happy Valley Gas Turbine. The Happy Valley Gas Turbine generator exceeds the manufacturer recommended criteria for a Level II Assessment.

4.0 Attachment

The report entitled "Generator Assessment – Happy Valley Gas Turbine" (Volume II, Tab 5) contains further project details.

Project Title: Install Partial Discharge Monitoring
Location: Holyrood Gas Turbine
Category: Generation
Definition: Other
Classification: Normal

1.0 Introduction

The Holyrood Gas Turbine Generator, which was installed in 2015, has a peaking capacity of 123.5 MW and is not equipped with a generator insulation partial discharge monitoring system.

On-line partial discharge monitoring provides information required for condition assessment of the Holyrood Gas Turbine Generator winding insulation. Such assessment allows Newfoundland and Labrador Hydro to detect potential issues and implement, if necessary, corrective action to avoid an internal generator electrical fault due to winding insulation failure.

The lack of a partial discharge monitoring system for the Holyrood Gas Turbine Generator increases the risk of undetected insulation deterioration and the possible development of a generator internal electrical fault, that could take 6 months or more to repair.

2.0 Project Description

The project will:

- Procure and install a generator partial discharge monitoring system at the Holyrood Gas Turbine; and
- Integrate the generator insulation condition monitoring system with an existing remote monitoring system.

The project estimate is included in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	15.0	0.0	**15.0**
Labour	30.9	122.8	0.0	**153.7**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	321.0	0.0	**321.0**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	2.3	47.2	0.0	**49.5**
Contingency	4.6	69.0	0.0	**73.6**
Total	**37.8**	**575.0**	**0.0**	**612.8**

3.0 Project Justification

The lack of a partial discharge monitoring system on the Holyrood Gas Turbine Generator increases the risk of undetected insulation deterioration and the possible development of a generator internal electrical fault, that could take six months or more to repair. This project will facilitate the continued reliable operation of the Holyrood Gas Turbine.

4.0 Attachment

The report entitled "Install Partial Discharge Monitoring - Holyrood Gas Turbine" (Volume II, Tab 6) contains further project details.

Project Title: Terminal Station Refurbishment and Modernization (2020–2021)
Location: Various
Category: Transmission and Rural Operations
Definition: Pooled
Classification: Normal

1.0 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. Newfoundland and Labrador Hydro ("Hydro") has 70 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 2020 Capital 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 of equipment foundations;
- Installation of fire suppression systems in control buildings;
- Refurbishment of control buildings;
- Replacement of terminal station lighting;

- Replacement of battery banks and chargers
- Protection, control, and monitoring replacements and modernization; and
- Refurbishment of the Wabush Terminal Station.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1,098.3	781.4	0.0	**1,879.7**
Labour	1,164.8	1,677.0	0.0	**2,841.8**
Consultant	240.0	262.5	0.0	**502.5**
Contract Work	725.6	1,599.8	0.0	**2,325.4**
Other Direct Costs	68.2	364.1	0.0	**432.3**
Interest and Escalation	186.1	498.9	0.0	**685.0**
Contingency	229.0	884.1	0.0	**113.1**
Total	**3,712.0**	**6,067.8**	**0.0**	**9,779.8**

The Terminal Station Refurbishment and Modernization project is a consolidation of various asset management programs for the refurbishment, replacement, or installation of terminal station assets. Descriptions of these assets and Hydro's asset management strategies are found in Revision 4 of the "Terminal Station Asset Management Overview."[1]

The Terminal Station Refurbishment and Modernization project does not include projects related to growth or isolated issues for a particular terminal station; these projects are proposed separately.

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

2.0 Project Justification

Hydro replaces or refurbishes assets that have deteriorated, or pose a safety or environmental risk, such as those assets containing polychlorinated biphenyl ("PCB"). 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

[1] "2020 Capital Budget Application," vol. II, tab 7.

and selection and justification of projects can be found in the "Terminal Station Asset Management Overview."

3.0 Future Plans

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

4.0 Attachments

The reports entitled "Terminal Station Refurbishment and Modernization" and "Terminal Station Asset Management Overview" (Volume II, Tab 7) contain further project details.

Project Title: Provide Service Extensions

Location: Various

Category: Transmission and Rural Operations - Distribution

Definition: Pooled

Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") provides direct service to over 38,000 customers within its service areas. Hydro provides service hook-ups on an as-required basis using customer-driven service requests. This is a single year project to provide an annual allotment for new service connections and street lights, based on past expenditures and forecasted activity within the regions.

2.0 Background

Hydro receives service requests for residential and general service, driven by local growth and activity within Hydro's three service regions: Central, Northern, and Labrador. Service requests can include residential developments, the addition of cabin developments, and establishment of new business developments. Each customer requires interconnection to the local distribution service system. Service requests are received by Hydro's Customer Service Team and plans are developed by the local regions to provide the service extensions required to meet the service requests. In some cases, Contributions in Aid of Construction ("CIAC") are required, and are applied under Hydro's CIAC Policy.

Five year historical expenditures under this annual project are provided in Table 1.

Table 1: Five Year Historical Expenditures ($000)

Region	2014		2015		2016		2017		2018	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
Central	1,490	1,660	1,600	1,437	1,751	1,842	1,750	1,531	1,660	1,103
Northern	1,460	1,366	1,460	1,371	1,218	1,498	1,470	1,623	1,270	1,220
Labrador	3,220	1,848	3,020	2,198	2,720	1,242	1,930	1,522	1,590	1,297
Total	**6,170**	**4,814**	**6,080**	**5,006**	**5,689**	**4,582**	**5,150**	**4,675**	**4,520**	**3,620**

3.0 Project Justification

In recent years, Hydro has seen an overall decline in the requirement for service extensions on the distribution system, as reflected in the actual expenditures from 2014 to 2018 shown in Table 1. The proposed project estimate, as provided in Table 2, is based on an analysis of the historical expenditures within the past five years for the provision of service extensions by region supplemented with regional planning input with respect to future activity expenditure levels. The budget by region is shown in Table 3.

4.0 Project Description

This is a single year project to provide an annual allotment for new service connections and street lights, based on past expenditures and forecasted activity within the regions. Specific details regarding the actual activity are not available.

Table 2: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	2,188.8	0.0	0.0	2,188.8
Labour	1,848.8	0.0	0.0	1,848.8
Consultant	0.0	0.0	0.0	0.0
Contract Work	143.8	0.0	0.0	143.8
Other Direct Costs	114.1	0.0	0.0	114.1
Interest and Escalation	188.5	0.0	0.0	188.5
Contingency	0.0	0.0	0.0	0.0
Subtotal	**4,484.0**	**0.0**	**0.0**	**4,484.0**
Cost Recoveries	(200.0)	0.0	0.0	(200.0)
Total	**4,284.0**	**0.0**	**0.0**	**4,284.0**

Table 3: Estimate for 2020 Service Extensions ($000)

Region	Budget
Central	1,557
Northern	1,332
Labrador	1,395
Total	**4,284**

5.0 Conclusion

This project is an annual allotment, adjusted from year to year depending on historical expenditures, for Hydro's connection of new residential and general service requests.

Project Title: Diesel Genset Replacements
Location: Mary's Harbour
Category: Transmission and Rural Operations - Generation
Definition: Pooled
Classification: Normal

1.0 Introduction

The community of Mary's Harbour is located on the southeast coast of Labrador where Newfoundland and Labrador Hydro ("Hydro") utilizes a diesel generating plant consisting of four diesel generators to provide electrical service to approximately 260 customers in the community.

2.0 Project Description

This project is proposed to replace two diesel generator units ("gensets") in Mary's Harbour. Unit 2037 (545 kW) and Unit 2083 (800 kW) will be replaced with a 545 kW and a 725 kW genset, respectively. Installation includes all mechanical, electrical, and protection and controls work necessary for proper operation of the new units.

The project estimate is provided in Table 1

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1361.6	0.0	0.0	**1361.6**
Labour	1197.6	0.0	0.0	**1197.6**
Consultant	334.0	0.0	0.0	**334.0**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	480.2	0.0	0.0	**480.2**
Interest and Escalation	189.9	0.0	0.0	**189.9**
Contingency	337.4	0.0	0.0	**337.4**
Total	**3,900.7**	0.0	**0.0**	**3,900.7**

3.0 Project Justification

At the Mary's Harbour Diesel Generating Plant, diesel generator Unit 2037 has an expected service life of 132,000 operating hours, which it is forecast to reach in 2020, at which point it will be due for replacement. Unit 2083 has had a long standing vibration problem. After numerous consultations with the manufacturer, and after incurring repeated high maintenance costs and extended unit outages, Hydro has decided it is not feasible to continue operating this unit and is therefore proposing replacement.

This project is required to maintain reliable operation of the Mary's Harbour Diesel Generating Plant.

4.0 Attachment

The report entitled "Diesel Genset Replacements – Mary's Harbour" (Volume II, Tab 8) contains further project details.

Project Title: Purchase New Mobile Substation
Location: Bishop's Falls
Category: Transmission and Rural Operations
Definition: Other
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") owns a mobile substation, which is an emergency spare for a number of terminal stations and in-service transformers. Newfoundland Power has four mobile substations. Hydro and Newfoundland Power cooperate to optimize the use of the five units. Hydro has experienced instances when all mobile substations have been in service and a unit was not available for prompt response as an emergency spare.

The procurement of a new mobile substation will reduce the risk of an extended customer outage due to the unavailability of a mobile substation.

2.0 Project Description

This project consists of the procurement of a new 30 MVA, 138-69/25-12.5 kV mobile substation complete with a disconnect switch and on-load tap changer.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	591.0	2,364.0	0.0	2,955.0
Labour	60.3	59.8	0.0	120.1
Consultant	23.7	9.9	0.0	33.6
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	0.0	12.3	0.0	12.3
Interest and Escalation	26.0	133.5	0.0	159.5
Contingency	33.7	122.3	0.0	156.0
Total	**734.7**	**2,701.8**	**0.0**	**3,436.5**

3.0 Project Justification

This project is required to reduce the risk of extended customer outages due to the unavailability of a mobile substation for use as an emergency spare.

4.0 Attachment

The report entitled "Purchase New Mobile Substation – Bishop's Falls" (Volume II, Tab 9) contains further project details.

Project Title: Distribution System Upgrades
Location: Various
Category: Transmission and Rural Operations
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") uses two approaches to maintain or improve distribution system reliability performance. One approach is detailed in the Upgrade Distribution Systems project (Volume I, Section C), which Hydro uses to address smaller distribution replacements. The other approach is outlined in this document and addresses larger refurbishment requirements. These larger efforts to maintain or improve reliable distribution operation are determined either by condition assessments or by identification of distribution feeders that have poor reliability performance.

Through reliability performance analysis, feeders in the Bear Cove, St Anthony, and Fleur-de-Lys areas have been identified as requiring refurbishment and upgrading.

2.0 Project Description

In this project, Hydro proposes to undertake the following work for the identified feeders:

- Bear Cove L6: replace poles, insulators, cribs, crossarms, anchors, downguys, and hot line clamps, and install fault circuit indicators.
- St Anthony L3: replace poles, insulators, conductor, cribs, crossarms, anchors, downguys, and transformers, reroute feeder, and install animal guards
- Fleur-de-Lys L1: replace poles, insulators, conductor, cribs, crossarms, anchors, downguys, and transformers, reroute feeder, and install fault circuit indicators.
- Fleur-de-Lys L2: replace poles, insulators, cribs, crossarms, anchors, downguys, and transformers, and reroute feeder.

The project estimate is included in Table 1. The project will commence in 2020 and be completed in 2021.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	931.2	0.0	931.2
Labour	62.2	262.2	0.0	324.4
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	1380.0	0.0	1,380.0
Other Direct Costs	26.0	79.5	0.0	105.5
Interest and Escalation	5.7	236.2	0.0	241.9
Contingency	8.8	265.3	0.0	274.1
Total	**102.7**	**3,154.4**	**0.0**	**3,257.1**

3.0 Project Justification

This project is proposed to improve the reliability of feeders Bear Cove L6, St Anthony L3, Fleur-de-Lys L1 and Fleur-de-Lys L2.

4.0 Attachment

The report entitled "Distribution System Upgrades (2020–2021) – Various" (Volume II, Tab 10) contains further project information.

Project Title: Upgrade Distribution System
Location: Various
Category: Transmission and Rural Operations
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") provides direct service to over 38,000 customers within its service area. The distribution system serving these customers requires normal upgrading of individual structures and equipment on an as-required basis to correct issues identified as a result of operational field inspections or storm damage. This is an annual single year project to provide for an allotment based on past expenditures within the regions to provide for localized upgrades due to service deficiencies or small-magnitude replacement due to storm damage.

2.0 Background

Hydro maintains its distribution system through regular preventive maintenance inspections. As a result of these inspections, defects are identified and individual replacements of structures or equipment are sometimes required. In addition, storm damage can also necessitate replacement of distribution infrastructure. Five year historical expenditures under this annual project are provided in Table 1. Based on historical expenditures Hydro forecasts an anticipated project estimate for the following year. In some cases, Contributions in Aid of Construction ("CIAC") are required, and are applied under Hydro's CIAC Policy. This project should not be confused with the "Distribution System Upgrades (2020–2021) - Various" project, which is a separate two-year project to provide for reconstruction of Hydro's worst-performing distribution feeders.

Table 1: Five-Year Historical Expenditures

Region	2014		2015		2016		2017		2018	
	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual
Central	1,700	1,861	1,720	1,887	1,870	1,877	1,870	1,671	1,870	1,706
Northern	1,270	854	1,210	730	880	993	1,120	924	880	1,079
Labrador	400	859	410	370	900	709	900	610	900	420
Total	**3,370**	**3,574**	**3,340**	**2,987**	**3,650**	**3,579**	**3,890**	**3,204**	**3,650**	**3,205**

3.0 Project Justification

In recent years, Hydro has seen an overall decline in the requirement for unplanned upgrades on the distribution system, as reflected in the actual expenditures from 2014 to 2018 shown in Table 1. The proposed project estimate, as provided in Table 2, is based on an analysis of the historical expenditures within the past five years for distribution upgrading by region supplemented with regional planning input with respect to future activity expenditure levels. The budget by region is shown in Table 3.

4.0 Project Description

This is an annual single year project to provide an allotment for upgrades to the distribution system, based on past expenditures and forecasted activity within the regions. Specific details regarding the actual activity are not available.

Table 2: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1,910.1	0.0	0.0	**1,910.1**
Labour	1,107.2	0.0	0.0	**1,107.2**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	126.4	0.0	0.0	**126.4**
Other Direct Costs	2.7	0.0	0.0	**2.7**
Interest and Escalation	138.6	0.0	0.0	**138.6**
Contingency	0.0	0.0	0.0	**0.0**
Subtotal	**3,285.0**	**0.0**	**0.0**	**3,285.0**
Cost Recoveries	(90.0)	0.0	0.0	**(90.0)**
Total	**3,195.0**	**0.0**	**0.0**	**3,195.0**

Table 3: Estimate for 2020 Upgrade Distribution Systems ($000)

Region	Budget
Central	1,737
Northern	882
Labrador	576
Total	**3,195**

5.0 Conclusion

This is an annual single year allotment that is adjusted from year to year depending on historical expenditures for correction of issues identified through operational inspections and for as-required upgrades to the distribution system.

Project Title: Wood Pole Line Management Program
Location: Various
Category: Transmission and Rural Operations - Transmission
Definition: Other
Classification: Normal

1.0 Introduction

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, 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.

2.0 Project Description

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 program is based on two, 10-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 5-year capital schedule in the "Wood Pole Line Management Program" report.[1]

The estimate for this project is shown in Table 1.

[1] "2020 Capital Budget Application," vol. II, tab 11, "Wood Pole Line Management Program," app. A.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	304.6	0.0	0.0	**304.6**
Labour	1,636.9	0.0	0.0	**1,636.9**
Consultant	100.0	0.0	0.0	**100.0**
Contract Work	406.0	0.0	0.0	**406.0**
Other Direct Costs	95.8	0.0	0.0	**95.8**
Interest and Escalation	3.1	0.0	0.0	**3.1**
Contingency	246.3	0.0	0.0	**246.3**
Total	**2,792.7**	**0.0**	**0.0**	**2,792.7**

3.0 Project Justification

As wood poles age, their preservative retention levels decrease and the poles become increasingly subject 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 is 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.

4.0 Attachment

The report entitled "Wood Pole Line Management," (Volume II, Tab 11) contains further project details.

Project Title: Replace Transformer T7
Location: Holyrood Terminal Station
Category: Transmission and Rural Operations
Definition: Other
Classification: Normal

1.0 Introduction

The 138 kV section of the Holyrood Terminal Station ("TS") has three 230 kV/138 kV transformers, T6, T7, and T8. Holyrood Transformer T7 ("Holyrood T7") is a 25/33.3/41.7 MVA power transformer with a 230 kV/138 kV voltage rating. An internal inspection of this transformer indicated that this unit is in poor condition and it was removed from service.

Due to the loss of this transformer, Hydro's ability to supply the load on the 138 kV transmission loop between the Western Avalon TS and the Holyrood TS is weakened. The replacement of this transformer is recommended.

2.0 Project Description

This scope includes the following items:

- Removal and disposal of Holyrood T7;
- Purchase of Churchill Falls Transformer T31 ("Churchill Falls T31"), currently serving L1301 and Labrador East, from Nalcor's Muskrat Falls project;
- Removal of Churchill Falls T31 from the Churchill Falls Switchyard;
- Transportation of Churchill Falls T31 from the Churchill Falls Switchyard to the Holyrood TS;
- Installation and commissioning of Churchill Falls T31 at the Holyrood TS on a new pad with an oil containment system; and
- The completion of protection upgrades to replace protection relays, metering equipment, wiring, and cables; commissioning shall include paralleling of the new transformer with the existing Holyrood Transformer T6 ("Holyrood T6") and Holyrood Transformer T8 ("Holyrood T8").

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1,195.8	0.0	0.0	**1,195.8**
Labour	230.9	0.0	0.0	**230.9**
Consultant	130.0	0.0	0.0	**130.0**
Contract Work	734.2	0.0	0.0	**734.2**
Other Direct Costs	8.3	0.0	0.0	**8.3**
Interest and Escalation	149.0	0.0	0.0	**149.0**
Contingency	229.9	0.0	0.0	**229.9**
Total	**2,678.1**	**0.0**	**0.0**	**2,678.1**

3.0 Project Justification

The loss of Holyrood T7 weakens Hydro's ability to supply the load on the 138 kV transmission loop between the Western Avalon TS and the Holyrood TS. Hydro can meet peak load conditions with all remaining equipment in service; however, the loss of the next largest transformer in the loop (Holyrood T8) with Holyrood T7 out of service would result in the overload of Holyrood T6. Following this event, the 138 kV transmission loop would have to be opened to balance the load on the Western Avalon TS and Holyrood TS to offload Holyrood T6. The loss of Newfoundland Power's transmission line 64L with Holyrood T7 out of service would result in the overload of Western Avalon Transformers T1 and T2 in the Western Avalon TS. Load flow analysis indicates that load shedding would be required to eliminate these transformer overloads.

The absence of Holyrood T7 results in an increased probability of shedding customer loads supplied via the Western Avalon TS to the Holyrood TS transmission loop

4.0 Attachment

The report entitled "Replace Transformer T7 – Holyrood Terminal Station" (Volume II, Tab 12) contains further project details.

Project Title: Overhaul Diesel Units
Location: Various
Category: Transmission and Rural Operations - Generation
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro's ("Hydro") diesel engine overhaul plan has been developed to ensure the reliability of diesel engines at its diesel generating stations. Hydro has 24 diesel generating stations, 20 of which are prime power stations serving a total of approximately 4,400 customers. To support reliable operation of diesel engines, major overhauls are required periodically to achieve the expected service lives and provide reliable operation.

Hydro overhauls 1200 rpm engines after 30,000 hours of operation with replacement after 120,000 hours of operation and 1800 rpm engines after 20,000 hours of operation with replacement after 100,000 hours. Hydro has determined, based upon the cost of replacement parts, that it may be cost comparable to replace the engine instead of overhauling an engine, if the engine is available with acceptable delivery. If an overhaul occurs it will include such items as:

- pistons;
- liners;
- main bearings;
- connecting rod bearings;
- fuel injectors;
- oil cooler;
- turbo charger;
- water pump;
- oil pump;
- cylinder heads;

- fuel lines;
- fuel pumps; and
- gaskets.

As the costs of parts can fluctuate, in 2020 Hydro will execute the lowest cost alternative for each of the engines requiring overhaul.

2.0 Project Description

This project will overhaul the following diesel engines:

- Grey River 2062;
- Little Bay Islands 2058;
- McCallum 2063;
- Charlottetown 2089;
- Postville 2096;
- Cartwright 2036;
- Makkovik 2029;
- Nain 574;
- Nain 591; and
- St. Lewis 2080.

In addition, the following units will have their alternators overhauled:

- St. Anthony 544; and
- St. Lewis 2080.

Occasionally, a unit in one of the diesel plants across Hydro's operating area experiences an issue that necessitates an unplanned overhaul, or reaches the numbers of operating hours earlier than anticipated. Where appropriate, Hydro may complete such an overhaul under this project and, if possible, defer one of the units noted above that are planned for completion.

1 The project estimate is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1,027.0	0.0	0.0	1,027.0
Labour	707.9	0.0	0.0	707.9
Consultant	0.0	0.0	0.0	0.0
Contract Work	88.0	0.0	0.0	88.0
Other Direct Costs	205.1	0.0	0.0	205.1
Interest and Escalation	75.9	0.0	0.0	75.9
Contingency	207.0	0.0	0.0	207.0
Total	**2,310.9**	**0.0**	**0.0**	**2,310.9**

2 3.0 Future Plans

3 The overhaul of diesel engines is a continuous program that will need to continue as long as there are
4 prime power diesel generating plants. The long-term plan for diesel engine overhauls forecasts 33
5 overhauls over the next five years (i.e., 2020–2024), which is an average of approximately 7 overhauls
6 annually and is based on overhaul intervals of 20,000 and 30,000 operating hours for 1800 rpm and
7 1200 rpm units, respectively. The long-term plan is based on the present-day operating conditions and is
8 subject to change as the loading on a plant or other factors change with time. Changes to the operating
9 conditions can change the average number of annual overhauls.

10 4.0 Attachment

11 The report entitled "Overhaul Diesel Units - Various" (Volume II, Tab 13) contains further project details.

Project Title: Diesel Plant Fire Protection (2020–2021)
Location: Charlottetown
Category: Transmission and Rural Operations – Rural Generation
Definition: Other
Classification: Normal

1.0 Introduction

There is no fire suppression system in the Charlottetown Diesel Generating Plant. Without automated fire protection, Newfoundland and Labrador Hydro's ("Hydro") experience has been that fire related damage to a Diesel Generating Plant may be extensive and result in an extended customer outage. Since 2014, Hydro has been installing automatic fire protection systems to mitigate the risk of fire damage to its Diesel Generating Plants.

2.0 Project Description

This project will install an automated fire protection system at the Charlottetown Diesel Generating Plant. The work includes:

- Design, procurement, installation, and commissioning of a hybrid nitrogen water mist fire protection system; and
- Installation of a new storage shelter for nitrogen cylinders, water cylinders, pipe distribution system, monitoring/activation system, and associated equipment outside the powerhouse, including required foundations, electrical work and ventilation.

The project estimate is provided in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	86.9	104.6	0.0	**191.5**
Consultant	60.0	60.0	0.0	**120.0**
Contract Work	0.0	1,258.9	0.0	**1,258.9**
Other Direct Costs	5.7	8.1	0.0	**13.8**
Interest and Escalation	8.7	116.6	0.0	**125.3**
Contingency	15.2	143.2	0.0	**158.4**
Total	**176.5**	**1,691.4**	**0.0**	**1867.9**

3.0 Project Justification

This project is required to minimize the damage that could result if a fire were to occur in the Charlottetown Diesel Generating Plant. The damage could result in the community being left without power for an extended period of time.

4.0 Attachment

The report entitled "Diesel Plant Fire Protection (2020–2021)" (Volume II, Tab 14) contains further project details.

Project Title: Terminal Station In-Service Failures
Location: Various
Category: Transmission and Rural Operations - Terminal Stations
Definition: Other
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("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 approval by the Board of Commissioners of Public Utilities in time to be included in its annual Capital Budget Application. The identification is done through the preventive maintenance program using various condition based assessments and 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 the occurrence of an actual failure, the identification of an incipient failure, or determination of 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.

Hydro is proposing that, within this project, it undertake the immediate capital refurbishment and replacement work[1] required for Terminal Stations to maintain the integrity and reliability of electricity transmission by this infrastructure as well as to ensure the availability of capital spares[2] required to support such work. These activities will be undertaken in accordance with the philosophies outlined throughout the "Terminal Station Asset Management Overview" (see Volume II, Tab 7). Examples of the activities that may be undertaken in this project are outlined in Appendix A. Hydro uses historical data

[1] This work will not include actions that more appropriately can be executed as Unforeseen or Capital Budget Supplemental projects.

[2] Capital spares are major spare parts that meet the definition of capital assets that are kept on hand to be used in the event of an unexpected breakdown or failure of equipment thereby expediting the return of the equipment to service. Capital spares are important in reducing periods of interruption in the generation and transmission of electricity.

and asset management personnel judgement to predict the magnitude of the Terminal Station In-Service Failures project budget.

2.0 Background

2.1 Operating Experience

The 2018 Terminal Station In-Service Failures project consisted of 21 corrective actions with a total expenditure of $2,268,800. The corrective actions are detailed in Appendix A.

3.0 Project Justification

Due to the nature of Terminal Station systems and equipment, unanticipated failures and deterioration will occur. This project provides an effective and timely means to undertake the immediate capital refurbishment and replacement work required for Terminal Stations to maintain the integrity and reliability for transmission of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work.

4.0 Project Description

Hydro is proposing to undertake the immediate capital refurbishment and replacement work required for its Terminal Stations to maintain the integrity and reliability for the transmission of electricity by this infrastructure as well as to ensure the availability of capital spares required to support such work. At this time, Hydro does not have any planned capital spare acquisitions; however, throughout 2020, Hydro may purchase capital spares identified by asset management personnel as requiring immediate procurement to offset deficiencies in its capital spares.

The estimate for this project is shown in Table 1. Based on the expenditures noted in Appendix A, and current expenditures under the 2019 Terminal Station In-Service Failures project, Hydro has reassessed the approved amount in the 2019 Terminal Station In-Service Failures project[3] and proposes a new value shown in Table 1 for the 2020 Terminal Station In-Service Failures project.

[3] The 2019 Terminal Station In-Service Failures project was approved at $1,000,000 in Board Order No. P.U. 46(2018) on December 10, 2018.

Table 1: Project Estimate ($000)

Project Cost	**2020**	**2021**	**Beyond**	**Total**
Material Supply	950.0	0.0	0.0	**950.0**
Labour	259.4	0.0	0.0	**259.4**
Consultant	100.8	0.0	0.0	**100.8**
Contract Work	100.0	0.0	0.0	**100.0**
Other Direct Costs	14.2	0.0	0.0	**14.2**
Interest and Escalation	75.6	0.0	0.0	**75.6**
Contingency	0.0	0.0	0.0	**0.0**
Total	**1500.0**	**0.0**	**0.0**	**1500.0**

As there is no planned refurbishment or replacement work or capital spares acquisitions, no project schedule is provided for those activities.

Appendix A

2018 In-Service Failure Activities

Table A-1: 2018 In-Service Failure Activities

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Replace Five 230 kV Instrument Transformers, Churchill Falls Terminal Station	895.3	Inspection of five instrument transformers in 2017 revealed that the transformers were leaking oil and required replacement: • 230-21 A-Phase CT/PT; • 230-21 B-Phase CT; • 230-21 C-Phase CT; • 230-22 A-Phase CT/PT; and • 230-23 A-Phase CT/PT.	Five new instrument transformers were ordered in 2017. They were received and installed in 2018, replacing the five leaking instrument transformers.
Purchase Spare Circuit Breakers for Standby Equipment Pool	489.2	Hydro reviewed standby equipment pool requirements for circuit breakers in its 195 terminal stations. With expected delivery periods for replacement circuit breakers ranging from 4 to 6 months, and to reduce downtime related to a circuit breaker failure, it was determined that one breaker for each of the following voltage ratings should be added to the standby equipment pool: 72.5 kV; 145 kV; and 245 kV.	Three spare circuit breakers were purchased for the standby equipment pool: • 72.5 kV circuit breaker; • 145 kV circuit breaker; and • 245 kV circuit breaker.
Purchase Spare Disconnect Switches for Standby Equipment Pool	185.7	Hydro reviewed standby equipment pool requirements for disconnect switches in its 195 terminal stations. With expected delivery periods for replacement disconnect switches of approximately 48 weeks, and to reduce downtime related to disconnect switch failure, it was determined that one disconnect switch for each of the following voltage ratings should be added to the standby equipment pool: 72.5 kV; 145 kV; and 245 kV for both horizontal and vertical configurations.	Six spare disconnect switches were purchased for the standby equipment pool: • 72.5 kV vertical mount; • 72.5 kV horizontal mount; • 145 kV vertical mount; • 145 kV horizontal mount; • 245 kV vertical mount; and • 245 kV horizontal mount.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Replace Breaker B7L38, Holyrood Terminal Station	141.5	On December 16, 2017, severe weather on the Avalon Peninsula resulted in the tripping of TL 242 (Soldiers Pond to Hardwoods), TL 265 (Holyrood to Soldiers Pond), Holyrood L2 (station service feed to station service transformer SST-12 for the Holyrood Thermal Generating Station) and Holyrood Bus B6 and B7 due to a bus lockout. Investigation on December 16, 2017 identified that Breaker B7L38 had its line side bushings burned on all three phases as a result of Newfoundland Power's breaker at Seal Cove not clearing the fault due to fuses blown in the trip circuit for the breaker. The damage was severe to Breaker B7L38's three line side bushings and the insulators and associated current transformers. Refurbishment of the breaker was ruled out due to the 16–18 week expected delivery time for parts from the original equipment manufacturer. A spare breaker was available in Hydro's inventory.	Breaker B7L38 was replaced with an available spare breaker.
Breaker B2L21 Overhaul, Peter's Barren Terminal Station	79.4	During inspections, Breaker B2L21 was identified as leaking sulfur hexafluoride (SF_6) gas to the atmosphere. Overhaul of the breaker was required to prevent a flashover in the breaker and to minimize any loss of SF_6 gas.	Breaker B2L21 was overhauled.
Replace X1 Bushing on Transformer T8, Wabush Terminal Station	75.8	Transformer T8 X1 bushing failed on August 16, 2018 resulting in a forced outage to Transformer T8. The bushing failed due to a failed top terminal seal caused by corrosion of the bushing at a sealed joint. The failed bushing was unsuitable for repair due to the corrosion, and transformer T8 cannot operate without an X1 bushing, therefore the restoration of Transformer T8 required the replacement of the X1 bushing.	The X1 bushing on Transformer T8 was replaced.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Transformer T4 Tap Changer Overhaul, Hardwoods Terminal Station	64.9	Testing of the Transformer T4 tap changer conducted in December 2017 revealed that there was a high risk of failure and an immediate overhaul of the tap changer diverter switch was required.	Transformer T4 tap changer was overhauled.
Replace CT on B9B10-1, Bay d'Espoir Terminal Station 2	45.0	An infrared scan revealed that the 230 kV CT on disconnect switch B9B10-1 B-Phase was excessively hot (100°C) at the primary connection terminals. This was determined to be due to galvanic corrosion on the copper-aluminum connection. Upon disassembly, the spacer dowels were found to be melted and a significant oil leak had developed. This condition required 230 kV Breaker B9B10 to be taken out of service resulting in the primary ring bus open until the current transformer was replaced. Immediate replacement of the current transformer was required to restore system reliability.	Bay d'Espoir Terminal Station 2 • The 230 kV CT on B9B10-1 B-Phase was replaced.
Replace B-Phase CT on Breaker 46-38, Wabush Terminal Station	39.7	During inspection, the CT on Breaker 46-38 B-Phase was found to have an oil leak on the top head unit and it required immediate replacement.	The 46-38 B-Phase CT was replaced.
Replace Disconnect Switch B3T2-1, Stony Brook Terminal Station	36.7	Inspection revealed that Disconnect Switch B3T2-1 (138 kV) had damaged hinge side parts that rendered it inoperable on two phases. Replacement parts were not available for this breaker, which was 49 years old, and it required replacement.	A new disconnect switch was procured and installed to replace the failed Disconnect Switch B3T2-1.
Replace A-Phase CT on B1L32, Stony Brook Terminal Station	34.4	Inspection revealed that the A-Phase CT on B1L32 developed an oil leak internal to its junction box around the gland plate, which began leaking out through the box. The CT was de-energized to avoid any further oil loss and possible catastrophic failure. The leaking CT location had added safety concerns to personnel as it is located directly in front of the Control Building's main door and	The A-Phase CT on B1L32 was replaced.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
		parking area. Immediate replacement was required to restore B1L32 and the ring bus to service.	
Purchase Spare Station Service Voltage Transformer, Oxen Pond Terminal Station	29.1	It was determined that a spare station service voltage transformer was required after three new station service voltage transformers were installed in the Oxen Pond Terminal Station for a second station service supply.	A spare station service voltage transformer was purchased for the standby equipment pool.
Purchase Spare Motor Operator for Circuit Switcher for Western Avalon B1T1, B1T2 and Stephenville B1L09	28.6	In June 2018, Circuit Switcher B1T1 at Western Avalon was identified as non-operational. Further inspection found that a coupling from the motor going to the linkage that operates the opening and closing of the circuit switcher was broken. The original equipment manufacturer was able to repair the existing equipment; however, replacement parts are not available if future repairs are required. This identified the need to have a spare available in the standby equipment pool.	A spare motor operator was procured for the standby equipment pool.
Replace 125 Vdc Battery Bank, Bear Cove Terminal Station	25.7	Discharge testing of the 125 Vdc battery bank revealed that multiple cells within the bank had dropped below the acceptable level of 1.75 volts per cell, and the battery bank required replacement.	A replacement 125 Vdc battery bank was procured and installed.
Replace Current/Voltage Transformer on TL205 B-Phase, Buchans Terminal Station	23.3	Hydro's Energy Control Center operators observed high and low voltage fluctuations in the secondary voltages followed by a protection failure alarm of the 230 kV B-Phase current/voltage transformer on TL 205. TL 205 was removed from service and crews were dispatched to site. Upon arrival the work crew found oil leaking from the base of the unit. Immediate replacement with an available spare from inventory was required to put TL 205 back in service.	The failed current/voltage transformer was replaced with an available spare.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Replace Bus 2 C-Phase Current/Voltage Transformer, Sunnyside Terminal Station	20.2	During scheduled six-year maintenance on Bus 2 current/voltage transformers in the Sunnyside Terminal Station, the C-Phase current/voltage transformer was found to have a severely corroded terminal block and accessories in its junction box. Upon removal of the terminal block for replacement, the secondary protective spark gap was found to be badly burnt and shorted out. The planned Doble Testing showed a 400-500% increase of its capacitor power factor. Doble Engineering was consulted and they recommended to not re-energize the current/voltage transformer. As a result, immediate replacement was required to restore Bus 2 to service.	Bus 2 C-Phase current/voltage transformer was replaced.
Replace Bus B1 Potential Transformer, Cow Head Terminal Station	17.9	An inspection in October 2017 identified deterioration of the Bus B1 PT due to corrosion (placing it at a high risk of failure), requiring immediate replacement. The PT was manufactured in 2006 and was of a carbon steel design, whereas Hydro's current standard is for stainless steel or aluminum design.	The Bus B1 PT was replaced with a unit that meets Hydro's current standard (stainless steel/aluminum).
Replace Capacitor Bank 2 Overvoltage Relay, St. Anthony Airport Terminal Station	13.3	While performing scheduled preventive maintenance on March 28, 2018, capacitor bank overvoltage relay 59N was found to be inoperative and requiring replacement. This resulted in Capacitor Bank 2 being out of service until the relay could be replaced.	An overvoltage relay was procured and installed to replace the failed Capacitor Bank 2 overvoltage relay.
Replace 6.9 kV Fuse Holder and Fuses, Bottom Brook Terminal Station	13.2	During the activity to isolate equipment for work protection in June 2018, the 6.9 kV fuse for station service on transformer T3 failed and required replacement. No replacement fuses were available for this vintage, which resulted in the requirement to replace the entire fuse/fuse holder assembly.	The 6.9 kV fuse and fuse holder was replaced.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Replace Neutral Overcurrent Relay on Transformer T1, Plum Point Terminal Station	5.8	On April 9, 2018, protective relaying locked out Transformer T1 in response to a fault on Line 1 during blizzard conditions, which lead to a loss of electrical supply to approximately 4,867 customers fed via the Plum Point, Bear Cove, Roddickton, Main Brook, and St. Anthony Terminal Stations. Analysis of the event determined that the neutral overcurrent relay on Transformer T1 had tripped for a feeder fault due to the failure of the induction disc to reset. Immediate replacement was required to prevent reoccurrence.	The neutral overcurrent relay on Transformer T1 was replaced.
Replace Surge Arrestor H1 on Transformer T12, Bay d'Espoir Terminal Station 2	4.1	Doble Testing on the surge arresters for Transformer T12, revealed that the H1 surge arrester failed testing. A replacement arrester was required to ensure continued protection for Transformer T12.	Surge Arrestor H1 on Transformer T12 was replaced.

Project Title: Replace Powerhouse Roofing System
Location: L'Anse Au Loup and St. Anthony
Category: Transmission and Rural Operations – Rural Generation
Definition: Pooled
Classification: Normal

1.0 Introduction

The L'Anse au Loup and St. Anthony Diesel Generating Stations' powerhouse roofing systems have performed well since their original installation; however, at nearly 50 years of age they are nearing the end of their anticipated service life. In recent years, the roofing systems have developed leaks within the engine hall, office, and storage areas.

Failure to restore the integrity of the roofing system will result in continued infiltration of water. This will inevitably lead to deterioration of the powerhouse structure and poses a risk to the sensitive electrical equipment and other infrastructure.

Newfoundland and Labrador Hydro is proposing to replace the powerhouse roofing systems at the L'Anse au Loup and St. Anthony Diesel Generating Stations.

2.0 Project Description

This two-year project will replace the metal panel roof system for L'Anse au Loup and St. Anthony Diesel Generating Stations.

The scope of work includes the following:

- Completion of the detailed design including the preparation of architectural details for various roof, flashing and trim components, and design of roof top fall protection system;
- Replacement of existing roof insulation, metal roofing panels, and ridge vent; and
- Supply and installation of fall protection system.

Detailed design is planned for 2020 and the completion of the roof replacements in 2021.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	0.0
Labour	64.3	78.8	0.0	143.1
Consultant	42.7	108.4	0.0	151.1
Contract Work	0.0	792.7	0.0	792.7
Other Direct Costs	1.9	9.3	0.0	11.2
Interest and Escalation	7.6	88.8	0.0	96.4
Contingency	8.8	117.8	0.0	126.6
Total	**125.3**	**1,195.8**	**0.0**	**1,321.1**

3.0 Project Justification

The L'Anse au Loup and St. Anthony Diesel Generating Stations' powerhouse roofing systems are nearing the end of their service life. Failed mechanical fasteners and roof panel seams have resulted in leaks. The infiltration of water poses a risk to the electrical equipment and other infrastructure housed within these structures.

Previous attempts to repair the roof via the application of an elastomeric coating system have proven to be short-term solutions. Given the roofing system's age and condition, its replacement is required to ensure the integrity of the building envelope.

4.0 Attachment

The report entitled "Replace Powerhouse Roofing System – L'Anse Au Loup and St. Anthony" (Volume II, Tab 15) contains further project details.

Project Title: Diesel Plant Ventilation Upgrade
Location: Nain
Category: Transmission and Rural Operations – Distribution Labrador
Definition: Other
Classification: Normal

1.0 Introduction

The diesel plant in Nain was built in 2002 and is a two story building that houses four diesel generator units with a combined capacity of 3,865 kW. At the time of construction, a ventilation system was installed to exchange air inside the building with outside air and to ensure a minimum number of air changes take place per hour. This is required for two purposes. One was to extract stale air, containing a build-up of fumes and odors, from the building. The other was to ensure the engine hall did not exceed an acceptable ambient air temperature due to heat build-up from the diesel generator units.

Since the initial construction of the plant, time additional generation has been added. This increased ventilation requirements; however, the system was not expanded at the time. In addition, the exhaust fans of the ventilation system are in poor condition and have high maintenance costs due to their internal design. The roof mount installation has exposed them to severe wind gusts, which has resultant in hood damage.

2.0 Project Description

This project will upgrade the original plant ventilation system with a new higher capacity system that will provide adequate cooling and reduce maintenance. The scope of work includes:

- Partial removal of the existing ventilation system and roof patching after the exhaust fans have been removed; and
- Supply and installation of new fans, louvers, dampers, hoods, motor starters, thermostats, and other associated equipment.

The new design will specify all direct drive wall mounted fans to be installed. This will lessen the damage potential from high winds and allow more efficient maintenance activities to take place. All fans will be accessible by using an aerial lift rather than having to use a ladder to climb onto the roof.

The plan includes engineering design and material procurement in 2020 and installation and site work in 2021.

The project estimate is provided in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	78.7	91.9	0.0	**170.6**
Consultant	50.0	30.0	0.0	**80.0**
Contract Work	0.0	425.0	0.0	**425.0**
Other Direct Costs	5.7	8.1	0.0	**13.7**
Interest and Escalation	8.2	52.2	0.0	**60.4**
Contingency	20.2	83.2	0.0	**103.4**
Total	**162.7**	**690.4**	**0.0**	**853.1**

3.0 Project Justification

The ventilation system does not provide adequate plant ventilation to facilitate reliable operation of the diesel generator units.

4.0 Attachment

The report entitled "Diesel Plant Ventilation Upgrade - Nain" (Volume II, Tab 16) contains further project details.

Project Title: Additions for Load Growth for Makkovik and Hopedale
Location: Makkovik and Hopedale
Category: Transmission and Rural Operations — Distribution Upgrades
Definition: Pooled
Classification: Normal

1.0 Introduction

The peak demand in both Makkovik and Hopedale is growing and an analysis of the most recent forecast has indicated that in 2020, during peak load, voltage levels that violate Newfoundland and Labrador Hydro's ("Hydro") Distribution Planning Criteria are expected to occur.

2.0 Project Description

This proposed project consists of completing distribution line upgrades on both the Makkovik and Hopedale isolated distribution systems to address the load growth occurring in both communities and to eliminate voltage violations for the forecasted loads. The work required includes the design, procurement, and construction involved with the following:

- Hopedale: Replace 1.8 km of existing 1/0 AASC[1] three phase distribution line with 477 ASC[2] primary and 4/0 AASC neutral.
- Makkovik: Replace 1.3 km of existing 1/0 AASC three phase distribution line with 477 ASC primary and 4/0 AASC neutral, and upgrade 500 m of single phase distribution line to three phase distribution line.

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

[1] Aluminum alloy stranded conductor.
[2] Aluminum stranded conductor.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	171.5	0.0	0.0	**171.5**
Labour	376.3	0.0	0.0	**376.3**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	120.0	0.0	0.0	**120.0**
Other Direct Costs	72.3	0.0	0.0	**72.3**
Interest and Escalation	32.0	0.0	0.0	**32.0**
Contingency	74.0	0.0	0.0	**74.0**
Total	**846.1**	**0.0**	**0.0**	**846.1**

3.0 Project Justification

This project is required to meet the growing electricity needs of Hydro's customers in the Makkovik and Hopedale distribution systems. According to load flow analysis that are based on recent load studies, the forecasted load growth results in low voltage violations of Hydro's distribution planning criteria in both distribution systems. Customer equipment, which is subjected to voltage conditions that violate Hydro's distribution planning criteria, could potentially malfunction or become damaged.

A number of alternatives were considered to address the expected low voltages and a detailed economic analysis was completed. This analysis demonstrated that the least cost alternative to prevent low voltage conditions from occurring is to reconductor a portion of both distribution lines. This project will ensure the continued supply of quality power to Makkovik and Hopedale.

4.0 Attachment

The report entitled "Additions for Load – Distribution System – Makkovik and Hopedale" (Volume II, Tab 17) contains further project details.

Project Title: Upgrade Line Depots
Location: Burgeo and Fogo Island
Category: Transmission and Rural Operations - Properties
Definition: Pooled
Classification: Normal

1.0 Introduction

The Fogo Island and Burgeo Line Depot facilities are utilized by personnel as a base of operations and storage facility in these areas to support local transmission and distribution operations. Aspects of the facilities such as roofs, windows, siding, support members, plumbing, lighting, and concrete slabs are deteriorated. This project proposal is to refurbish these facilities.

The project is estimated to cost approximately $648,300 with scheduled completion in 2020.

2.0 Project Description

The project is for the refurbishment of the Burgeo and Fogo Island Line Depots. The scope of work includes:

- Fogo Island Line Depot:
  - Replacement of windows;
  - Replacement of damaged metal siding;
  - Installation of a new heat recovery ventilation ("HRV") unit;
  - Mechanical and plumbing upgrades to the building;
  - Replacement of exterior lighting; and,
  - Replacement of a storage shed.
- Burgeo Line Depot:
  - Replacement of the EPDM[1] roof;
  - Replacement of concrete pads;

[1] Ethylene propylene diene monomer ("EPDM").

- Refurbishment of concrete building foundations;
- Installation of a new HRV unit;
- Mechanical and plumbing upgrades to the building;
- Replacement of storage shed doors; and,
- Replacement of the wire storage ramp.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	88.9	0.0	0.0	**88.9**
Consultant	172.0	0.0	0.0	**172.0**
Contract Work	286.0	0.0	0.0	**286.0**
Other Direct Costs	11.5	0.0	0.0	**11.5**
Interest and Escalation	24.4	0.0	0.0	**24.4**
Contingency	65.5	0.0	0.0	**65.5**
Total	**648.3**	**0.0**	**0.0**	**648.3**

3.0 Project Justification

This project maintains the operational capability of the buildings and extends the life span of the Fogo Island and Burgeo Line Depot facilities

4.0 Attachment

The report entitled "Upgrade Line Depots - Various" (Volume II, Tab 18) contains further project details.

Project Title: Replace Light and Heavy Duty Vehicles (2020–2021)
Location: Various
Category: General Properties – Transportation
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") operates a fleet of vehicles comprised of approximately 270 light-duty vehicles (cars, pickup trucks, and vans) and 65 heavy-duty vehicles (aerial devices, material handlers, and boom trucks). The fleet is 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.

This project provides for the replacement of light-duty and heavy-duty vehicles that meet the established replacement criteria. Hydro's replacement criteria are similar to other utilities. This project will contribute to the reliable operation of Hydro's light-duty and heavy-duty vehicle fleet.

2.0 Project Description

This project proposes the replacement of 29 light-duty and 10 heavy-duty vehicles.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	1,467.9	1,282.3	0.0	2,750.2
Labour	3.0	2.0	0.0	5.0
Consultant	0.0	0.0	0.0	0.0
Contract Work	0.0	0.0	0.0	0.0
Other Direct Costs	2.0	2.0	0.0	4.0
Interest and Escalation	152.6	159.2	0.0	311.8
Contingency	0.0	138.0	0.0	138.0
Total	**1,625.5**	**1,583.5**	**0.0**	**3,209.0**

3.0 Project Justification

This project will contribute to the reliable operation of Hydro's light-duty and heavy-duty vehicle fleet.

4.0 Attachment

The report entitled "Replace Light and Heavy Duty Vehicles (2020–2021) – Various" (Volume II, Tab 19) contains further project details.

Project Title: Replace Elevator Motors and Control Equipment
Location: Hydro Place
Category: General Properties
Definition: Other
Classification: Normal

1.0 Introduction

Hydro Place, located in St. John's, Newfoundland and Labrador, serves as the corporate headquarters for Newfoundland and Labrador Hydro ("Hydro"). It is a six story office building constructed in 1988 that provides work space for approximately 550 employees. The building has two elevators to allow access to all levels. The elevator motors and control equipment are original to the building. In recent years the elevators have been out of service many times due to controls and mechanical failures.

This project is being proposed by Hydro to provide reliable elevator operation at Hydro Place.

2.0 Project Description

The scope of work for this project includes:

- Replacement of motors;
- Replacement of control system hardware;
- Programming of new control installations;
- Testing for proper functionality; and
- Completion of electrical and civil temporary relocation work to facilitate old equipment removals and installation of new.

The estimate for this project is shown in Table 1 with work commencing in 2020 with planned completion in 2021.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	77.1	86.7	0.0	**163.8**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	460.0	0.0	**460.0**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	4.4	46.2	0.0	**50.6**
Contingency	7.6	54.7	0.0	**62.3**
Total	**89.1**	**647.6**	**0.0**	**736.7**

3.0 Project Justification

This project is required to provide reliable elevator operation at Hydro Place. Elevator failures and malfunctions are occurring more frequently. The elevators are beyond the average service life for elevators of that vintage, and parts have started to become unavailable due to obsolescence.

4.0 Attachment

The report entitled "Replace Elevator Motors and Control Equipment – Hydro Place" (Volume II, Tab 20) contains further project details.

Project Title: Replace Personal Computers
Location: Hydro Place
Category: General Properties – Information Systems
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") personnel have assigned laptop, desktop, or work station computers to access business software applications. To support its business and maintain operational reliability for its software applications and information, Hydro must keep computing devices current. This includes accessories to those devices such as: monitors; keyboards; mice; and cables.

2.0 Background

2.1 Existing System

Preliminary analysis based on device age has identified 106 laptop, 138 desktop, 3 work station, and 10 ruggedized mobile computers that will be approaching the end of their useful lives by the end of 2020. This increases the risk of device failures and decreases compatibility with modern software applications. In addition, these devices are no longer covered under vendor maintenance agreements.

2.2 Operating Experience

Based on utility industry best practices, the lifecycle for computers is five years for laptops, six years for desktops and work stations, and seven years for thin-client computers. Hydro has a lifecycle criterion for computing devices similar to other companies, including Newfoundland Power.

Hydro purchases maintenance agreements to provide warranty coverage for four years for laptops and five years for desktops and workstations, meaning these devices are used for a one year period without warranty coverage.

3.0 Project Justification

Computing infrastructure must be maintained at a level necessary to provide the required performance and capacity to effectively run business applications.

If computing devices are not kept current, the following scenarios could occur:

- Inability to install new software applications and upgrade existing applications;
- Decreased processing speed and increased potential for lost data;
- Unsupported operating systems for patches and vulnerability updates; and
- Decreased productivity during the repair or reimaging process.

4.0 Project Description

Hydro is proposing the replacement of 106 laptop, 138 desktop, 3 work stations, and 10 ruggedized mobile computers. A reassessment of equipment to be replaced will occur in January 2020 as the proposed quantities are a forecast based upon lifecycle retirements and the number of new units required to accommodate new software applications or work methods.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	479.7	0.0	0.0	**479.7**
Labour	33.1	0.0	0.0	**33.1**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	70.2	0.0	0.0	**70.2**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	32.1	0.0	0.0	**32.1**
Contingency	58.3	0.0	0.0	**58.3**
Total	**673.3**	**0.0**	**0.0**	**673.3**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Create Requests for Proposals, schedules, and secure resources.	January 2020	March 2020
Design:		
Create project plan.	February 2020	May 2020
Procurement:		
Award Requests for Proposals and order materials.	March 2020	October 2020
Construction:		
Implement upgrades.	March 2020	October 2020
Commissioning:		
Go live with upgrades.	May 2020	October 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

Using personal computing devices that are approaching end of life could impede Hydro's ability to ensure business software applications execute effectively and electronic business data is secure. This project would replace personal computing devices approaching end of life and eliminate such a risk.

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

2020 Capital Budget Application
Capital Projects Over $200,000 and Less Than $500,000

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Projects over $200,000 and less than $500,000
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Definition	Classification	Page Ref.
Generation							
Upgrade Compressed Air System - Holyrood Gas Turbine	70.7	317.7	0.0	388.4	Other	Normal	
Upgrade Uninterruptible Power Supply 3 & 4 - Holyrood	0.0	348.7	0.0	348.7	Other	Normal	D-2
Total Generation	**70.7**	**666.4**	**0.0**	**737.1**			
Tranmission and Rural Operations							
Upgrade Terminal Station for Mobile Substation (2019-2020) - St. Anthony	89.3	402.7	0.0	492.0	Other	Normal	
Install Recloser Remote Control (2019-2020) - Rocky Harbour	66.1	319.9	0.0	386.0	Other	Normal	
Install Energy Efficiency Lighting in Diesel Plants - Various	223.0	122.2	0.0	345.2	Pooled	Justifiable	
Replace Light Duty Mobile Equipment - Various	0.0	499.6	0.0	499.6	Pooled	Normal	D-5
Upgrade Fuel Storage Tanks - Charlottetown	0.0	467.2	0.0	467.2	Other	Normal	D-10
Upgrade Fire Suppression System - Bishop's Falls	0.0	91.6	292.6	384.2	Other	Normal	D-15
Replace Automation Equipment - Rigolet	0.0	363.8	0.0	363.8	Other	Normal	D-19
Install Recloser Remote Control (2020-2021) - Hampden and Upper Salmon	0.0	71.3	185.3	256.6	Pooled	Normal	D-23
Purchase Meters and Metering Equipment - Various	0.0	244.2	0.0	244.2	Pooled	Normal	D-33
Purchase Tools & Equipment less than $50,000 - Central	0.0	242.1	0.0	242.1	Pooled	Normal	
Purchase SF_6 Multi-Analyzer - Various	0.0	207.1	0.0	207.1	Other	Normal	D-35
Total Transmission and Rural Operations	**378.4**	**3,031.7**	**477.9**	**3,888.0**			
General Properties							
Replace Radomes - Various	0.0	384.5	0.0	384.5	Pooled	Normal	D-38
Replace Peripheral Infrastructure - Hydro Place	0.0	222.1	0.0	222.1	Pooled	Normal	D-51
Total General Properties	**0.0**	**606.6**	**0.0**	**606.6**			
Total Projects over $200,000 and less than $500,000	**449.1**	**4,304.7**	**477.9**	**5,231.7**			

Project Title: Upgrade Uninterruptible Power Supply 3 & 4
Location: Holyrood
Category: Generation
Definition: Other
Classification: Normal

1.0 Introduction

There are four independent uninterruptable power supply ("UPS") units installed at the Holyrood Thermal Generating Station ("Holyrood TGS"). These UPS units are used to provide uninterrupted power to various systems during system disruptions such as: interruptions to the electricity supply to the generating station due to a problem with the Holyrood Terminal Station equipment. Two units are planned for replacement under this project.

2.0 Background

2.1 Existing System

UPS units 1, 2, and 3 are dedicated to steam turbine generator Units 1, 2, and 3, respectively. These UPS units supply backup electrical energy to the Holyrood TGS' distributed control system, burner management systems, turbine and boiler instrumentation, and plant environmental systems. Each UPS unit provides approximately one hour of service to maintain electrical power to systems within the Holyrood TGS. UPS unit 4 is used for plant common systems which includes systems such as: fire protection, public address phones, and some of the steam turbine generator Unit 3 distributed control system, which will be used after post-steam operation. The UPS units are in service on a continual basis. The status of each UPS unit is continually monitored by the UPS unit internal control system and by an external battery monitoring system.

UPS 3 and UPS 4 are planned for replacement and were placed into service in 2001.

2.2 Operating Experience

Since 2010, these units have been in an "end of life" status, meaning that there is limited or no availability of parts and no technical support from the original equipment manufacturer ("OEM"). Parts and technical support are required to be able to respond to electronics or control board failures. Battery cell failures can be identified and corrected quickly without this support.

3.0 Analysis

The Holyrood TGS Unit 3 steam turbine generator is anticipated to remain in operation as a synchronous condenser after the Holyrood TGS transitions to post-steam operation. UPS capability is required while Unit 3 is operating in synchronous condenser mode, thus requiring UPS 3 and UPS 4 to remain in operation. Given the unavailability of parts and technical support, future failures may not be repairable and refurbishment of the control system is unlikely. Newfoundland and Labrador Hydro ("Hydro") has determined UPS 3 and UPS 4, which are required for post-steam operation, should be replaced. UPS 1 and UPS 2 will not be required for post-steam operation. Hydro proposes that UPS 1 and UPS 2 not be replaced at this time given the short remaining operating life. As a risk mitigation strategy, parts from the old UPS 3 and UPS 4 will be retained as spares for UPS 1 and UPS 2.

4.0 Project Description

The scope of this project consists of:

- Perform a load management/protection coordination study to confirm the specifications of the replacement UPS systems;
- Procure and install two UPS units, tie in existing cables, and install any required devices; and
- Remove and dispose of cells from UPS Units 3 and 4.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	161.4	0	0	**161.4**
Labour	104.7	0	0	**104.7**
Consultant	10.0	0	0	**10.0**
Contract Work	22.2	0	0	**22.0**
Other Direct Costs	1.0	0	0	**1.0**
Interest and Escalation	19.6	0	0	**19.6**
Contingency	29.8	0	0	**29.8**
Total	**348.7**	**0**	**0**	**348.7**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Open project and review schedule.	January 2020	February 2020
Design:		
Conduct site visits and detailed design.	February 2020	March 2020
Procurement 1:		
Issue and award Requests for Proposals for load management/protection coordination study.	March 2020	April 2020
Deliverable		
Completion and review of load management/protection coordination study.	April 2020	May 2020
Procurement 2:		
Tender and award: purchase order for supply of materials and contract for installation	May 2020	June 2020
Construction/Commissioning:		
Replace existing battery banks.	August 2020	September 2020
Closeout:		
Close out project.	November 2020	December 2020

5.0 Conclusion

There are four independent UPS units installed at the Holyrood TGS. These UPS units are used to provide uninterrupted power to various systems during system disruptions. Since 2010, these units have been in an "end of life" status, meaning that there is limited or no availability of parts and no technical support from the OEM.

Holyrood Unit 3 generator is anticipated to remain in operation as a synchronous condenser after the Holyrood TGS transitions to post-steam operation in 2021. Reliable UPS 3 and UPS 4 capability is required to maintain reliable operation of the Holyrood TGS until end of steam and, in the long term, to provide synchronous condenser capacity.

Project Title: Replace Light-Duty Mobile Equipment
Location: Various
Category: General Properties – Transportation
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") employees operate in many locations across the Province and need reliable light-duty utility equipment to effectively fulfil their duties.

The mobile equipment fleet is strategically distributed across Hydro's operating areas throughout the Province and is utilized on a daily basis by support staff engaged in the maintenance and repair of the electrical system. As equipment ages, it experiences increasing downtime that could negatively impact response times for emergency outages or planned maintenance.

In consultation with other utilities involved with the Canadian Utility Fleet Council, Hydro has established its mobile equipment replacement guidelines that consider the age and operating conditions for the equipment. Hydro's replacement criteria can is shown in Table 1.

Table 1: Hydro's Replacement Criteria for Mobile Equipment

Equipment	Age (Years)
Snowmobiles/ATVs: Transmission Line Crews	3–5
Snowmobiles/ATVs: Other	5–7
Light-Duty Trailers	6–8
Heavy-Duty Trailers	12–15

2.0 Background

2.1 Existing System

Hydro operates a fleet of light-duty mobile equipment comprised of approximately 120 snowmobiles, 70 ATVs, 120 trailers, and other miscellaneous equipment.

2.2 Operating Experience

As equipment ages, it experiences increasing downtime that could negatively impact response times for emergency outages or planned maintenance. In many cases, light-duty equipment is regularly operated under rough conditions and is subject to accelerated wear and tear. Table 2 provides a history of light-duty mobile equipment purchases.

Table 2: Historical Information

Year	Capital Budget ($000)	Actual Expenditures ($000)	Units	Cost per Unit ($000)	Equipment
2019	469.6	436.2 Committed	35	Various	10 ATVs 8 Trailers 17 Snowmobiles
2018	429	416.6	33	Various	16 ATVs 1 Misc. 9 Trailers 7 Snowmobiles
2017	270	268.4	29	Various	11 ATVs 1 Forklift 1 Misc. 4 Trailers 12 Snowmobiles
2016	348	351.4	27	Various	13 ATVs 8 Snowmobiles 6 Trailers

2.3 Maintenance History

Light-duty equipment is inspected in accordance with the preventive maintenance schedule and all maintenance and repairs are performed by third-party service providers as needed. Detailed costs are not tracked for this category of asset.

3.0 Project Justification

This project is necessary to maintain a reliable light-duty equipment fleet. Failure to replace these units will lead to increasing maintenance costs and less reliable equipment. This equipment is often used in remote areas and must be reliable to ensure the safety of users.

4.0 Project Description

This project proposes the replacement of 10 ATVs, 14 snowmobiles, and 14 light-duty trailers in accordance with the replacement criteria provided in section 1.0.

A detailed listing of the age of the assets being replaced under this project is provided in Appendix A.

The estimate for this project is shown in Table 3.

Table 3: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	445.0	0.0	0.0	**445.0**
Labour	4.4	0.0	0.0	**4.4**
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	27.7	0.0	0.0	**27.7**
Contingency	22.5	0.0	0.0	**22.5**
Total	**499.6**	**0.0**	**0.0**	**499.6**

This project is scheduled for completion by December 31, 2020.

5.0 Conclusion

Hydro needs a fleet of reliable light-duty utility equipment to maintain the electrical system. Failure to replace the listed units will lead to increasing maintenance costs and less reliable equipment.

This project is proposed so Hydro can maintain a reliable light-duty vehicle fleet.

Appendix A

Light-Duty Mobile Equipment Assets for Replacement

Table A-1: Light-Duty Mobile Equipment Assets for Replacement

Type	Description	Age at Retire	Age	Condition
ATV	V7129, 2008 Polaris X2 500	11.9	X	High Maintenance
ATV	V7228, 2010 Yamaha Big Bear 400	10.2	X	Age
ATV	V7229, 2010 Yamaha Big Bear 400	10.2	X	Age
ATV	V7233, 2010 ARGO Avenger	10.2	X	High Maintenance
ATV	V7277, 2012 ARGO Avenger	8.2	X	High Maintenance
ATV	V7289, 2013 Polaris 6×6 Big Boss	7.1	X	High Maintenance
ATV	V7301, 2013 ARGO AVENGER	7.0	X	High Maintenance
ATV	V7366, 2014 Outlander 6×6 650	5.2	X	Age
ATV	V7368, 2016 Outlander 450 XT	5.0	X	Rough
ATV	V7370, 2016 Outlander 450 XT	5.0	X	Rough
Light-Duty Trailer	V8731, 2000 Country Trailer Sales	19.8	X	Age
Light-Duty Trailer	V8685, 1996 Easy Hauler Skidoo	24.6	X	Age
Light-Duty Trailer	V8789, 1994 Snowmobile Trailer	26.2	X	Age
Light-Duty Trailer	V8806, 1996 Miller EL Utility	24.2	X	Age
Light-Duty Trailer	V8856, 2001, Venture Boat Trailer	19.0	X	Age
Light-Duty Trailer	V8884, 2007 Frenchy Trailer	12.7	X	Age
Light-Duty Trailer	V8892, 2009 NN 12' Covered Trailer	10.6	X	Age
Light-Duty Trailer	V8893, 2009 NN 12' Covered Trailer	10.6	X	Age
Light-Duty Trailer	V8910, 2010 Kargo Max 22' Trailer	10.0	X	Age
Light-Duty Trailer	V8912, 2010 Kargo Max 14' V NOSE	10.0	X	Age
Light-Duty Trailer	V8917, 2010 Kargo Max 14' Trailer	9.8	X	Age
Light-Duty Trailer	V8918, 2010 Kargo Max 14' Trailer	9.8	X	Age
Light-Duty Trailer	V8954, 2012 Kargo Max 12' Trailer	7.9	X	High Maintenance
Light-Duty Trailer	V8960, 2012 Kargo Max 12' Trailer	7.9	X	High Maintenance
Snowmobile	V7221, 2010 BRP Tundra R 550	10.2	X	Age
Snowmobile	V7226, 2010 BRP Tundra R 550	10.2	X	Age
Snowmobile	V7282, 2013 BRP Tundra R 550	7.9	X	Age
Snowmobile	V7320, 2014 BRP Tundra LT ACE 600	6.8	X	High Maintenance
Snowmobile	V7363, 2015 Polaris Indy 550	5.4	X	Rough
Snowmobile	V7377, 2016 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7379, 2016 Polaris WTLX	4.8	X	Usage
Snowmobile	V7383, 2016 Polaris Indy 550	4.8	X	Usage
Snowmobile	V7395, 2016 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7396, 2015 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7397, 2016 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7398, 2016 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7399, 2016 Polaris Indy 550	4.8	X	Rough
Snowmobile	V7402, 2016 Polaris Indy 550	4.8	X	Rough

Project Title: Upgrade Fuel Storage Tanks
Location: Charlottetown
Category: Transmission and Rural Operations – Rural Generation
Definition: Other
Classification: Normal

1.0 Introduction

The Charlottetown Diesel Plant contains five diesel generating units with a total installed capacity of 3,450 kW. The diesel plant is the lone generation source for the community of Charlottetown. The bulk fuel storage system in Charlottetown consists of a 300,000 litre vertical fuel storage tank. Newfoundland and Labrador Hydro's ("Hydro") asset management practices require that diesel generating station vertical fuel storage tanks be internally inspected on a 10-year cycle. The tank in Charlottetown was in the plan for inspection in 2020.

2.0 Background

2.1 Existing System

Prior to the completion of the Trans Labrador Highway, Charlottetown was an isolated community and fuel delivery was completed by marine tanker. As the formation of sea ice prevents marine vessel winter access to Charlottetown, a 300,000 litre vertical storage tank was installed in 1984 to provide the required storage capacity. In 1998, another 300,000 litre vertical tank was added to provide for increases in fuel demand and ensure there was adequate fuel supply for the diesel generating plant until the dissipation of the ice in the spring of the year. Following the completion of the Trans Labrador Highway in 2002, road access to Charlottetown resulted in marine tanker fuel delivery being replaced by truck delivery. The ability to avail of more frequent fuel deliveries by road reduced the fuel storage requirement. In 2011, the 1998 vintage tank failed its internal inspection. As road delivery of fuel to the remaining tank would ensure adequate fuel supply for the generating plant, Hydro did not invest in repair of the failed tank and removed it from service.

2.2 Operating Experience

The remaining 1984 vintage 300,000 litre vertical fuel storage tank last underwent an internal inspection in 2008 and was again scheduled to be inspected in 2020. The tank has performed well throughout its service life; however, it is anticipated that repairs will be required to extend its service life as a result of the 2020 inspection.

3.0 Analysis

Vertical fuel storage tanks are typical at locations where substantial fuel storage capacity is required; however, Charlottetown no longer requires significant bulk storage. An analysis by Hydro determined that 300,000 litres of storage in the interconnected community is not required. It was determined that five 40,000 litre fuel tanks, with a usable storage of approximately 36,000 litres per tank, provide almost 3.5 weeks of storage for Charlottetown which would be sufficient given the availability of fuel delivery by road. A review was conducted to determine the least-cost option for the Charlottetown bulk fuel storage.

3.1 Identification of Alternatives

The alternatives considered included:

1) The completion of an internal tank inspection of the vertical fuel storage tank and the implementation of any repairs identified during the inspection; and
2) Replacement of the 300,000 litre vertical fuel storage tank with five horizontal fuel storage tanks, consisting of three used horizontal tanks (relocated from William's Harbour) and the installation two new horizontal tanks, with a total usable storage of approximately 180,000 litres.

3.2 Evaluation of Alternatives

3.2.1 Alternative 1: Inspect and Refurbish Existing Vertical Tank

Alternative 1 consists of the completion of an internal tank inspection and the implementation of any repairs identified as necessary to address the inspection findings. Pricing for the completion of the tank cleaning and inspection were derived from the completion of similar works on other vertical fuel storage tanks. While the extent of the tank repairs is unknown until the inspection is completed, findings from recent inspections of similar tanks were used to develop a reasonable estimate of the likely repairs for the tank located in Charlottetown. Within the net present value ("NPV") analysis, the tank inspection was repeated every 10 years with adjustments made to repair estimates in consideration of service life.

3.2.2 Alternative 2: Install Horizontal Tanks

Alternative 2 consists of replacing the existing 300,000 litre vertical fuel storage tank with three used horizontal 40,000 litre storage tanks (relocated from William's Harbour) and two new horizontal 40,000 litre storage tanks. For the purposes of the assessment, the horizontal tanks are assumed to have a service life of 30 years. As these horizontal tanks are fabricated in accordance with ULC CAN4-S601,[1] they are unable to be recertified for reuse if field modified. Consequently, a replacement cost for these tanks was carried after each 30-year service interval. Inspection costs for the horizontal tanks were derived from the completion of similar inspections on other horizontal fuel storage tanks as part of Hydro's tank inspection policy. The analysis also considered the elimination of maintenance, inspection, and upgrade costs associated with the existing secondary spill containment system utilized by the vertical tank, as the horizontal tanks do not require this infrastructure.

3.3 Recommended Alternative

A cost-benefit analysis with a study period of 30 years was completed. This study period considered one complete replacement cycle for the horizontal storage tanks and three inspection cycles for the vertical tank. Following the end of the study period, the vertical tank will be 65 years old and, while difficult to predict, it is reasonable to presume that the cost to extend its service life will continue at least at comparable levels as expenditures to the end of Year 65. Alternative 2 was determined to be the least-cost option. A summary of the results of the analysis are shown in Table 1.

Table 1: Cost-Benefit Analysis Summary Table ($)

Alternatives	NPV	NPV Difference between Alternative and the Least-Cost Alternative
Alternative 1: Inspect and Refurbish Vertical Tanks	677,066	41,960
Alternative 2: Install Horizontal Tanks	635,106	0

Hydro recommends proceeding with Alternative 2: Install Horizontal Tanks.

[1] Underwriters Laboratories of Canada ("ULC"), "Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids," originally published May 1, 1984.

4.0 Project Description

The scope of work includes the following:

- Purchase and installation of two new 40,000 litre double-wall, vacuum sealed, horizontal fuel storage tanks;
- Connection of the five horizontal tanks to the fuel pipe distribution system; and
- Cleaning and removal of existing 300,000 litre vertical fuel storage tank.

The estimate for this project is shown in Table 2.

Table 2: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	100.0	0.0	0.0	**100.0**
Labour	92.5	0.0	0.0	**92.5**
Consultant	30.8	0.0	0.0	**30.8**
Contract Work	177.1	0.0	0.0	**177.1**
Other Direct Costs	3.7	0.0	0.0	**3.7**
Interest and Escalation	19.1	0.0	0.0	**19.1**
Contingency	44.0	0.0	0.0	**44.0**
Total	**467.2**	**0.0**	**0.0**	**467.2**

The anticipated project schedule is shown in Table 3.

Table 3: Project Schedule

Activity	Start Date	End Date
Planning:		
Budget review, scope statement, schedule, and risk assessment	February 2020	February 2020
Design:		
Detailed design and prepare tender package	April 2020	May 2020
Procurement:		
Prepare specification and requisition	April 2020	April 2020
Fabrication and delivery of fuel tanks	May 2020	July 2020
Construction:		
Complete fuel tank installation	July 2020	August 2020
Closeout:		
Project completion, interest cut-off , and lessons learned	September 2020	October 2020

5.0 Conclusion

The existing vertical fuel storage tank for the Charlottetown Diesel Plant was scheduled for inspection in 2020. A change in the mode of fuel delivery has reduced the site fuel storage requirement for Charlottetown. A cost benefit analysis determined that replacement of the vertical storage tank with horizontal tanks is more economical than proceeding with its continued use and ongoing refurbishment of the vertical storage tank.

Hydro proposes to replace the existing vertical storage tank with horizontal fuel storage tanks to ensure reliable fuel storage at Charlottetown Diesel Plant.

Project Title: Upgrade Fire Suppression System
Location: Bishop's Falls
Category: Transmission and Rural Operations - Properties
Definition: Other
Classification: Normal

1.0 Introduction

The Bishop's Falls Complex consists of several buildings located on approximately 10 hectares of land on the Botwood Highway near the eastern end of Bishop's Falls. It is the main operational center for Newfoundland and Labrador Hydro's ("Hydro") Transmission and Rural Operations.

The existing fire suppression system at the Bishop's Falls Complex consists of a sprinkler system that covers most of the Office/Warehouse Building. Figure 1 shows a floor plan of the Office/Warehouse Building.

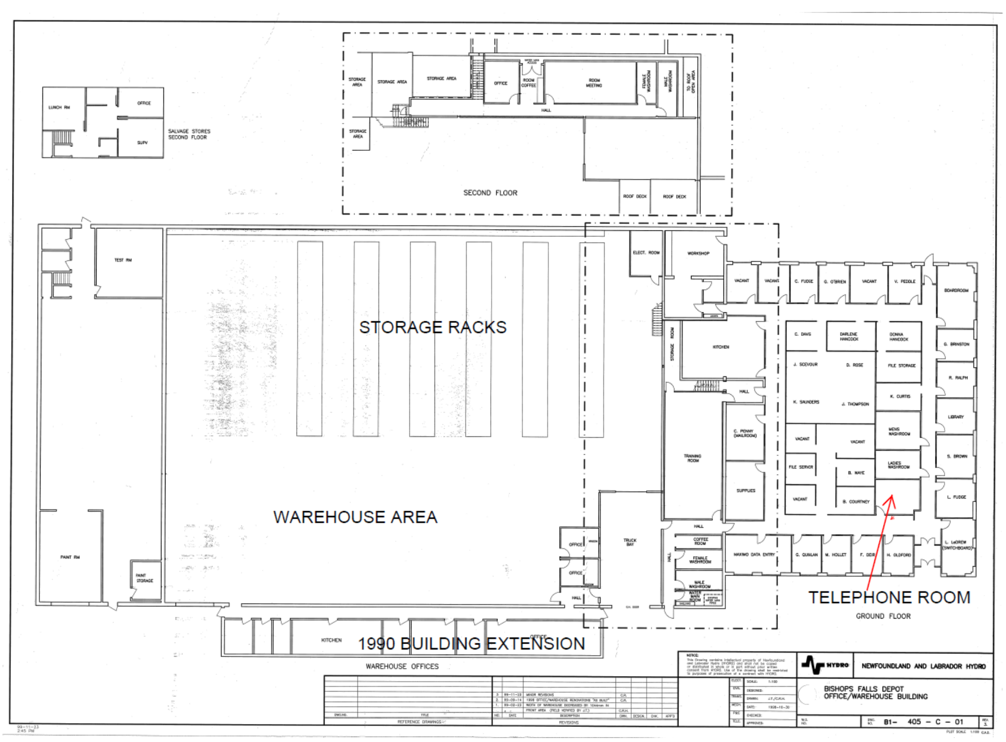

Figure 1: Office/Warehouse Building Floor Plan

2.0 Background

All areas of the Office/Warehouse Building, with the exception of the Telephone Room, have a fire suppression system. The sprinkler system is supplied with water from an eight inch pipe connected to the municipal water system. In the event of a fire, a booster fire pump starts up automatically to increase water pressure for more effective operation of the sprinkler system.

2.1 Existing System

Existing warehouse sprinklers are ceiling mounted, at a height of approximately seven metres. The sprinklers provide adequate fire suppression for the open warehouse (see Figure 1); however, there is approximately 170 square metres of shelf space with unprotected racks. The ceiling sprinklers, in conjunction with the fire water supply pumping and piping arrangement, cannot provide strong enough water flow to reach within the racks to provide effective fire suppression.

The office block (see Figure 1), with the exception of the Telephone Room, is protected from fire with a water sprinkler system only. There is no fire-rated wall enclosing the Telephone Room. Thus, if a fire started in the Telephone Room, it would go undetected and would not be suppressed until it spread to other parts of the office block, resulting in a higher level of damage within and outside the Telephone Room.

3.0 Analysis

It was decided that extending the existing wet sprinkler system to provide fire suppression to the warehouse storage racks and Telephone Room was the best alternative. Other types of fire suppression systems were considered from a high-level perspective for both the warehouse racks and the Telephone Room. In each case, the capital cost was judged to be materially greater then extending the existing wet sprinkler system and the annual operating cost would also be greater. The life expectancy of other types of suppression systems is estimated to be comparable to extending the existing wet sprinkler system.

4.0 Project Description

The project will extend the existing sprinkler system in the Office/Warehouse Building by:

1) Installation of water sprinklers in the warehouse storage racks; and
2) Installation of water sprinklers in the Telephone Room.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	2.0	0.0	**2.0**
Labour	57.7	99.6	0.0	**157.3**
Consultant	20.0	16.8	0.0	**36.8**
Contract Work	0.0	122.9	0.0	**122.9**
Other Direct Costs	1.2	2.9	0.0	**4.1**
Interest and Escalation	4.8	24.0	0.0	**28.8**
Contingency	7.9	24.4	0.0	**32.3**
Total	**91.6**	**292.6**	**0.0**	**384.2**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Prepare scope statement and work breakdown structure.	January 2020	April 2020
Design:		
Prepare functional specifications for the supply and installation tender.	August 2020	September 2020
Procurement:		
Engage consultant for functional specifications.	May 2020	July 2020
Tender for supply and installation work and award contract.	January 2021	May 2021
Construction:		
Complete installation work.	June 2021	September 2021
Commissioning:		
Commissioning fire protection system.	September 2021	September 2021
Closeout:		
Prepare project closeout documents.	October 2021	December 2021

5.0 Conclusion

The Bishop's Falls Complex is the main operational center for Hydro's Transmission and Rural Operations.

The Bishop's Falls Warehouse contains equipment and materials that are necessary for Hydro to maintain assets with minimal disruption to customer service. The items are kept on storage racks; existing sprinklers do not provide adequate fire suppression within the storage racks.

A fire in the office block telephone room could go undetected and would not be suppressed until it spread to other parts of the office block or until firefighters arrived, resulting in a higher level of damage inside and outside the telephone room.

Hydro is proposing this project to address these deficiencies in the fire suppression system at the Bishop's Falls Complex.

Project Title: Replace Automation Equipment
Location: Rigolet
Category: Transmission and Rural Operations
Definition: Other
Classification: Normal

1.0 Introduction

The Rigolet Diesel Plant uses a Human-Machine Interface ("HMI"), a Programmable Logic Controller ("PLC"), and electronic metering to provide automated control of the plant operations and information to its operating personnel. The HMI is the computer-based operator interface that provides automated, centralized monitoring and control of the plant's diesel generators, display and recording of engine parameters, metering, and alarms. The HMI centralizes operator interaction with the equipment (i.e., to start and stop units, and to respond to unit alarms). The PLC is an electronic control system that is programmed to automatically operate equipment based on data collected from the diesel mechanisms (e.g., temperature, status, etc.), metering, and HMI. The electronic meters are multifunction devices that provide local parameters to the HMI and PLC as well as communicate plant output, station service, and generator loads to a production service system located at Hydro Place. Newfoundland and Labrador Hydro ("Hydro") has been replacing obsolete automation equipment at diesel plants since 2014.

2.0 Background

2.1 Existing System

The existing HMI system uses Schneider Electric Monitor Pro 7.2 Supervisory Control and Data Acquisition ("SCADA") software, which is no longer available. Support for the software ceased on December 31, 2017. The HMI computer server has a Windows 2003 Operating System, which is no longer supported by Microsoft and replacing the existing server with a newer server is not possible as the installed Monitor Pro software is not compatible with newer operating system software.

The PLC is of the Schneider Quantum series, installed in 2010, and operates on obsolete programming software called ProWorx 32. The PLC is not compatible with the newer technology utilized in the modern HMI systems used to replace the current obsolete HMI.

2.2 Operating Experience

The current HMI has recurring lock-ups and has to be restarted in order to continue operating. Local operators have indicated that this consistently occurs over a period of several days, often twice a week, subject to the number of alarms that occur. The issue appears to be related to HMI memory storage capability; however, the HMI is not able to be upgraded due to obsolescence.

The PLC has operated reliably since 2010.

3.0 Analysis

3.1 Identification of Alternatives

Given that the equipment is obsolete, there are no viable alternatives to the path chosen for this project. The project is consistent with system replacements in other rural automated diesel plants in recent years.

4.0 Project Description

The project scope of work includes:

- Replacement of HMI computer server;
- Installation of Trihedral VTScada software for the HMI;
- Installation of required network switches;
- Modification of existing plant PLC programs to align with new HMI configuration and development of new HMI;
- Installation of modern Schneider Electric PLC with Ethernet capability and support of latest configuration software; and
- Schematic and wiring diagram revisions for upgrade.

The new HMI will consist of a modern PC server with the latest Microsoft Windows operating system and VTScada software, which is the standard application across Hydro diesel plants. New graphics screens will be developed based on existing layouts with enhancements subject to discussions with local Operators. Additional communications infrastructure will be installed to implement an Ethernet network topology across the plant devices. The existing PLC programming will be adapted to the new PLC platform and configured to operate with the HMI development. Existing ION meters will be retained as they are compatible with proposed upgrade.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	29.2	0.0	0	**29.2**
Labour	228.7	0.0	0	**228.7**
Consultant	11.3	0.0	0	**11.3**
Contract Work	0.0	0.0	0	**0.0**
Other Direct Costs	48.5	0.0	0	**48.5**
Interest and Escalation	14.4	0.0	0	**14.4**
Contingency	31.7	0.0	0	**31.7**
Total	**363.8**	0.0	**0**	**363.8**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Open work order; plan, develop, and maintain detailed schedules.	February 2020	March 2020
Design:		
Site visit, review CBP, and develop bill of materials,	March 2020	March 2020
design system, order materials, develop graphics, and develop PLC logic.	March 2020	May 2020
Procurement:		
Order all materials	March 2020	May 2020
Construction:		
Install PLC and network components, run network cables, and install HMI server.	July 2020	August 2020
Commissioning:		
Confirm operation of system and load balancing of diesel units.	September 2020	September 2020
Closeout:		
Complete all documentation, draft all as-built drawings, and close work orders.	October 2020	October 2020

5.0 Conclusion

The project that Hydro is proposing will correct the deficiencies with the existing HMI and the unit PLC at the Rigolet Diesel Plant.

The HMI hardware and software used in the control of the Rigolet Diesel Plant is obsolete and does not operate reliably and requires replacement. Replacing the HMI system will require replacement of the unit PLC as the current PLC is not compatible with modern HMI systems.

Project Title: Install Recloser Remote Control (2020–2021)
Location: Hampden and Upper Salmon
Category: Transmission and Rural Operations – Distribution Central
Definition: Pooled
Classification: Normal

1.0 Introduction

In the 2019 Capital Budget Application, Newfoundland and Labrador Hydro ("Hydro") proposed the establishment of a Recloser Automation Program. At that time, the automation of 49 reclosers was prioritized based on the individual recloser accumulated scores for six factors:

- Number of customers serviced;
- Site accessibility;
- Site location;
- Major customer serviced (e.g., mine, hospital, etc.);
- Energy Control Centre ("ECC") rotation list for load shedding; and
- Reliability performance measure (SAIDI).[1]

Appendix A provides a description of the factors and the methodology for how the reclosers were prioritized. The top ten reclosers from the 2018 analysis are proposed to be automated between 2019 and 2024.

Under the current Recloser Remote Control Program initiated in 2019, Hydro will submit annual Capital Budget Application proposals to automate the ten highest priority reclosers. Hydro will re-evaluate the need to automate the remaining reclosers prior to future proposals.

This project proposes to automate the following reclosers in 2020-2021:

- B1L1: Upper Salmon Terminal Station ("Upper Salmon TS"); and
- HA1-R1: Hampden Terminal Station ("Hampden TS").

[1] System Average Interruption Duration Index ("SAIDI").

2.0 Background

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. This switching can be conducted manually by personnel at the recloser or remotely by ECC personnel in St. John's if the recloser is connected to Hydro's Supervisory Control and Data Acquisition ("SCADA") system.

2.1 Existing System

The Hampden TS recloser (HA1-R1) and the Upper Salmon TS recloser (B1L1) are not remotely controlled by the ECC. Presently, these reclosers can only be operated locally by personnel at the terminal stations.

3.0 Analysis

Using the priority ranking method included in Appendix A, the Hampden TS recloser (HA1-R1) obtained a score of 405, and the Upper Salmon TS recloser (B1L1) obtained a score of 275. This ranking establishes these reclosers as the next units that Hydro proposes to automate. The following is a description of how the score for Hampden TS HA1-R1 was determined:

- Factor 1 Number of Customers Serviced: yields a score of 3 since Hampden Line 1 services less than 500 customers (288);
- Factor 2 Site Accessibility: yields a score of 3 since there is road access to the site with moderate difficulty;
- Factor 3 Site Location: yields a score of 5 since the recloser is located in the Hampden TS;
- Factor 4 Major Customer Serviced: yields a score of 3 since there is a saw mill being supplied by Line 1;
- Factor 5 ECC Rotation List for Load Shedding: yields a score of 3 since it is on the ECC rotation list for underfrequency trips; and
- Factor 6 Reliability Performance Measure (SAIDI): yields a score of 1 since the SAIDI value for Line 1 is less than 5 (3.18).

The product of the individual scores yields an overall score of 405.

The following is a description of how the score for Upper Salmon TS B1L1 was determined:

- Factor 1 Number of Customers Serviced: yields a score of 1 since Upper Salmon Line 1 services less than 100 customers (1);
- Factor 2 Site Accessibility: yields a score of 11 since, from time to time, the plant is only accessible by helicopter. This is the case in winter, while spilling is occurring, and when the road is washed out due to spilling or extreme rainfall/melting events;
- Factor 3 Site Location: yields a score of 5 since the recloser is located in the Upper Salmon TS;
- Factor 4 Major Customer Serviced: yields a score of 5 since a large generation plant is the main customer;
- Factor 5 ECC Rotation List for Load Shedding: yields a score of 1 since it is not on the ECC rotation list for underfrequency trips; and
- Factor 6 Reliability Performance Measure (SAIDI): yields a score of 1 since the SAIDI value for Line 1 is less than 5 (1.00).

The product of the individual scores yields an overall score of 275.

Site location and the presence of a major customer are the largest factors contributing to the ranking of the Hampden TS and Upper Salmon TS reclosers. In the case of Hampden TS, there is a saw mill operating on Line 1 and, although there is road access to the site, there may be accessibility issues due to typically high snowfall levels and the distance to the closest line terminal.[2] Furthermore, Hampden TS is in the underfrequency load shedding system, which elevates its priority relative to many others. In the case of Upper Salmon TS, the availability of the Upper Salmon Hydroelectric Generating Station could be compromised by an inability to remotely operate the recloser on Line 1 given that site is limited to helicopter only access during and immediately following a water release[3] and access may be restricted during winter months by the necessity to travel by snowmobile or helicopter.

[2] Springdale Line Depot is 100 km away.
[3] Water release from West Salmon Spillway floods the access road.

4.0 Project Description

The scope of work includes:

- Purchase and installation of new communications infrastructure at Hampden TS. There is currently no communications infrastructure available at this terminal station;
- Utilization of existing communications infrastructure at Upper Salmon TS;
- Purchase and installation of a new recloser at Upper Salmon TS as the existing recloser does not have communications capability;
- Configuration of reclosers at Hampden TS and Upper Salmon TS for remote control and data collection capability by the ECC; and
- Configuration and commissioning of computer systems in the ECC to communicate with the reclosers at Hampden TS and Upper Salmon TS.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	54.1	0.0	**54.1**
Labour	52.7	85.5	0.0	**138.2**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	8.8	14.9	0.0	**23.7**
Interest and Escalation	3.6	15.5	0.0	**19.1**
Contingency	6.2	15.3	0.0	**21.5**
Total	**71.3**	**185.3**	**0.0**	**256.6**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning: Open work orders; plan, develop, and maintain schedules.	April 2020	September 2021
Design: Prepare detailed designs, develop bill of materials, and develop SCADA points.	April 2020	May 2021
Procurement: Order all materials.	February 2021	May 2021
Construction: Install reclosers; install, connect, and configure communications; and configure reclosers.	June 2021	August 2021
Commissioning: Confirm operation of system and all values/controls appearing at Energy Control Centre.	September 2021	September 2021
Closeout: Complete project close out documentation and as-built drawings.	October 2021	November 2021

5.0 Conclusion

In the 2019 Capital Budget Application, Hydro proposed to establish a Recloser Automation Program. The Hampden TS recloser (HA1-R1) and the Upper Salmon TS recloser (B1L1) are the next reclosers that Hydro proposes to be automated under this program.

Appendix A

Recloser Automation Priority List and Methodology

Methodology to Determine Priority for Recloser Automation

There are six factors considered in the prioritization of recloser automation, as shown in Table A-1 to Table A-6. Each of the six factors has a number of levels to indicate the impact of that factor on the Distribution System. To evaluate a recloser for automation, Hydro determines a score for each of the six factors. The total overall score assigned for the recloser is the product of each of the factor's individual scores.

Table A-1: Factor One: Number of Customer Serviced

Level	Definition	Score
1	< 100 Customers	1
2	< 500 Customers	3
3	< 1000 Customers	5
4	> 1000 Customers	7

Table A-2: Factor Two: Site Accessibility

Level	Definition	Score
1	Road Access with No Difficulty	1
2	Road Access with Minor Difficulty	3
3	Road Access with Moderate Difficulty	5
4	Road Access with Major Difficulty	7
5	Access by Ferry	9
6	Access by Airplane	11

Table A-3: Factor Three: Site Location of Recloser

Level	Definition	Score
1	Line	1
2	Substation	3
3	Terminal Station	5

Table A-4: Major Customer Serviced

Level	Definition	Score
1	No Major Customer Serviced	1
2	Mine, Hospital, Large Sawmill, Small Generation Plant	3
3	Large Generation Plant	5

Table A-5: Feeder Included in Energy Control Centre Rotation List for Underfrequency Trips[4]

Level	Definition	Score
1	No	1
2	Yes	3

Table A-6: Reliability Performance Measure, SAIDI Value Excluding Loss of Supply, Schedule Power Outage, and Customer Request[5]

Level	Definition	Score
1	< 5	1
2	< 10	2
3	< 15	3
4	< 20	4
5	< 25	5
6	< 30	6
7	< 35	7
8	< 40	8
9	< 45	9
10	< 50	10
11	> 50	11

The following example shows how the priority score was determined for Hampden TS Recloser, HA1-R1:

- Number of Customers Serviced: Level 2, which gives a Score of 3
- Site Accessibility: Level 2, which gives a Score of 3
- Site Location: Level 3, which gives a Score of 5
- Any Major Customer Serviced: Level 2, which gives a Score of 3
- Energy Control Center Rotation List for Load Shedding: Level 2, which gives a Score of 3
- SAIDI: Level 1, which gives a Score of 1

The total overall score for recloser HA1-R1 is the product of 3, 3, 5, 3, 3, and 1, which equals 405.

Table A-7 provides a list of Hydro's reclosers ranked from highest to lowest priority for automation and plan for replacement.

[4] Hydro has a set of feeders that may be shed for underfrequency trips so as to maintain electrical system stability.
[5] This is the SAIDI value before recloser automation.

Table A-7: Recloser List

Rank	Distribution System	Location	Recloser	Total Score	Program Year
1	Rocky Harbour	Terminal Station	RH2-R1	405	2019–2020
2	Hampden	Terminal Station	HA1-R1	405	2020–2021
3	Upper Salmon	Recloser Station	B1L1	275	2020–2021
4	Coney Arm	Terminal Station	CA1-R1	275	2021–2022
5	Jackson's Arm	Terminal Station	JA2-R1	270	2021–2022
6	Jackson's Arm	Terminal Station	JA1-R1	270	2021–2022
7	Bottom Waters	Burlington Substation	BU4-R1	225	2022–2023
8	Farewell Head	Fogo Island Substation	FH1-R3	189	2022–2023
9	Rocky Harbour	Terminal Station	RH1-R1	150	2019–2020
10	Main Brook	Terminal Station	MB1-R2	150	2023–2024
11	Conne River	Terminal Station	CR1-R1	135	
12	Parsons Pond	Terminal Station	PP1-R1	135	
13	South Brook	Robert Arm Substation	SB7-R2	126	
14	Monkstown	Paradise River TS	L58T1	125	
15	Farewell Head	Fogo Island Substation	F06-R1	108	
16	Bay d'Espoir	Terminal Station	BD1-R1	105	
17	South Brook	Triton Substation	TR5-R1	90	
18	Bottom Waters	Feeder L3	BW3-R2	90	
19	English Harbour West	Feeder L1	EH1-R2	90	
20	Glenburnie	Terminal Station	GL1-R1	90	
21	Glenburnie	Terminal Station	GL2-R1	90	
22	Bottom Waters	Feeder L1	BW1-R4	81	
23	Bottom Waters	La Scie Substation	LS7-R1	81	
24	Farewell Head	Change Island Substation	CH3-R1	81	
25	Holyrood	Terminal Station	HR1-R1	75	
26	Roddickton	Feeder L1	R01-R3	60	
27	Farewell Head	Fogo Island Substation	F05-R1	60	
28	Upper Salmon	Feeder L1	US1-R2	55	
29	Bottom Waters	Brent's Cove Substation	BW3-R3	54	
30	Fleur-de-Lys	Recloser Sub	FL1-R2	54	
31	St. Anthony	Cook's Hr. Substation	CH7-R1	54	
32	Bottom Waters	Feeder L2	BW2-R3	45	
33	Wiltondale	Terminal Station	WD1-R1	45	
34	South Brook	Feeder L4	SB1-R4	30	
35	Barachoix	Feeder L4	BA4-R2	30	
36	St. Anthony	Feeder L1	SA1-R3	30	
37	Farewell Head	Fogo Island Substation	F04-R1	27	
38	Bay d'Espoir	Terminal Station	BD2-R1	25	
39	Bay d'Espoir	Terminal Station	BD3-R1	25	
40	Bottom Waters	Feeder L2	BW2-R2	18	

Rank	Distribution System	Location	Recloser	Total Score	Program Year
41	Fleur-de-Lys	Feeder L1	FL1-R1	18	
42	Barachoix	Feeder L1	BA1-R2	18	
43	King's Point	Feeder L1	KP1-R2	18	
44	Bay d'Espoir	Feeder L1	BD1-R2	15	
45	Grandy Brook	Burgeo Substation	BU3-R1	9	
46	Grandy Brook	Burgeo Substation	BU2-R1	9	
47	Hawke's Bay	Feeder L3	HB3-R2	5	
48	Bay d'Espoir	Feeder L1	BD1-R3	3	
49	Grandy Brook	Burgeo Substation	BU4-R1	3	

Project Title: Purchase Meters and Metering Equipment
Location: Various
Category: Transmission and Rural Operations - Metering
Definition: Pooled
Classification: Normal

1.0 Introduction

Revenue meters enable Newfoundland and Labrador Hydro ("Hydro") to accurately record energy demand and power consumption by its customers. Under the Government of Canada's *Electricity and Gas Inspection Act and Regulations*[1] Hydro is mandated by Measurement Canada to ensure that in-service meters are accurate, in good working condition, and removed from service before the meter expiry date. Under the legislation, Hydro receives Retest Orders requiring Hydro to test specific meter types and vintage for accuracy. Hydro also receives customer requests to test the accuracy of meters.

2.0 Background

2.1 Operating Experience

Revenue meters and required associated equipment[2] are procured annually to replace those removed from inventory for field use. This inventory must be adequate to:

- Supply meters required by new customer service requests;
- Facilitate execution of Federal Government Retest Orders and customer accuracy testing requests, and to replace meters that fail related testing; and
- Replace meters due to damage, technology change, and obsolescence.

3.0 Project Justification

This project will facilitate the provision of reliable and accurate revenue metering for customers and ensure compliance with the *Electricity and Gas Inspection Act and Regulations*.

[1] *Electricity and Gas Inspection Act*, RSC, 1985, c-E-4 and *Electricity and Gas Inspection Regulations,* SOR/86-131.
[2] Items such as: metering tanks, potential transformers, current transformers, and collectors.

4.0 Project Description

This project will purchase 126 demand meters and 584 residential meters directly from the manufacturer intact with the seal of Measurement Canada as well as required associated equipment.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	181.0	0.0	0.0	**181.0**
Labour	30.0	0.0	0.0	**30.0**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	11.0	0.0	0.0	**11.0**
Interest and Escalation	8.7	0.0	0.0	**8.7**
Contingency	13.5	0.0	0.0	**13.5**
Total	**244.2**	**0.0**	**0.0**	**244.2**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Prepare meter order.	January 2020	January 2020
Design:		
Prepare drawings.	January 2020	February 2020
Procurement:		
Order meters and equipment.	January 2020	April 2020
Construction:		
Install meters and equipment.	May 2020	December 2020
Commissioning:		
Verify installation.	May 2020	December 2020
Closeout:		
Close out project.	December 2020	December 2020

5.0 Conclusion

Hydro must provide reliable and accurate revenue metering to maintain compliance with the *Electricity and Gas Inspection Act and Regulations*.

This project is proposed to enable Hydro to meet this requirement.

Project Title: Purchase SF_6 Multi-Analyzer
Location: Various
Category: Transmission and Rural Operations
Definition: Other
Classification: Normal

1.0 Introduction

Sulfur Hexafluoride (“SF_6”) is a gas used extensively in high-voltage breakers, but is a potent greenhouse gas. Newfoundland and Labrador Hydro (“Hydro”) plans to purchase appropriate SF_6 Multi-Analyzer test sets to minimize the release of SF_6 gas during regular equipment maintenance.

2.0 Background

SF_6 gas is an industry wide insulation medium for high-voltage equipment; however, it is a potent greenhouse gas that is 22,800 times more powerful than carbon dioxide. Hydro’s use of SF_6 gas-insulated breakers will increase as it replaces deteriorated breakers and adds new breakers to the electrical system. Hydro currently has 172 high-voltage breakers that use SF_6 gas as the insulation medium.

SF_6 gas degrades each time a SF_6 gas-insulated breaker operates particularly when the breaker is interrupting short-circuit current. Maintaining acceptable quality and concentration of SF_6 gas in the breaker is required to ensure the reliable operation of a SF_6 gas-insulated breaker. Hydro’s maintenance procedure requires that the SF_6 gas be tested for purity and concentration each time a breaker is topped up with SF_6 gas.

2.1 Existing System

Hydro has two types of test sets which it uses to check the quality of SF_6 gas. The first test set type, the SF_6 Multi-Analyzer, is specifically designed for SF_6 circuit breakers and is able to test the dew point, the concentration of SF_6 in the gas in the breaker and the purity of the SF_6. The SF_6 Multi-Analyzer captures the SF_6 gas removed from the breaker during testing and will either pump the gas back into the breaker or into a storage container, ensuring SF_6 gas is not released into the environment. The second test set type is older and was used to determine the quality of compressed air used in air-blast circuit breakers, but can also be used to test the dew point of SF_6 gas; however, this second test set type cannot capture the SF_6 gas during testing and, therefore, SF_6 gas is released into the environment.

Maintenance personnel based in Bishop Falls have been using a SF_6 Multi-Analyzer since 2018, which is better for the environment and also provides additional valuable information used to understand the health of the equipment. Maintenance personnel based in Whitbourne, Stephenville, Port Saunders, and Happy Valley-Goose Bay have continued to use the second test set type.

3.0 Analysis

The only alternative to the purchase of the SF_6 Multi-Analyzer is to continue to use the second test set type, which would mean continued release of SF_6 gas into the environment. Hydro does not believe this is a valid alternative.

4.0 Project Description

This project is proposing the purchase of four SF_6 Multi-Analyzers, one for each of the following maintenance centres: Whitbourne, Stephenville, Port Saunders, and Happy Valley-Goose Bay.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	163.0	0.0	0.0	**163.0**
Labour	24.1	0.0	0.0	**24.1**
Consultant	0.0	0.0	0.0	**0.00**
Contract Work	0.0	0.0	0.0	**0.00**
Other Direct Costs	0.0	0.0	0.0	**0.00**
Interest and Escalation	10.6	0.0	0.0	**10.6**
Contingency	9.4	0.0	0.0	**9.4**
Total	**207.1**	**0.0**	**0.0**	**207.1**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Open work order, plan and develop detailed schedules.	January 2020	February 2020
Design:		
Specification development for SF_6 analyzers, tender/procurement.	February 2020	April 2020
Procurement:		
Purchase four SF_6 analyzers.	May 2020	August 2020
Closeout:		
Closer work order, complete all documentation and lessons learned.	September 2020	September 2020

5.0 Conclusion

The purchase of appropriate SF_6 Multi-Analyzer test sets will provide additional test data and ensure Hydro does not release SF_6 gas into the atmosphere during testing of SF_6 gas-insulated circuit breakers.

Project Title: Replace Radomes
Location: Various
Category: General Properties – Telecontrol
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") is undertaking a project to replace 15 microwave antenna radomes.[1] The purpose of this project to reduce the probability of system outages resulting from radome failure. Hydro's radome asset management replacement criteria are based on operational experience and the manufacturers' recommendations and are focused on reducing the probability of electrical system outages resulting from radome failure.

Each year, radomes are replaced at different sites throughout the network, depending on age and condition. The radome replacements scheduled for 2020-2024 is provided in Appendix A. Fifteen radomes are scheduled to be replaced in 2020.

2.0 Background

2.1 Existing Equipment

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 across Hydro's system. 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

[1] Radomes are the protective covers that enclose the delicate components of the microwave antennas in Hydro's microwave radio system.

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 horns 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 to prevent the accumulation of ice and snow that could bend or break the feed horn; they 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 (see Figure 3) and the material can be torn free by wind. Such tears may result in severe damage to the delicate antenna components.

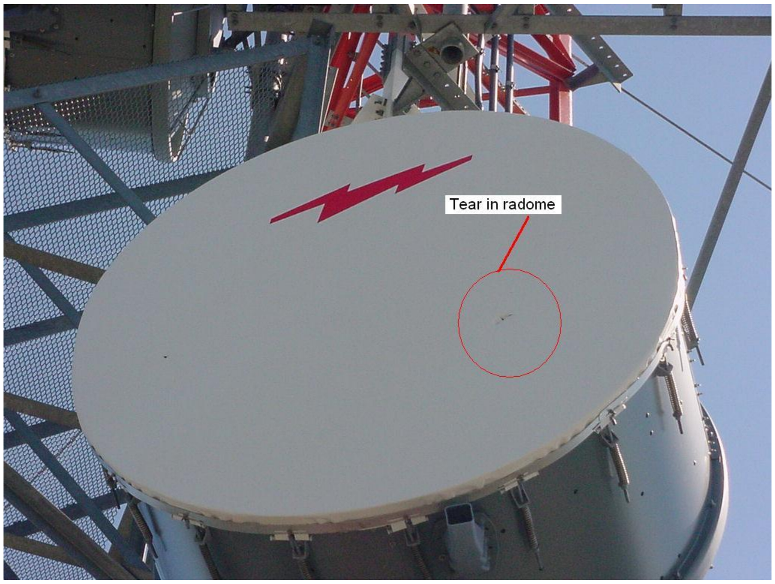

Figure 2: Tear in Radome

Figure 3: Heavily Damaged Radome

1 Other modes of failure are less common. Ice falling from the tower can damage radome components,
2 such as the hardware that hold the radome in place, as shown in Figure 4. Vandalism through the use of
3 shotguns, rocks, or other projectiles has also occurred at sites that are accessible by road. Each of these
4 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.

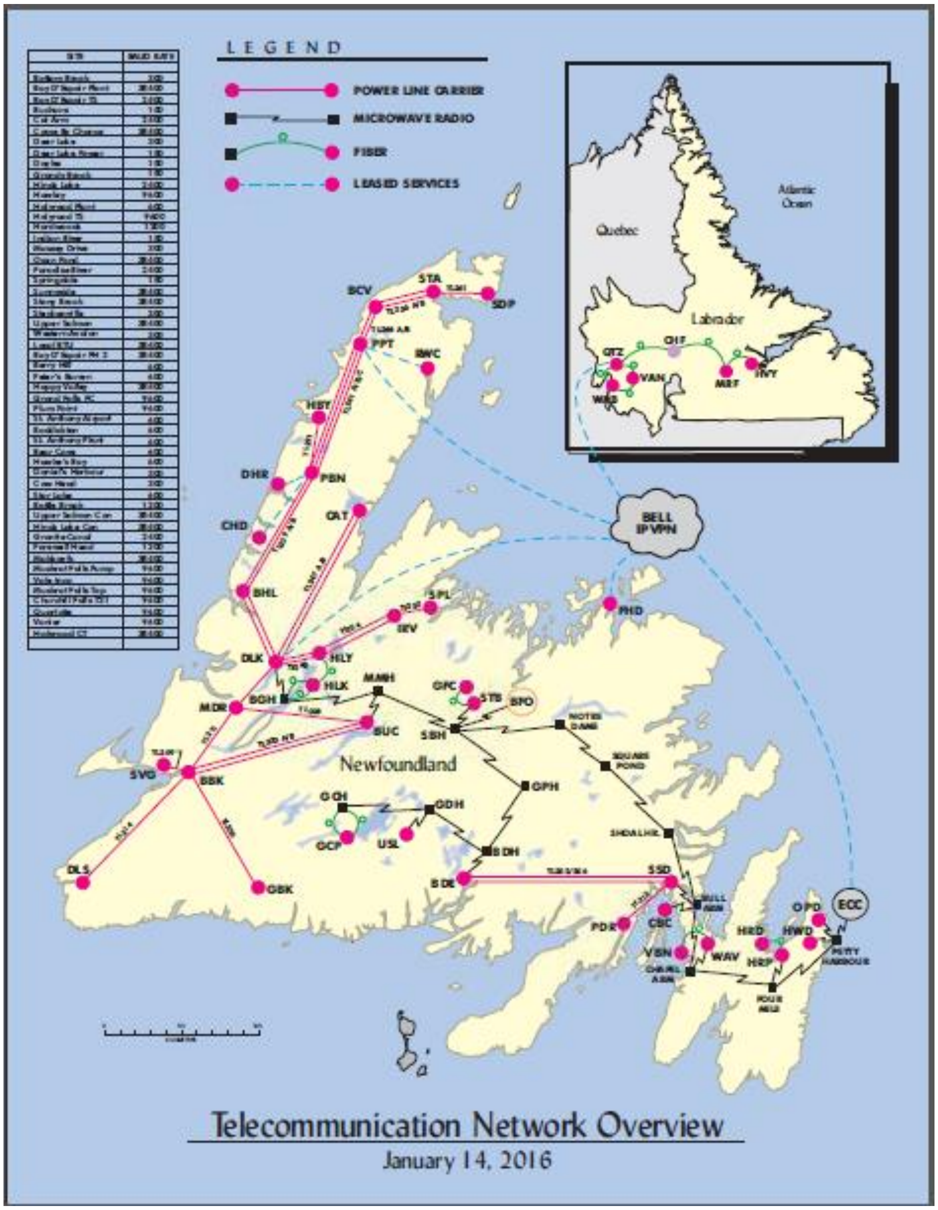

Figure 5: Telecommunication Network including Microwave Towers

The original microwave communications system was installed in 1979 and consisted of 9 towers that connected the Bay d’Espoir generating facility to the Stony Brook Terminal Station and west to Hinds Lake Hydraulic Generation Plant and Deer Lake Terminal Station. In 2001 the microwave network was expanded by adding 11 towers on the East Coast from Hydro Place in St. John’s to Sunnyside Terminal Station and all stations in between. The last expansion occurred in 2003, linking Bull Arm Hill to Sandy Brook Hill with the construction of 3 new towers. This provided reliable communications between Bay d'Espoir and all the major 230 kV terminal stations. Each of these towers has between one and seven parabolic dishes that are protected by a radome cover.

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 scheduled over multiple years. The current schedule for the next five years is included in Appendix A.

Due to the decision to schedule the replacement of radomes over multiple years, some radomes will be left in-service for periods longer 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 failure of the microwave system. The impact of a microwave failure today could have a greater effect than the incident of 1996 (see section 2.2) 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 230 kV 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 could likely cause and/or extend customer outages.

2.2 Operating Experience

2.2.1 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, antennas could not be replaced for an additional three weeks 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.

2.2.2 Vendor Recommendations

As a result of the costs and outage time associated with the 1996 wind storm, Hydro personnel 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.

2.3 Maintenance History

There are no maintenance or support arrangements associated specifically with radomes. Radome inspection is included as part of an overall annual tower inspection program.

Radomes are visually inspected each year when the tower is inspected, or as soon as practicable 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 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.

3.0 Analysis

3.1 Identification of Alternatives

There are no viable alternatives to radome replacement.

3.2 Evaluation of Alternatives

There are no upgrades available for a radome. It must be replaced based upon the estimated useful life or upon observed damage during inspection.

3.3 Recommended Alternative

Radomes should be replaced proactively based on vendor's recommendations of useful life.

4.0 Project Description

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	73.7	0.0	0.0	**73.7**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	258.8	0.0	0.0	**258.8**
Other Direct Costs	8.4	0.0	0.0	**8.4**
Interest and Escalation	9.6	0.0	0.0	**9.6**
Contingency	34.0	0.0	0.0	**34.0**
Total	**384.5**	**0.0**	**0.0**	**384.5**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Prepare project plan and site visits.	January 2020	February 2020
Design:		
Complete tender package.	February 2020	March 2020
Procurement:		
Purchase radomes.	April 2020	April 2020
Construction:		
Install radomes.	May 2020	September 2020
Commissioning:		
Site inspections.	October 2020	October 2020
Closeout:		
Close out project.	November 2020	December 2020

5.0 Conclusion

Hydro's Radome Replacement Program is based on operational experience and manufacturers' recommendations and is necessary in order to prevent outages caused by radome damage. Due to operational risks associated with the failure of corporate microwave equipment, this project is a proactive approach to minimizing failures of microwave antenna radomes. Future replacements will be proposed in future capital budget applications. Radome replacements are planned for each of the next five years as listed in Appendix A.

Appendix A

Radome Replacement Schedule

Table A-1: Radome Site Identifiers

Abbreviation	Site Name
BAH	Bull Arm Hill Microwave/Repeater
BDE	Bay d'Espoir Terminal Station
BDH	Bay d'Espoir Hill Microwave/Repeater
BFI	Bishops 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 Centre
FMH	Four Mile Hill Microwave/Repeater
GCH	Granite Canal Hill Microwave
GDH	Godaleich Hill Microwave/Repeater
GPH	Gull Pond Hill Microwave
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

Table A-2: 2020 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model No.	Last Replaced
BAH	CAH	3.0 m (10')	Andrew Solutions	HP10-71D	2012
BGH	MMH	2.4 m (8')	CableWave	DA8-71hp	2013
BGH	DLP	3.6 m (12')	CableWave	DA12-71hp	2013
GCH	GDH	3.0 m (10')	Andrew Solutions	HP10-71D	2012
GCH	GDH	2.4 m (8')	Andrew Solutions	HP8-71D	2012
GDH	GCH (main)	3.0 m (10')	Andrew Solutions	HP10-71D	2012
GDH	GCH (div)	2.4 m (8')	Andrew Solutions	HP8-71D	2012
GDH	BDH	3.0 m (10')	CableWave	DA10-71hp	2013
GDH	USL	3.0 m (10')	CableWave	DA10-71hp	2013
HRP	FMH	2.4 m (8')	Andrew Solutions	HP8-71D	2012
MMH	SBH	3.6 m (12')	CableWave	DA12-71hp	2013
MMH	BGH	2.4 m (8')	CableWave	DA8-71hp	2013
PHH	ECC	2.4 m (8')	Andrew Solutions	HP8-71D	2012
SBH	MMH	3.6 m (12')	CableWave	DA12-71hp	2013
USL	GDH	3.0 m (10')	CableWave	DA10-71hp	2013

Table A-3: 2020 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model No.	Last Replaced
BDE	BDH	1.8 m (6')	CableWave	DA6-71hp	2014
BDH	GPH	1.8 m (6')	CableWave	DA6-71hp	2014
BDH	BDE	1.8 m (6')	CableWave	DA6-71hp	2014
BFI	SBH	2.4 m (8')	Andrew Solutions	HP8-71GE	2013
BUC	MMH	1.8 m (6')	CableWave	DA6-71hp	2014
DLK	DLP	4.5 m (15')	Gabriel Antenna	SR15-71B	2013
FMH	PHH (div)	1.8 m (6')	Andrew Solutions	HP6-71E	2013
NDH	SPH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2013
NDH	SPH (div)	3.6 m (12')	Andrew Solutions	HP12-71E	2013
NDH	SBH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2013
NDH	SBH (div)	3.6 m (12')	Andrew Solutions	HP12-71E	2013
SBH	NDH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2013
SBH	NDH (div)	3.0 m (10')	Andrew Solutions	HP10-71D	2013
SBH	BFI	2.4 m (8')	Andrew Solutions	HP8-71GE	2013

Table A-4: 2022 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model No.	Last Replaced
BDH	GPH	2.4 m (8')	Andrew Solutions	HP8-71D	2014
BDH	GDH	3.0 m (10')	Andrew Solutions	HP10-71D	2014
SHH	BAH (main)	2.4 m (8')	Andrew Solutions	HP8-71GE	2014
SHH	BAH (div)	2.4 m (8')	Andrew Solutions	HP8-71GE	2014
SHH	SPH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2014
SHH	SPH (div)	3.6 m (12')	Andrew Solutions	HP12-71E	2014
SPH	SHH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2014
SPH	SHH (div)	3.6 m (12')	Andrew Solutions	HP12-71E	2014
SPH	NDH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2014
SPH	NDH (div)	3.6 m (12')	Andrew Solutions	HP12-71E	2014

Table A-5: 2023 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model No.	Last Replaced
GPH	SBH (div)	3.6 m (12')	CableWave	DA12-71hp	2016
GPH	BDH	1.8 m (6')	CableWave	DA6-71hp	2016
SBH	GPH	3.6 m (12')	CableWave	DA12-71hp	2016
SBH	STB	1.8 m (6')	CableWave	DA6-71hp	2016

Table A-6: 2024 Radome Replacements

Tower	Direction	Antenna			
		Size	Vendor	Model No.	Last Replaced
BAH	CAH	2.4 m (8')	Andrew Solutions	HP8-71D	2016
BAH	CBC	1.8 m (6')	Andrew Solutions	HP6-71E	2016
BAH	SSD	1.8 m (6')	Andrew Solutions	HP6-71E	2016
GPH	SBH (main)	3.6 m (12')	Andrew Solutions	HP12-71E	2016
GPH	BDH	2.4 m (8')	Andrew Solutions	HP8-71D	2016
SBH	GPH	3.6 m (12')	Andrew Solutions	HP12-71E	2016
SBH	MMH	3.0 m (10')	Andrew Solutions	HP10-71D	2016

Project Title: Replace Peripheral Infrastructure
Location: Hydro Place
Category: General Properties – Information Systems
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro's ("Hydro") peripheral infrastructure consists of such items as Multi-Function Printer Devices ("MFD"), laser-printers, plotters, video-conference units, video-display projectors, and digital-signage media-player controllers. This peripheral infrastructure must be reliable to support business processes, such as printing, and facilitating the requirements for local and remote meetings, which are required for the efficient operation of the organization.

2.0 Background

The typical service life for a peripheral device is four to five years. Hydro purchased maintenance agreements that cover the larger MFDs for five years. The smaller printers, projectors, and media-player devices are covered by the default vendor product warranty of between one to three years.
Hydro generally schedules replacement of peripheral equipment on a five year lifecycle; however, an annual review is completed for equipment without warranty to determine if it needs to replaced sooner.
The decision to replace a peripheral not under warranty is based on the following criteria:

- Age and failure-status;
- Availability of alternate printing;
- Availability of support;
- Product roadmap and availability of features; and
- Business' printing requirements and number of users supported.

2.1 Existing Equipment

Hydro currently has approximately 200 printers, 11 video conference systems, 62 projectors, 7 display televisions, and 19 smart boards in 8 facilities throughout Newfoundland and Labrador.

2.2 Operating Experience

The units scheduled for replacement in 2020 have all been in service for five years or more and their maintenance contracts and warranties have expired.

3.0 Project Justification

Peripheral infrastructure must be reliable in order to adequately support Hydro's business needs.

4.0 Project Description

The project presently plans to replace 19 MFDs, 6 printers, 5 lockout/tag printers, 1 plotter, 4 video conference units, 6 video projectors, and 9 digital signage media players in 2020. The final quantity of replacements will be determined during project execution based upon the operating requirements, unforeseen failures, and equipment conditions to the end of 2020.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	159.5	0.0	0.0	**159.5**
Labour	33.2	0.0	0.0	**33.2**
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	10.2	0.0	0.0	**10.2**
Contingency	19.2	0.0	0.0	**19.2**
Total	**222.1**	**0.0**	**0.0**	**222.1**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Create Requests for Proposals, schedules, and secure resources.	January 2020	March 2020
Design:		
Create project plan.	February 2020	May 2020
Procurement:		
Award Requests for Proposals and order materials.	March 2020	October 2020
Construction:		
Implement upgrades.	March 2020	October 2020
Commissioning:		
Go live with upgrades.	May 2020	October 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

Hydro's peripheral infrastructure is necessary to support business processes and must be reliable to avoid downtime, which would impact productivity.

This proposed project will maintain the overall reliability of Hydro's peripheral infrastructure.

E. Capital Projects Over $50,000 and Less Than $200,000

2020 Capital Budget Application
Capital Projects Over $50,000 and Less Than $200,000

newfoundland labrador hydro
a nalcor energy company

Newfoundland and Labrador Hydro
2020 Capital Budget Application
Projects over $50,000 and less than $200,000
($000)

Project Description	Expended to 2019	2020	Future Years	Total	Definition	Classification	Page Ref.
Generation							
Purchase Tools and Equipment less than $50,000	-	62.7	-	62.7	Pooled	Normal	
Total Generation	-	**62.7**	-	**62.7**			
Transmission and Rural Operations							
Replace Sewage Lift System - Rigolet	-	127.9	-	127.9	Other	Normal	E-2
Purchase Tools & Equipment less than $50,000 - Labrador	-	102.4	-	102.4	Pooled	Normal	
Purchase Tools & Equipment less than $50,000 - Northern	-	94.9	-	94.9	Pooled	Normal	
Total Transmission and Rural Operations	-	**325.2**	-	**325.2**			
General Properties							
Remove Safety Hazards - Various	0.0	198.6	0.0	198.6	Other	Normal	E-6
Replace Battery Banks and Chargers - Various	0.0	195.9	0.0	195.9	Pooled	Normal	E-9
Upgrade Core IT Infrastructure - Hydro Place	0.0	193.7	0.0	193.7	Pooled	Normal	E-12
Replace Network Communications Equipment - Various	0.0	186.8	0.0	186.8	Pooled	Normal	E-15
Replace Remote Terminal Units - Various	0.0	157.1	0.0	157.1	Pooled	Normal	E-17
Refresh Security Software - Hydro Place	0.0	110.2	0.0	110.2	Pooled	Normal	E-20
Upgrade Software Applications - Hydro Place	0.0	65.4	0.0	65.4	Pooled	Normal	E-23
Purchase Tools and Equipment less than $50,000 Telecontrol	0.0	93.4	0.0	93.4	Pooled	Normal	
Purchase Office Equipment less than $50,000	0.0	60.9	0.0	60.9	Pooled	Normal	
Total General Properties	-	**1,262.0**	-	**1,262.0**			
Total Projects over $50,000 and under $200,000	-	**1,649.9**	-	**1,649.9**			

Project Title: Replace Sewage Lift System
Location: Rigolet
Category: Transmission and Rural Operations
Definition: Other
Classification: Normal

1.0 Introduction

The Rigolet Diesel Plant site includes a building and accommodation trailers. These facilities have washrooms that drain into the sewage lift system. The Rigolet Diesel Plant's sewage lift system has been in place for approximately 25 years.

2.0 Background

2.1 Existing System

The lift station consists of a grinder pump in a holding tank that is housed in a wooden box to pump sewage and wastewater through sewer lines and into the Town of Rigolet's sewer system.

2.2 Operating Experience

The system was not designed considering the site conditions such as: bedrock, slope of land, water runoff, etc. The existing system is not sealed and ground water infiltrates the existing pump (Figure 1 to Figure 3). The system was sized for use by plant operators only. When maintenance staff, line crews, and/or other personnel are on site, the demand on the lift station is much higher, especially if the extra personnel are staying in the accommodation trailers on site. In these situations, the pump often runs continuously causing the pump to fail two to four times a year. When the pump fails, sewage backs up and flows over the ground near the lift system and outside the accommodation trailers. At these times, all personnel must travel elsewhere to use washroom facilities and staff staying in the accommodation trailers must stay elsewhere due to the inability to run water or flush toilets.

Figure 1: Existing Sewage Lift System

Figure 2: Existing Sewage Lift System

Figure 3: Existing Sewage Lift System

3.0 Project Justification

This project is required to provide a reliable sewage lift system to ensure the removal of waste from the Rigolet Diesel Plant site.

4.0 Project Description

The project at the Rigolet Diesel Plant consists of the design and installation of a new sewage lift system and piping that will move sewage from the diesel plant into the Town of Rigolet's sewer system.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	15.0	0.0	0.0	**15.0**
Labour	39.2	0.0	0.0	**39.2**
Consultant	11.6	0.0	0.0	**11.6**
Contract Work	41.8	0.0	0.0	**41.8**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	5.4	0.0	0.0	**5.4**
Contingency	14.9	0.0	0.0	**14.9**
Total	**127.9**	**0.0**	**0.0**	**127.9**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Design transmittal, project schedule, etc.	January 2020	February 2020
Design:		
Develop pump and lift system size and tender documents.	March 2020	April 2020
Procurement:		
Tender and award construction contract.	April 2020	May 2020
Construction:		
Install new lift system.	August 2020	August 2020
Commissioning:		
Perform final inspection and acceptance.	August 2020	August 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

The Rigolet Diesel Plant has an inadequate sewage lift station and waste removal piping.

This project is proposed to install a new sewage lift and waste removal piping to provide a reliable means to remove sewage waste from site and transport it to the Town of Rigolet's sewage system.

Project Title: Remove Safety Hazards
Location: Various Sites
Category: General Properties – Administrative
Definition: Other
Classification: Normal

1.0 Introduction

Safety hazards are identified through Newfoundland and Labrador Hydro's ("Hydro") Safe Work Observation Program ("SWOP") by employees, contractors, and others who access Hydro facilities. In some cases, capital expenditure may be required to promptly mitigate the safety hazards and maintain a safe workplace.

2.0 Background

SWOP involves workers actively looking for safety hazards and problems that may otherwise go unnoticed that could lead to serious health and/or safety issues for Hydro customers, employees, contractors, and the general public.

Safety concerns identified in SWOP can often be mitigated through an operating or procedural change, through communication with applicable groups, or through work executed under an operating budget account. When it is concluded that a mitigation measure is a capital item, a cost estimate is completed for the mitigation work and is submitted to Hydro's Engineering Services Department for consideration under the Remove Safety Hazards category. These requests are reviewed and, if warranted, the funding is approved by the Manager, Project Execution.

2.1 Operating Experience

Table 1 lists the projects completed in 2018, which total $166,300.

Table 1: Projects Completed in 2018 ($000)

Location	Project Description	Cost
Hydro Place (St. John's)	Replacement of concrete approach pad outside shipping and receiving.	27.6
Holyrood Thermal Generating Station	Installation of H_2S Monitoring System.	128.6
Hardwoods Gas Turbine	Installation of exciter module access stairs.	10.1
Total		**166.3**

Table 2 shows the budget and actual expenditures from 2015 to 2019.

Table 2: Capital Expenditure History ($000)

Year	Budget	Actual
2019	198.5	-
2018	199.4	166.3
2017	198.6	185.9
2016	199.3	175.4
2015	194.9	176.9

3.0 Project Justification

This project is justified on Hydro's requirement to provide a safe work environment for its employees in compliance with the Occupational Health and Safety Regulations[1] which state:

> 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.

This project provides Hydro with the budget to address unsafe situations, 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 application process. These deficiencies, as reported under SWOP, need to be immediately corrected to provide a safe work environment.

4.0 Project Description

This proposed project provides the funds necessary to allow Hydro to efficiently address safety hazards identified through SWOP that are capital in nature and require prompt corrective actions.

The estimate for this project is shown in Table 3.

[1] *Occupational Health and Safety Regulations*, *2012*, NLR, 5/12, under the *Occupational Health and Safety Act (OC2012-005).*

Table 3: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	100.0	0.0	0.0	**100.0**
Labour	89.6	0.0	0.0	**89.6**
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	9.0	0.0	0.0	**9.0**
Contingency	0.0	0.0	0.0	**0.0**
Total	**198.6**	**0.0**	**0.0**	**198.6**

Actual expenditures are subject to the magnitude of the approved work scopes, in conjunction with the location in which the work is to be completed—both of which are unknown during the budget proposal process.

As this budget relates to unanticipated safety issues, no schedule is available.

5.0 Conclusion

Some safety hazards, identified in Hydro's SWOP, require prompt corrective actions. Hydro is proposing this project to allow for timely corrective actions that are capital in nature.

Project Title: Replace Battery Banks and Chargers

Location: Various

Category: General Properties – Network Services

Definition: Pooled

Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro's ("Hydro") 48 Vdc chargers ensure that 48 Vdc batteries are fully charged in the event of a station service power loss. Hydro uses the 48 Vdc battery banks as part of the backup systems for maintaining power to Hydro's communication equipment throughout the electrical system. Hydro establishes battery charger service life criteria based on performance, reliability, and availability of support from the manufacturer.

2.0 Background

2.1 Existing Equipment

The 48 Vdc chargers at Petty Harbour Hill, Chapel Arm Hill, Bull Arm Hill, and Four Mile Hill telecommunication sites were installed in 2000. These chargers have a planned 20-year service life and are reaching the end of that service life.

2.2 Operating Experience

In 2017, the charger at Four Mile Hill failed before the end of its intended service life of 20 years and was not repairable. A temporary charger is currently in place until the proper replacement unit can be installed. The manufacturer has discontinued support for the charger models at these sites; therefore, parts or spares are no longer available to repair or refurbish the charger units.

3.0 Project Justification

This project is required for the continued reliable operation of the backup power supply in Petty Harbour Hill, Chapel Arm Hill, Bull Arm Hill, and Four Mile Hill telecommunication sites. If batteries or chargers fail, reliable operation of the grid is at risk as sufficient power may not be available to maintain communications and controls in the event of an outage.

4.0 Project Description

This project will replace 48 Vdc Charger Systems at Petty Harbour Hill, Chapel Arm Hill, Bull Arm Hill, and Four Mile Hill telecommunication sites.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	62.3	0.0	0.0	**62.3**
Labour	66.0	0.0	0.0	**66.0**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	30.0	0.0	0.0	**30.0**
Other Direct Costs	11.8	0.0	0.0	**11.8**
Interest and Escalation	8.8	0.0	0.0	**8.8**
Contingency	17.0	0.0	0.0	**17.0**
Total	**195.9**	**0.0**	**0.0**	**195.9**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Prepare project plan and site visits.	January 2020	February 2020
Design:		
Complete charger tender package and installation tender package.	February 2020	March 2020
Procurement:		
Issue purchase orders for charger and installation.	March 2020	April 2020
Construction:		
Install chargers.	July 2020	September 2020
Commissioning:		
Perform site inspections.	July 2020	September 2020
Closeout:		
Close out project.	October 2020	December 2020

5.0 Conclusion

The charger equipment at Petty Harbour Hill, Chapel Arm Hill, Bull Arm Hill, and Four Mile Hill telecommunication sites is reaching the end of its service life and the equipment manufacturer is no longer providing replacement parts. This project is proposed to replace the chargers to maintain reliable operation of 48 Vdc backup electrical power for operation of its telecommunications equipment at Petty Harbour Hill, Chapel Arm Hill, Bull Arm Hill, and Four Mile Hill telecommunication sites.

Project Title: Upgrade Core IT Infrastructure
Location: Hydro Place
Category: General Properties – Information Systems – Computer Operations
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") has IT/OT[1] infrastructure including: servers; random-access memory ("RAM"); storage; operating systems; and data centres to permit OT, software applications, and IT services to function in conjunction with the Energy Management System ("EMS") in order to support the operation of the electrical grid.

2.0 Background

Hydro's OT and IT infrastructure includes over 180 servers, 7 TB of RAM, 11 TB of disk storage, and a variety of Windows and Linux operating systems. Hydro's servers and storage are used on a continuous basis and are active for the life of the equipment. These devices are used to maintain and monitor the electrical utility system. One of these functions is to interface with Human Machine Interface ("HMI") systems located in facilities to collect data from monitoring systems and relay that data back to the EMS.

While industry best practice is to replace servers and storage devices on a five-year lifecycle, Hydro has had acceptable performance of this infrastructure by obtaining a five-year warranty on its server and storage infrastructure and then, after the five-year warranty period expires, the equipment is placed on a vendor maintenance program that is reviewed and renewed quarterly until the devices are replaced. The factors that are considered when determining upgrade scheduling for servers, storage, and data center infrastructure components are to:

- Address obsolescence/maintaining vendor support;
- Provide infrastructure management; and
- Assess the ability to run existing and new applications.

[1] Information technology ("IT") and operational technology ("OT").

2.1 Existing System

Hydro currently has multiple facilities running HMI systems that require a workstation component. Hydro has six virtual machine hosts located in the primary and backup EMS Control Centres running on the Operations Technology Network with 512 GB of RAM each. These machines host virtual servers that run Supervisory Control and Data Acquisition ("SCADA") applications.

2.2 Operating Experience

The workstation computers for Hydro's HMI control systems perform adequately; however, in 2020, two of these workstations, located at the Hawkes Bay Diesel Plant and the Ramea Diesel Plant, will be beyond their five-year lifecycle and will require replacement.

The existing quantity of memory for the virtual memory hosts does not permit additional software to be installed. As a result, the existing servers will not be able to accommodate upgrades to software and operating systems or allow for the creation of new virtual servers from the virtual host, which are also required to support software upgrades. These deficiencies will limit Hydro's ability to upgrade operational technology software. Adding memory capacity in 2020 will allow for an EMS upgrade in 2021.

3.0 Project Justification

Core IT/OT infrastructure must be maintained so as to work reliably in conjunction with the EMS in order to support the operation of the electrical system.

4.0 Project Description

This project will replace two workstation computers located in the diesel generation facilities at Hawkes Bay and Ramea. These workstations are part of the HMI control systems that have been in production for five years.

The project will also expand the memory for three virtual server hosts in the primary and backup control centers from 512 GB to 768 GB.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	109.2	0.0	0.0	**109.2**
Labour	40.2	0.0	0.0	**40.2**
Consultant	18.8	0.0	0.0	**18.8**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	8.8	0.0	0.0	**8.8**
Contingency	16.7	0.0	0.0	**16.7**
Total	**193.7**	**0.0**	**0.0**	**193.7**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Create Requests for Proposals, schedules, and secure resources.	January 2020	March 2020
Design:		
Create project plan.	February 2020	May 2020
Procurement:		
Award Requests for Proposals and order materials	March 2020	October 2020
Construction:		
Implement upgrades.	March 2020	October 2020
Commissioning:		
Go live with upgrades.	May 2020	October 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

Hydro proposes to replace two workstation computers for HMI control systems and the expansion of memory for three virtual server hosts from 512 GB to 768 GB to ensure that its IT/OT infrastructure involved in operation of the electrical system work reliably.

Project Title: Replace Network Communications Equipment
Location: Various
Category: General Properties – Telecontrol
Definition: Pooled
Classification: Normal

1.0 Introduction

The Newfoundland and Labrador Hydro ("Hydro") Communications Network transports protection and control data and voice traffic between offices, terminal stations, generating stations, and the Energy Control Centre as required to operate the electrical system and to conduct business functions. There are approximately 600 networking devices. Networking devices are replaced as they reach "end of support" in their life cycle, which is when the vendor no longer provides hardware or software support for continued operation. Devices at end of support are vulnerable to hardware and software defects and security threats.

2.0 Background

2.1 Existing Equipment

In 2020, 30 devices, 22 switches, and 8 routers will be at end of support. These network devices have operated reliably to date.

3.0 Project Justification

This project is required to maintain reliable operation of Hydro's Communication Network.

4.0 Project Description

This project includes the planning, design, procurement, and implementation of new network devices at multiple locations across Newfoundland and Labrador to replace 30 devices, 22 switches, and 8 routers at end of support.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	65.2	0.0	0.0	**65.2**
Labour	86.8	0.0	0.0	**86.8**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	9.3	0.0	0.0	**9.3**
Interest and Escalation	9.5	0.0	0.0	**9.5**
Contingency	16.0	0.0	0.0	**16.0**
Total	**186.8**	**0.0**	**0.0**	**186.8**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning: Prepare scope statement and resource and network outage schedule.	January 2020	February 2020
Design: Prepare network drawings and design packages and refine bill of materials.	February 2020	March 2020
Procurement: Submit requisitions for Cisco equipment (standing offer).	March 2020	April 2020
Construction: Configure and install new equipment.	May 2020	November 2020
Commissioning: Test network connectivity.	May 2020	November 2020
Closeout: Update as-built drawings and close out project.	November 2020	December 2020

5.0 Conclusion

The Hydro communications network utilizes networking devices to operate the electrical system and to conduct business functions. Network devices are replaced as they reach the end of support when the vendor no longer provides hardware or software support.

In 2020, 30 devices, 22 switches, and 8 routers will be at end of support and require replacement.

This proposed project will facilitate the maintenance of reliable operation of Hydro's communication network.

Project Title: Replace Remote Terminal Units
Location: Various
Category: General Properties – Telecontrols
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") uses a remote telemetry unit ("RTU") to remotely control its equipment and to transmit data from the equipment site to the Energy Control Centre in Hydro Place. Older RTUs are GE Multilin D20 models. The D20 RTU processor card ("D20M++") was discontinued by the manufacturer in the late 1990s but repair services were provided. In 2014, electronic components for the D20M++ became unavailability and the manufacturer is no longer repairing defective modules; therefore, the Multilin D20 model is obsolete.

2.0 Background

2.1 Existing Equipment

There are nine GE Multilin D20-based RTUs in service. This equipment is used in substations, terminal stations, generating stations, and any other location where Supervisory Control and Data Acquisition is required by the Energy Control Center for monitoring of Hydro's system.

2.2 Operating Experience

The last failure, in July of 2014, required the installation of a spare RTU as Hydro no longer had spare modules to complete repairs and GE had stopped repairing modules.

3.0 Project Justification

A failure of the D20M++ processor will lead to a forced and unscheduled upgrade of the D20 RTU, resulting in a two- to four-day outage during which the Energy Control Centre would have no remote monitoring or remote control ability of the affected station. In such a situation, the location may need to be staffed in order to manually execute control procedures and to provide data to the Energy Control Centre.

4.0 Project Description

Hydro is proposing the replacement of five GE Multilin D20 RTUs with the latest model of the D20 processor at the Cat Arm Hydroelectric Generating Station, Hawkes Bay Terminal Station, Peter's Barren Terminal Station, St. Anthony Diesel Plant, and St. Anthony Airport Terminal Station. Hydro may change the location of the replacement processor modules should other network modernization projects facilitate completing the RTU upgrade at the same time.

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 proposed project will be completed using Hydro personnel.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	55.8	0.0	0.0	**55.8**
Labour	74.0	0.0	0.0	**74.0**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	0.0	0.0	0.0	**0.0**
Other Direct Costs	9.4	0.0	0.0	**9.4**
Interest and Escalation	3.9	0.0	0.0	**3.9**
Contingency	14.0	0.0	0.0	**14.0**
Total	**157.1**	**0.0**	**0.0**	**157.1**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Prepare project plan and site visits.	January 2020	February 2020
Design:		
Complete tender package.	February 2020	March 2020
Procurement:		
Purchase upgrade kits.	April 2020	April 2020
Construction:		
Install upgrade kits.	May 2020	September 2020
Commissioning:		
Perform site inspections.	October 2020	October 2020
Closeout:		
Close out project.	November 2020	December 2020

5.0 Conclusion

As the GE Multilin D20 model manufacturer no longer repairs failed modules, Hydro has to replace these obsolete units. Hydro is proposing to replace five RTUs in 2020.

Project Title: Refresh Security Software
Location: Hydro Place
Category: General Properties – Information Systems – Software Applications
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro's ("Hydro") increasing reliance on information and operational systems, and its expanding data networks, increases exposure to security threats to its Information and Operating Technology ("IT/OT") infrastructure. Hydro has security software applications, systems, and equipment to permit operating technology software applications and information technology services to function reliability. A security incident involving the loss of corporate data, or access to critical business, plant, or energy control systems would result in unplanned costs to contain, investigate, and remediate the incident as well as investments to change systems or processes, if required. To mitigate the risk of a security incident, industry best practice is to refresh security software on a five-year lifecycle.

2.0 Background

2.1 Existing System

Hydro currently has endpoint-protection on operational technology computer equipment including: workstations, desktops, laptops, servers, and mobile devices.

For the last two years, Hydro has utilized multiple industrial control system ("ICS") installations for cybersecurity threat-identification and remediation.

2.2 Operating Experience

The security software applications, systems, and equipment have performed adequately; however, an annual hardware review of devices has identified additional endpoints that require endpoint protection.

The cyber security team has also identified the need to add another node to Hydro's existing ICS security platform solution.

3.0 Project Justification

This project is required to ensure all Hydro servers, storage, and endpoint computer devices are protected by antivirus, intrusion-detection, and related services that are vital to the reliable and secure operation of IT/OT computing environments.

4.0 Project Description

This project will purchase and install approximately 80 security software licenses for advanced endpoint protection. The final number of licenses required will be determined during project execution.

The project will also implement an additional ICS installation to extend existing instances for cybersecurity threat identification and remediation.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	58.9	0.0	0.0	**58.9**
Labour	19.3	0.0	0.0	**19.3**
Consultant	16.9	0.0	0.0	**16.9**
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	0.0	0.0	**5.6**
Contingency	9.5	0.0	0.0	**9.5**
Total	**110.2**	**0.0**	**0.0**	**110.2**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Create Requests for Proposals, schedules, and secure resources.	January 2020	March 2020
Design:		
Create a project plan.	February 2020	May 2020
Procurement:		
Award Requests for Proposals and order materials.	March 2020	October 2020
Construction:		
Implement upgrades.	March 2020	October 2020
Commissioning:		
Go live with upgrades.	May 2020	October 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

Hydro's increasing reliance on information and operational systems and expanding data networks increases exposure to security threats to its critical infrastructure. Hydro maintains licensing and vendor support for several cybersecurity software programs to ensure capability to manage cybersecurity threat detection and remediation.

Hydro proposes this project to ensure it has adequate cybersecurity tools to mitigate security threats to IT/OT infrastructure and software.

Project Title: Upgrade Software Applications
Location: Hydro Place
Category: General Properties – Information Systems – Software Applications
Definition: Pooled
Classification: Normal

1.0 Introduction

Newfoundland and Labrador Hydro ("Hydro") utilizes software applications in its Supervisory Control and Data Acquisition ("SCADA") system to transmit information between system equipment and the Energy Control Centre relating to the operation and control of the electrical system. The information is used by the Energy Management System ("EMS") software application to maintain the operation and control of the electrical system.

2.0 Background

2.1 Existing System

Hydro currently uses a SCADA Data Collection/Reporting Services application that supports Hydro's EMS by allowing historical viewing of operations data. Hydro also uses a Power Meter Management application, which provides information about diesel generating station equipment operations.

2.2 Operating Experience

Hydro reviews SCADA supporting applications annually for updates and typically updates are scheduled every two to three years to stay current with software patches and address security vulnerabilities. The last SCADA Data Collection/Reporting Services software upgrade was performed in 2018. The last upgrade of the Power Meter Management software was performed in 2017.

3.0 Project Justification

Software upgrades are required for the reliable operation of the SCADA Data Collection/Reporting Services and the Power Meter Management software. These applications transmit essential information relating to the operation and control of the electrical system between system equipment and the Energy Control Centre.

4.0 Project Description

This project will upgrade the SCADA Data Collection/Reporting Services and Power Meter Management applications.

The estimate for this project is shown in Table 1.

Table 1: Project Estimate ($000)

Project Cost	2020	2021	Beyond	Total
Material Supply	0.0	0.0	0.0	**0.0**
Labour	26.7	0.0	0.0	**26.7**
Consultant	0.0	0.0	0.0	**0.0**
Contract Work	30.8	0.0	0.0	**30.8**
Other Direct Costs	0.0	0.0	0.0	**0.0**
Interest and Escalation	2.2	0.0	0.0	**2.2**
Contingency	5.7	0.0	0.0	**5.7**
Total	**65.4**	**0.0**	**0.0**	**65.4**

The anticipated project schedule is shown in Table 2.

Table 2: Project Schedule

Activity	Start Date	End Date
Planning:		
Create Requests for Proposals, schedules, and secure resources.	January 2020	March 2020
Design:		
Create project plan.	February 2020	May 2020
Procurement:		
Award Requests for Proposals and order materials.	March 2020	October 2020
Construction:		
Implement upgrades.	March 2020	October 2020
Commissioning:		
Go live with upgrades	May 2020	October 2020
Closeout:		
Close out project.	September 2020	November 2020

5.0 Conclusion

In its SCADA system, Hydro utilizes the SCADA Data Collection/Reporting Services and Power Meter Management software applications to transmit information between system equipment and the Energy Control Centre relating to the operation and control of the electrical system.

Hydro is proposing to upgrade the SCADA Data Collection/Reporting Services and Power Meter Management software applications to maintain reliable operation of its SCADA system.

F. Leasing Costs

2020 Capital Budget Application
Leasing Costs

July 2019

There Are No Items for This Section

G. Capital Expenditures
2015–2024

2020 Capital Budget Application
Capital Expenditures 2015–2024

Newfoundland and Labrador Hydro
2020 Capital Budget
Single-Year Projects Over $50,000
($000)

	Actuals				Budget					
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Generation	54,188.8	64,260.2	39,101.5	59,756.8	32,866.5	20,965.7	40,555.6	36,055.4	31,633.7	36,123.6
Transmission and Rural Operations	62,201.6	130,612.0	293,203.1	90,300.3	76,663.0	85,418.0	61,582.5	66,659.8	64,111.5	58,771.3
General Properties	8,728.9	9,068.8	8,436.3	6,928.0	8,639.3	5,563.6	9,278.4	5,946.8	6,396.8	6,988.7
Total Capital Expenditures	**125,119.3**	**203,941.0**	**340,740.8**	**156,985.1**	**118,168.8**	**111,947.3**	**111,416.5**	**108,662.1**	**102,142.1**	**101,883.7**

H. 2019 Capital Expenditures Overview

2020 Capital Budget Application
2019 Capital Expenditures Overview

July 2019

A report to the Board of Commissioners of Public Utilities

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1 # 1.0 Financial Schedules

Total Capital Project Variance
2019 Overview
($000)

Asset Type	Board Approved Budget	Total Project Expenditures and Forecast	Variance
Hydraulic	62,311	59,324	(2,987)
Thermal	7,434	8,073	639
Gas Turbines	27,611	21,387	(6,224)
Terminal Stations	143,844	134,505	(9,339)
Transmission	294,125	290,125	(4,000)
Distribution	18,417	18,343	(74)
Rural Generation	28,721	29,091	370
Properties	2,448	2,109	(339)
Metering	196	196	0
Information Systems	1,597	1,597	0
Rural Systems Tools and Equipment	2,043	2,043	0
Telecontrol	5,485	5,485	0
Transportation	4,264	4,264	0
Administration	949	949	0
Allowance for Unforeseen	1,600	1,600	0
Supplemental Projects	22,705	23,509	804
Projects Approved for Less Than $50,000	215	215	0
Total Capital Budget	**623,965**	**602,815**	**(21,150)**

2019 Capital Expenditures By Year
($000)

Summary	Capital Budget[1] A 2015	A 2016	A 2017	A 2018	B Carryover to 2019	C Original 2019	D (B+C) Revised 2019	E 2020 and Beyond	F (A+C+E) Total	Actual Expenditure and Forecast G 2015	G 2016	G 2017	G 2018	H YTD 2019	I Forecast Jul–Dec 2019	J 2020 and Beyond	K (G+H+I+J) Total	K-F Project Variance	H-D Annual Variance
2019 Projects						71,688.1	71,688.1	45,264.2	116,952.3				0.0	17,031	54,797	43,724.0	115,552.3	(1,400.0)	140.2
2018 Projects				53,107.8	22,217.3	49,813.2	72,030.5	3,715.0	106,636.0				29,951.4	11,532.0	53,549.4	4,340.3	99,373.1	(7,262.9)	(6,949.1)
2017 Projects			14,335.8	23,549.2	6,382.5	2,337.6	8,720.1	1,429.6	41,652.2			7,605.7	13,857.8	2,863.2	5,856.9	1,429.6	31,613.1	(10,039.1)	(0.0)
2016 Projects		8,708.0	18,374.1	21,725.3	2,293.4	6,597.3	8,890.7	11,116.8	66,521.5		6,346.5	12,429.4	25,603.9	5,021.0	7,052.6	11,116.8	67,570.2	1,048.7	3,182.9
2015 Projects	22.7	522.5	0.0	0.0	331.2	0.0	331.2	0.0	545.2	137.0	128.6	26.0	373.9	384.2	0.0	0.0	1,049.7	504.5	53.0
2014 Projects	4,403.0	75,284.3	194,552.4	17,418.3	1,716.2	0.0	1,716.2	0.0	291,658.0	2,018.2	59,317.8	213,663.7	10,942.1	499.6	1,216.6	0.0	287,658.0	(4,000.0)	0.0
Grand Total	**4,425.7**	**84,514.8**	**227,262.3**	**115,800.6**	**32,940.6**	**130,436.2**	**163,376.8**	**61,525.6**	**623,965.2**	**2,155.2**	**65,792.9**	**233,724.7**	**80,729.0**	**37,331.0**	**122,472.9**	**60,610.7**	**602,816.4**	**(21,148.8)**	**(3,572.9)**

2019 Capital Budget Approved by Board Order No. P.U. 46(2018)	116,140.7
New Project Approved by Board Order No. 38 (2018)	220.1
New Project Approved by Board Order No. 7 (2019)	600.0
New Project Approved by Board Order No. 9 (2019)	12,586.4
New Project Approved by Board Order No. 22(2019)	673.8
2018 New Projects under $50,000 Approved by Hydro	215.2
Total Approved Capital Budget Before Carryovers	130,436.2
Carryover Projects 2018 to 2019	32,940.6
Total Approved Capital Budget	**163,376.8**

[1] Annual budgets previous to 2019 pertain to projects that have expenditures in 2018.

2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Hydraulic In-Service Failures	-	-	-	-	-	1,250.0	1,250.0	-	1,250.0	-	-	-	-	271.8	978.2	-	1,250.0	-	-	
Hydraulic Generation Refurbishment and Modernization - Various Sites	-	-	-	-	-	10,313.6	10,313.6	5,486.5	15,800.1	-	-	-	-	2,326.3	7,987.3	5,486.5	15,800.1	-	-	
Purchase Tools and Equipment Less than $ 50,000	-	-	-	-	-	133.50	133.5	-	133.5	-	-	-	-	19.2	114.3		133.5	-	-	
2018 Projects																				
Install Remote Operation of Salmon Spillway - Bay d'Espoir	-	-	-	645.9	(239.5)	1,862.5	1,623.0	-	2,508.4	-	-	-	885.4	126.4	1,496.6	-	2,508.4	-	-	
Refurbish Backfill on Penstock #1 - Bay d'Espoir	-	-	-	1,630.4	1,567.2	-	1,567.2	-	1,630.4	-	-	-	63.2	11.5	-	-	74.7	(1,555.7)	(1,555.7)	1
Energy Efficiency Improvements - Various Sites	-	-	-	276.2	66.4	168.9	235.3	-	445.1	-	-	-	209.8	42.9	192.4	-	445.1	-	-	
Hydraulic Generation Refurbishment and Modernization - Various Sites	-	-	-	10,325.4	2,578.7	4,283.1	6,861.8	-	14,608.5	-	-	-	5,856.3	866.4	5,995.4	-	12,718.1	(1,890.4)	-	2
2017 Projects																				
Refurbish Powerhouse Station Services - Bay d'Espoir	-	-	413.2	2,473.3	1,840.0	1,460.6	3,300.6	-	4,347.1	-	-	43.0	1,003.5	1,268.0	2,032.6	-	4,347.1	-	-	
Replace Exciter Controls Units 1 to 6 - Bay d'Espoir	-	-	119.2	921.2	9.3	877.0	886.3	1,429.6	3,347.0	-	-	182.7	628.9	484.3	402.0	1,429.6	3,127.5	(219.5)	-	
Replace Slip Rings Units 1-6 - Bay d'Espoir	-	-	312.6	159.7	352.7	-	352.7	-	472.3	-	-	102.4	17.2	78.6	274.1	-	472.3	-	-	
Control Structure Refurbishments	-	-	1,735.3	452.9	144.1	-	144.1	-	2,188.2	-	-	991.4	709.3	57.9	86.2	-	1,844.8	(343.4)	-	3
2016 Projects																				
Upgrade Work - Cat Arm	-	558.3	1,353.0	0.0	30.3	-	30.3	-	1,911.3	-	240.4	760.6	1,376.3	188.4	1.6	-	2,567.3	656.0	159.7	4
Rehabilitate Shoreline Protection - Cat Arm	-	112.2	1,030.7	0.0	888.0	-	888.0	-	1,142.9	-	104.7	61.0	89.2	(254.9)	-	-	(0.0)	(1,142.9)	(1,142.9)	5
Replace Site Facilities - Bay d'Espoir	-	928.3	4,736.3	6,316.7	904.4	-	904.4	-	11,981.3	-	270.4	2,231.6	8,574.9	1,908.9	-	-	12,985.8	1,004.5	1,004.5	
2015 Projects																				
Replace Pump House and Associated Equipment - Bay d'Espoir	22.7	522.5	0.0	0.0	331.2	-	331.2	-	545.2	137.0	128.6	26.0	373.9	384.2	0.0	-	1,049.7	504.5	53.0	6
Total Hydraulic Generation Projects	**22.7**	**2,121.3**	**9,700.3**	**23,201.7**	**8,472.8**	**20,349.2**	**28,822.0**	**6,916.1**	**62,311.3**	**137.0**	**744.1**	**4,398.8**	**19,787.9**	**7,779.9**	**19,560.7**	**6,916.1**	**59,324.4**	**(2,986.9)**	**(1,481.4)**	

2019 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	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Overhaul Unit 3 Turbine Valve - Holyrood	-	-	-	-	-	3,290.5	3,290.5	-	3,290.5	-	-	-	-	2,548.6	141.9	-	2,690.5	(600.0)	(600.0)	7
Condition Assessment and Miscellaneous Upgrades - Holyrood	-	-	-	-	-	1,968.8	1,968.8	-	1,968.8	-	-	-	-	729.6	2,478.2	-	3,207.8	1,239.0	1,239.0	8
Thermal In-Service Failures	-	-	-	-	-	1,250.0	1,250.0	-	1,250.0	-	-	-	-	847.1	402.9	-	1,250.0	-	-	
Replace 258VDC Battery Banks - Holyrood	-	-	-	-	-	330.0	330.0	-	330.0	-	-	-	-	28.5	301.5	-	330.0	-	-	
Purchase Tools and Equipment Less than $ 50,000	-	-	-	-	-	15.4	15.4	-	15.4	-	-	-	-	-	15.4	-	15.4	-	-	
2018 Projects																				
Upgrade Cranes and Hoists - Holyrood	-	-	-	80.3	41.7	300.3	342.0	-	380.6	-	-	-	38.6	303.2	38.8	-	380.6	-	-	
Install Fire Detection in Outbuildings - Holyrood	-	-	-	198.6	128.2	0.0	128.2	-	198.6	-	-	-	70.4	87.4	40.8	-	198.6	-	-	
Total Thermal Generation Projects	**-**	**-**	**-**	**278.9**	**169.9**	**7,155.0**	**7,324.9**	**-**	**7,433.9**	**-**	**-**	**-**	**109.0**	**4,544.4**	**3,419.5**	**-**	**8,072.9**	**639.0**	**639.0**	

2019 Capital Expenditures By Category
($000)

Gas Turbine Generation Projects	Capital Budget									Actual Expenditure and Forecast								K-F	H-D	
	A				B	C	D (B+C)	E	F (A+C+E)	G				H	I	J	K (G+H+I+J)			
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Overhaul Olympus Gas Generator - Stephenville	-	-	-	-	-	1,666.8	1,666.8	-	1,666.8	-	-	-	-	52.6	1,614.2	-	1,666.8	-	-	
Construct Heated Storage for Spare Parts and Lube Oil - Hardwoods and Happy Valley	-	-	-	-	-	49.8	49.8	-	49.8	-	-	-	-	20.2	29.6	-	49.8	-	-	
Upgrade Compressed Air System - Holyrood Gas Turbine	-	-	-	-	-	70.7	70.7	317.7	388.4	-	-	-	-	6.7	64.0	317.7	388.4	-	-	
Upgrade HMI and AVR - Hardwoods	-	-	-	-	-	685.9	685.9	-	685.9	-	-	-	-	149.9	536.0	-	685.9	-	-	
Replace Main Fuel Valves - Hardwoods	-	-	-	-	-	404.2	404.2	-	404.2	-	-	-	-	96.6	307.6	-	404.2	-	0.0	
2018 Projects																				
Gas Turbine Equipment Replacement and Refurbishment - Hardwoods and Stephenville	-	-	-	997.9	480.2	429.3	909.5	-	1,427.2	-	-	-	371.3	112.8	796.7	-	1,280.8	(146.4)	-	9
Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine	-	-	-	8,829.9	6,093.1	3,012.7	9,105.8	-	11,842.6	-	-	-	2,583.8	841.4	3,389.0	-	6,814.2	(5,028.4)	(4,875.4)	10
Turbine Hot Gas Path Level 2 Inspection and Overhaul - Holyrood Gas Turbine	-	-	-	11,146.5	682.9	-	682.9	-	11,146.5	-	-	-	9,770.7	56.1	270.2	-	10,097.0	(1,049.5)	(356.6)	
Total Gas Turbine Generation Projects	-	-	-	20,974.3	7,256.2	6,319.4	13,575.6	317.7	27,611.4	-	-	-	12,725.8	1,336.3	7,007.3	317.7	21,387.1	(6,224.3)	(5,232.0)	

2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Terminal Station In-Service Failures	-	-	-	-	-	1,000.0	1,000.0	-	1,000.0	-	-	-	-	586.6	413.4	-	1,000.0	-	-	
Upgrade Terminal Station for Mobile Substation - St. Anthony	-	-	-	-	-	89.3	89.3	402.7	492.0	-	-	-	-	10.2	79.1	402.7	492.0	-	-	
Terminal Station Refurbishment and Modernization - Various Sites	-	-	-	-	-	10,891.1	10,891.1	19,061.8	29,952.9	-	-	-	-	1,022.3	9,187.7	19,061.8	29,271.8	(681.1)	(681.1)	
2018 Projects																				
Replace Transformer T1 - Buchans	-	-	-	249.0	150.0	2,086.1	2,236.1	-	2,335.1	-	-	-	99.0	341.7	1,894.4	-	2,335.1	-	-	
Implement Terminal Station Flood Mitigation - Springdale	-	-	-	186.2	50.4	787.8	838.2	-	974.0	-	-	-	135.8	38.1	471.2	625.3	1,270.4	296.4	(328.9)	11
Purchase Mobile DC Power Systems	-	-	-	270.9	229.0	695.6	924.6	-	966.5	-	-	-	41.9	45.5	879.1	-	966.5	-	-	
Terminal Station Refurbishment and Modernization - Various Sites	-	-	-	8,170.6	5,839.7	18,625.1	24,464.8	-	26,795.7	-	-	-	1,983.8	3,239.6	21,225.2	-	26,448.6	(347.1)	-	
2017 Projects																				
Replace 66 kV Station Service Feed - Holyrood	-	-	62.8	1,198.6	945.7	-	945.7	-	1,261.4	-	-	80.7	235.0	46.6	899.1	-	1,261.4	0.0	-	
Replace Substation - Holyrood	-	-	439.4	758.6	313.1	-	313.1	-	1,198.0	-	-	115.4	369.7	63.9	249.2	-	798.2	(399.8)	-	12
Terminal Station Refurbishment and Modernization - Various Sites	-	-	10,831.3	16,550.8	2,327.7	-	2,327.7	-	27,382.1	-	-	5,852.1	10,464.4	845.2	1,482.5	-	18,644.2	(8,737.9)	-	13
2016 Projects																				
Upgrade Circuit Breakers - Various Sites	-	6,969.1	10,808.7	15,408.6	479.9	6,597.3	7,077.2	11,116.8	50,900.5	-	5,599.5	8,877.8	15,184.2	3,071.2	7,051.0	11,116.8	50,900.5	(0.0)	3,045.0	
Upgrade Data Alarm Systems - Various Sites	-	74.4	234.1	-	(1.8)	-	(1.8)	-	308.5	-	49.7	116.0	144.6	44.7	-	-	355.0	46.5	46.5	
Install Breaker Failure Protection - Various Sites	-	65.7	211.3	-	(7.4)	-	(7.4)	-	277.0	-	81.8	382.4	234.7	62.7	-	-	761.6	484.6	70.1	14
Total Terminal Stations Projects	**0.0**	**7,109.2**	**22,587.6**	**42,793.3**	**10,326.3**	**40,772.3**	**51,098.6**	**30,581.3**	**143,843.7**	**0.0**	**5,731.0**	**15,424.5**	**28,893.1**	**9,418.3**	**43,831.9**	**31,206.6**	**134,505.4**	**(9,338.3)**	**2,151.6**	

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2019 Capital Expenditures by Category
($000)

Transmission Projects	Capital Budget									Actual Expenditure and Forecast								K-F	H-D	
	A				B	C	D	E	F (A+C+E)	G				H	I	J	K(G+H+I+J)			
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Wood Pole Line Management Program - Various Sites	-	-	-	-	-	2,467.0	2,467.0	-	2,467.0	-	-	-	-	1,071.0	1,396.0	-	2,467.0	-	-	
2014 Projects																				
230 kV Transmission Line - Bay d'Espoir to Western Avalon	4,403.0	75,284.3	194,552.4	17,418.3	1,716.2	0.0	1,716.2	-	291,658.0	2,018.2	59,317.8	213,663.7	10,942.1	499.6	1,216.6	-	287,658.0	(4,000.0)	-	
Total Transmission Projects	**4,403.0**	**75,284.3**	**194,552.4**	**17,418.3**	**1,716.2**	**2,467.0**	**4,183.2**	**-**	**294,125.0**	**2,018.2**	**59,317.8**	**213,663.7**	**10,942.1**	**1,570.6**	**2,612.6**	**-**	**290,125.0**	**(4,000.0)**	**-**	

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2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jun-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Provide Service Extensions - All Service Areas	-	-	-	-	-	4,900.0	4,900.0	-	4,900.0	-	-	-	-	1,393.7	3,506.3	-	4,900.0	-	-	
Provide Service Extensions - All Service Areas - CIAC	-	-	-	-	-	(200.0)	(200.0)	-	(200.0)	-	-	-	-	(42.9)	(157.1)	-	(200.0)	-	-	
Upgrade Distribution Systems - All Service Areas	-	-	-	-	-	3,565.0	3,565.0	-	3,565.0	-	-	-	-	1,619.1	1,945.9	-	3,565.0	-	-	
Upgrade Distribution Systems - All Service Areas - CIAC	-	-	-	-	-	(95.0)	(95.0)	-	(95.0)	-	-	-	-	(23.4)	(71.6)	-	(95.0)	-	-	
Distribution System Upgrades - Various Sites	-	-	-	-	-	390.8	390.8	5,490.1	5,880.9	-	-	-	-	62.6	328.2	5,490.1	5,880.9	-	-	
Condition Assessment for Submarine Cable - Farewell Head to Change Islands	-	-	-	-	-	300.1	300.1	-	300.1	-	-	-	-	0.3	299.8	-	300.1	-	-	
Additions for Load - Distribution System	-	-	-	-	-	186.7	186.7	-	186.7	-	-	-	-	9.9	176.8	-	186.7	-	-	
Install Recloser Remote Control (2019-2020) - Rocky Harbour	-	-	-	-	-	66.1	66.1	319.9	386.0	-	-	-	-	8.6	57.5	319.9	386.0	-	-	
2018 Projects																				
Distribution System Upgrades - Various Sites	-	-	-	383.8	190.2	2,771.2	2,961.4	-	3,155.0	-	-	-	193.6	769.6	2,191.8	-	3,155.0	-	-	
Install Recloser Remote Control - English Harbour West and Barachoix	-	-	-	63.7	49.9	275.0	324.9	-	338.7	-	-	-	13.8	130.0	120.9	-	264.7	(74.0)	(74.0)	
Total Distribution Projects	-	-	-	447.5	240.1	12,159.9	12,400.0	5,810.0	18,417.4	-	-	-	207.4	3,927.5	8,398.5	5,810.0	18,343.4	(74.0)	(74.0)	

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2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Overhaul Diesel Units - Various	-	-	-	-	-	2,511.3	2,511.3	-	2,511.3	-	-	-	-	584.3	1,927.0	-	2,511.3	-	-	
Additions for Load - Isolated Generation Systems	-	-	-	-	-	1,523.6	1,523.6	658.9	2,182.5	-	-	-	-	191.5	1,771.6	658.9	2,622.0	439.5	439.5	15
Diesel Plant Fire Protection (2019-2020)	-	-	-	-	-	377.2	377.2	1,540.2	1,917.4	-	-	-	-	-	-	-	-	(1,917.4)	(377.2)	16
Upgrade Diesel Plant Building - Ramea	-	-	-	-	-	352.5	352.5	-	352.5	-	-	-	-	23.3	329.2	-	352.5	-	-	
Replace Human Machine Interface - Cartwright	-	-	-	-	-	306.9	306.9	-	306.9	-	-	-	-	118.7	188.2	-	306.9	-	-	
Inspect Fuel Storage Tanks - Gray River	-	-	-	-	-	203.1	203.1	-	203.1	-	-	-	-	145.0	178.1	-	323.1	120.0	120.0	17
Diesel Genset Replacements (2019-2020)	-	-	-	-	-	525.6	525.6	3,421.8	3,947.4	-	-	-	-	28.9	496.7	3,421.8	3,947.4	-	-	
2018 Projects																				
Diesel Plant Engine Cooling System Upgrades - Various Sites	-	-	-	638.4	489.1	671.6	1,160.7	-	1,310.0	-	-	-	149.3	525.3	635.4	-	1,310.0	-	-	
Upgrade Ventilation - Cartwright	-	-	-	465.7	419.2	-	419.2	-	465.7	-	-	-	46.5	126.5	292.7	-	465.7	-	-	
Diesel Plant Fire Protection - Postville	-	-	-	505.6	468.4	336.4	804.8	-	842.0	-	-	-	37.2	86.0	718.8	-	842.0	-	-	
Inspect Fuel Storage Tanks - Black Tickle	-	-	-	818.7	337.0	-	337.0	-	818.7	-	-	-	481.7	55.4	505.1	-	1,042.2	223.5	223.5	18
Replace Secondary Containment System Liner - Nain	-	-	-	1,639.2	2,471.7	1,450.4	3,922.1	-	3,089.6	-	-	-	672.5	410.1	3,512.0	-	4,594.6	1,505.0	-	19
Diesel Genset Replacements - Makkovik	-	-	-	604.1	(981.0)	4,703.3	3,722.3	3,592.8	8,900.2	-	-	-	1,585.1	383.1	3,339.2	3,592.8	8,900.2	-	-	
Replace Automation Equipment - St. Anthony	-	-	-	307.4	180.2	1,565.9	1,746.1	-	1,873.3	-	-	-	127.2	514.4	1,231.7	-	1,873.3	-	0.0	
Total Rural Generation Projects	-	-	-	4,979.1	3,384.6	14,527.8	17,912.4	9,213.7	28,720.6	-	-	-	3,099.5	3,192.5	15,125.7	7,673.5	29,091.2	370.6	405.8	

2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Install Pole Storage Ramps - Wabush	-	-	-	-	-	301.7	301.7	-	301.7	-	-	-	-	30.3	271.40	-	301.7	-	-	
Upgrade Line Depots - Roddickton	-	-	-	-	-	344.7	344.7	-	344.7	-	-	-	-	46.0	298.70	-	344.7	-	-	
2018 Projects																				
Install Energy Efficiency Lighting in Diesel Plants - Various	-	-	-	104.0	36.0	119.0	155.0	122.2	345.2	-	-	-	68.0	38.0	117.00	122.2	345.2	-	-	
2017 Projects																				
Construct New Facilities - Various Sites	-	-	422.0	1,034.1	449.9	-	449.9	-	1,456.1	-	-	237.8	429.8	18.7	431.20	-	1,117.5	(338.6)	-	20
Total Properties Projects	**-**	**-**	**422.0**	**1,138.1**	**485.9**	**765.4**	**1,251.3**	**122.2**	**2,447.7**	**-**	**-**	**237.8**	**497.8**	**133.0**	**1,118.3**	**122.2**	**2,109.1**	**(338.6)**	**-**	

2019 Capital Expenditures By Category
($000)

Metering 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Purchase Meters and Metering Equipment - Various	-	-	-	-	-	196.4	196.4	-	196.4	-	-	-	-	39.7	156.7	-	196.4	-	-	
Total Metering Projects	**-**	**-**	**-**	**-**	**-**	**196.4**	**196.4**	**-**	**196.4**	**-**	**-**	**-**	**-**	**39.7**	**156.7**	**-**	**196.4**	**-**	**-**	

2019 Capital Expenditures By Category
($000)

Information Systems Projects	Capital Budget									Actual Expenditure and Forecast								K-F	H-D	
	A				B	C	D	E	F (A+C+E)	G				H	I	J	K (G+H+I+J)			
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Replace Personal Computers - Hydro Place	-	-	-	-	-	496.0	496.0	-	496.0	-	-	-	-	108.8	387.2	-	496.0	-	-	
Replace Peripheral Infrastructure - Hydro Place	-	-	-	-	-	221.8	221.8	-	221.8	-	-	-	-	32.3	189.5	-	221.8	-	-	
Upgrade Core IT Infrastructure - Hydro Place	-	-	-	-	-	359.4	359.4	-	359.4	-	-	-	-	5.9	353.5	-	359.4	-	-	
Upgrade Software Applications - Hydro Place	-	-	-	-	-	110.4	110.4	-	110.4	-	-	-	-	1.2	109.2	-	110.4	-	-	
Refresh Security Software - Hydro Place	-	-	-	-	-	90.7	90.7	-	90.7	-	-	-	-	0.6	90.1	-	90.7	-	-	
Perform Minor Enhancements - Hydro Place	-	-	-	-	-	47.1	47.1	-	47.1	-	-	-	-	14.8	32.3	-	47.1	-	-	
Upgrade Energy Management System - Hydro Place	-	-	-	-	-	271.7	271.7	-	271.7	-	-	-	-	99.4	172.3	-	271.7	-	-	
Total Information Systems Projects	-	-	-	-	-	1,597.1	1,597.1	-	1,597.1	-	-	-	-	263.0	1,334.1	-	1,597.1	-	-	

newfoundland labrador hydro
a nalcor energy company

2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Replace Light Duty Mobile Equipment - Various Sites	-	-	-	-	-	469.6	469.6	-	469.6	-	-	-	-	63.4	406.2	-	469.6	-	-	
Tools and Equipment Less than $50,000	-	-	-	-	-	373.2	373.2	-	373.2	-	-	-	-	47.5	325.7	-	373.2	-	-	
2018 Projects																				
Replace Off-Road Track Vehicles - Bishop's Falls and Bay d'Espoir	-	-	-	213.7	(35.8)	986.3	950.5	-	1,200.0	-	-	-	249.5	250.0	700.5	-	1,200.0	-	-	
Total Tools and Equipment	**-**	**-**	**-**	**213.7**	**(35.8)**	**1,829.1**	**1,793.3**	**-**	**2,042.8**	**-**	**-**	**-**	**249.5**	**360.9**	**1,432.4**	**-**	**2,042.8**	**-**	**-**	

2019 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Upgrade Telecontrol Facilities - Gull Pond Hill and Bay d'Espoir Hill	-	-	-	-	-	96.3	96.3	577.6	673.9	-	-	-	-	8.5	87.8	577.6	673.9	-	-	
Replace Teleprotection - TL 202 & TL 206	-	-	-	-	-	196.8	196.8	-	196.8	-	-	-	-	28.0	168.8	-	196.8	-	-	
Replace Network Communications Equipment - Various	-	-	-	-	-	189.5	189.5	-	189.5	-	-	-	-	111.8	77.7	-	189.5	-	-	
Upgrade Site Facilities - Various	-	-	-	-	-	49.4	49.4	-	49.4	-	-	-	-	49.2	0.2	-	49.4	-	-	
Replace Radomes - Various	-	-	-	-	-	263.5	263.5	-	263.5	-	-	-	-	21.9	241.6	-	263.5	-	-	
Upgrade Remote Terminal Units - Various	-	-	-	-	-	167.7	167.7	-	167.7	-	-	-	-	96.3	71.4	-	167.7	-	-	
Purchase Tools and Equipment less than $50,000	-	-	-	-	-	45.6	45.6	-	45.6	-	-	-	-	15.1	30.5	-	45.6	-	-	
2018 Projects																				
Replace PBX Phone Systems - Various	-	-	-	91.7	(43.2)	1,150.6	1,107.4	-	1,242.3	-	-	-	134.9	174.2	933.2	-	1,242.3	-	-	
Replace MDR 6000 Microwave Radio - Various	-	-	-	64.0	(17.5)	1,137.0	1,119.5	-	1,201.0	-	-	-	81.5	671.8	447.7	-	1,201.0	-	-	
Replace Teleprotection - TL261	-	-	-	57.6	(2.5)	459.8	457.3	-	517.4	-	-	-	60.1	256.1	201.2	-	517.4	-	-	
Replace Battery Banks and Chargers - Various	-	-	-	382.1	150.8	555.8	706.6	-	937.9	-	-	-	231.3	120.0	586.6	-	937.9	-	-	
Total Telecontrol Projects	**-**	**-**	**-**	**595.4**	**87.6**	**4,312.0**	**4,399.6**	**577.6**	**5,485.0**	**-**	**-**	**-**	**507.8**	**1,552.9**	**2,846.7**	**577.6**	**5,485.0**	**-**	**-**	

2019 Capital Expenditures By Category
($000)

Transportation

	A				B	C	D	E	F (A+C+E)	G				H	I	J	K (G+H+I+J)	K-F	H-D	
	Capital Budget									Actual Expenditure and Forecast										
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Replace Vehicles and Aerial Devices - Various Sites	-	-	-	-	-	1,248.1	1,248.1	594.9	1,843.0	-	-	-	-	4.5	1,243.60	594.9	1,843.0	-	-	
2018 Projects																				
Replace Vehicles and Aerial Devices - Various Sites	-	-	-	1,667.2	502.1	753.7	1,255.8	-	2,420.9	-	-	-	1,165.1	491.5	764.30	-	2,420.9	-	-	
Total Transportation	**-**	**-**	**-**	**1,667.2**	**502.1**	**2,001.8**	**2,503.9**	**594.9**	**4,263.9**	**-**	**-**	**-**	**1,165.1**	**496.0**	**2,007.9**	**594.9**	**4,263.9**	**-**	**-**	

Administration

	A				B	C	D	E	F (A+C+E)	G				H	I	J	K (G+H+I+J)	K-F	H-D	
	Capital Budget									Actual Expenditure and Forecast										
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2018	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Remove Safety Hazards - Various	-	-	-	-	-	197.5	197.5	-	197.5	-	-	-	-	9.7	187.8	-	197.5	-	-	
Security Improvements - Hydro Place	-	-	-	-	-	47.1	47.1	-	47.1	-	-	-	-	1.2	45.9	-	47.1	-	-	
Purchase Office Equipment	-	-	-	-	-	38.0	38.0	-	38.0	-	-	-	-	0.7	37.3	-	38.0	-	-	
2018 Projects																				
Upgrade Exterior of Building - Hydro Place	-	-	-	260.2	27.6	405.7	433.3	-	665.9	-	-	-	232.6	22.8	410.5	-	665.9	-	-	
Total Administration	**-**	**-**	**-**	**260.2**	**27.6**	**688.3**	**715.9**	**-**	**948.5**	**-**	**-**	**-**	**232.6**	**34.4**	**681.5**	**-**	**948.5**	**-**	**-**	

2019 Capital Expenditures By Category
($000)

Allowance For Unforeseen

	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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Contingency Fund	-	-	-	-	-	1,000.0	1,000.0	-	1,000.0	-	-	-	-	-	1,000.0	-	1,000.0	-	-	
Replace Engine #2051 - Rigolet	-	-	-	-	-	-	-	-	-	-	-	-	-	533.4	(533.4)	-	-	-	-	
Allowance for Unforeseen - Top Up P.U. 7 (2019)	-	-	-	-	-	600.0	600.0	-	600.0	-	-	-	-	-	600.0	-	600.0	-	-	
Total Allowance For Unforeseen	-	-	-	-	-	1,600.0	1,600.0	-	1,600.0	-	-	-	-	533.4	1,066.6	-	1,600.0	-	-	

Supplemental 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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Muskrat Falls to Happy Valley Interconnection	-	-	-	-	-	12,586.4	12,586.4	7,392.1	19,978.5	-	-	-	-	1,642.8	10,943.6	7,392.1	19,978.5	-	-	
Hinds Lake Unit Major Overhaul	-	-	-	-	-	259.5	259.5	-	259.5	-	-	-	-	-	259.5	-	259.5	-	-	
Level II Condition Assessments - Bay d'Espoir Penstock 4, Granite Canal and Hinds Lake Penstocks	-	-	-	-	-	414.3	414.3	-	414.3	-	-	-	-	7.7	406.6	-	414.3	-	-	
2018 Projects																				
Penstock Condition Assessments - Bay d'Espoir	-	-	-	1,120.6	223.8	-	223.8	-	1,120.6	-	-	-	1,682.5	114.8	109.0	-	1,906.3	785.7	-	21
Mary's Harbour Hydro Integration	-	-	-	195.5	146.3	-	146.3	-	195.5	-	-	-	49.2	104.3	42.0	-	195.5	-	-	
Mary's Harbour Hydro Integration - CIAC	-	-	-	(195.5)	(195.5)	-	(195.5)	-	(195.5)	-	-	-	-	(195.5)	-	-	(195.5)	-	-	
TL 226 and TL 239 Reroute	-	-	-	712.3	132.5	220.1	352.6	-	932.4	-	-	-	579.8	370.6	-	-	950.4	18.0	18.0	
Total Supplemental Projects Approved by the Board	-	-	-	1,832.9	307.1	13,480.3	13,787.4	7,392.1	22,705.3	-	-	-	2,311.5	2,044.7	11,760.7	7,392.1	23,509.0	803.7	18.0	

Projects Less than $50,000

	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	H-D	
	2015	2016	2017	2018	Carryover to 2019	Original 2019	Revised 2019	2020 and Beyond	Total	2015	2016	2017	2018	YTD 2019	Forecast Jul-Dec 2019	2020 and Beyond	Total	Project Variance	Annual Variance	Notes
2019 Projects																				
Building Vestibule Powerhouse - Holyrood	-	-	-	-	-	49.3	49.3	-	49.3	-	-	-	-	37.2	12.1	-	49.3	-	-	
Procure Spare Fuel Shut-Off Valve - Happy Valley Gas Turbine	-	-	-	-	-	31.2	31.2	-	31.2	-	-	-	-	24.0	7.2	-	31.2	-	-	
Unit 3 Electrical Testing - Holyrood	-	-	-	-	-	39.1	39.1	-	39.1	-	-	-	-	32.0	7.1	-	39.1	-	-	
Tanks 3 & 4 Life Expectancy Study - Holyrood	-	-	-	-	-	48.3	48.3	-	48.3	-	-	-	-	10.3	38.0	-	48.3	-	-	
Replace Silencer and Electrical Cables - Rigolet	-	-	-	-	-	47.3	47.3	-	47.3	-	-	-	-	-	47.3	-	47.3	-	-	
Total Projects Less than $50,000	-	-	-	-	-	215.2	215.2	-	215.2	-	-	-	-	103.5	111.7	-	215.2	-	-	

2.0 Variance Explanations

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 annual Capital Expenditures and Carryover Report when annual expenditures are final. All variance amounts are presented in thousands ($000).

2.1 Hydraulic Generation Projects

1) Refurbish Backfill on Penstock No. 1 – Bay d'Espoir

Original Budget: 1,630.4 **Forecast to Completion:** 74.7 **Variance:** (1,557.7)

This is a one-year project that commenced in 2018, carried over into 2019, and was subsequently canceled. An engineering consultant's report in 2018 concerning a failure of Bay d'Espoir Penstock 1 recommended suspending work on refurbishment of the backfill until completion of a condition assessment of Penstocks 1, 2 and 3. The condition assessment report, finalized in 2019, included a recommendation that refurbishment of the penstocks be completed within the next three to five years. Completing the backfill refurbishment at the same time as the future penstock refurbishment is the most cost efficient approach to execute the work. The engineering consultant confirmed that deferring the backfill work for three to five years does not introduce any material risk to the asset. Backfill refurbishment for Penstock 1 will be included in the scope of the future penstock refurbishment project.

2) Hydraulic Generation Refurbishment and Modernization - Various

Original Budget: 14,608.5 **Forecast to Completion:** 12,718.1 **Variance:** (1,890.4)

This is a two-year project (2018–2019) that commenced in 2018. The forecast variance in total project expenditures is primarily attributed to a reduced effort required for the Bay d'Espoir Unit 2 turbine overhaul. Upon disassembly of the unit in 2018, it was found that the discharge wear ring could be refurbished in-place, rather than be replaced, resulting in savings to materials and labour costs.

3) Control Structure Refurbishments

Original Budget: 2,188.2 **Forecast to Completion:** 1,844.8 **Variance:** (343.4)

This is a two-year project (2017–2018) that commenced in 2017 and has carried over into 2019. The project scope includes refurbishment work at four water control structures. The work was completed in 2018 at three of the locations (North Salmon Spillway Structure, Granite Canal Intake Structure, and Ebbegunbaeg Control Structure); however, the work for Burnt Dam was rescheduled to 2019 due to a delay in completing the engineering design. The forecast variance in total project expenditure is attributed to the internal labour and contract costs being less than originally estimated.

4) Upgrade Work – Cat Arm

Original Budget: 1,911.3 **Forecast to Completion:** 2,567.3 **Variance:** 656.0

This is a two-year project (2016–2017) that commenced in 2016 and has been carried over into 2019. One aspect of the project scope is the purchase and installation of two deflector servomotors. These servomotors have a long lead time and could not be ordered until an existing servomotor of the same design was installed, tested, and proven to meet the performance specifications. The existing servomotor was installed in September 2018 and determined to meet the performance specifications. The new servomotors were ordered in 2018, received in 2019, and will be installed during scheduled outages in 2019.

Another aspect of the project scope was to refurbish the spherical valve control system. The forecast variance in total project expenditures is associated with this scope. In particular, it is attributed to increased material requirements identified during detailed engineering design. As well, there were cost increases as a result of a change in construction strategy from the original plan of internal labour to the use of a contractor due to unavailability of internal resources. This scope was completed in 2018.

5) Rehabilitate Shoreline Protection - Cat Arm

Original Budget: 1,142.9 **Forecast to Completion:** 0 **Variance:** (1,142.9)

This is a two-year project (2016–2017) that commenced in 2016, carried over into 2019 and was subsequently canceled. During project planning, it was determined that there is risk of rock fall from the adjacent cliff into the construction zone. The identification of the necessity for risk mitigation to ensure a safe work site resulted in a pause on the project to estimate the associated cost and, if necessary, re-evaluate the project alternatives. A site survey was completed in September 2018 and a cost estimate for mitigation of the safety hazard was completed in December 2018. These costs were used in 2019 to update the project estimate and re-evaluate the cost benefit analysis of project alternatives. The updated analysis showed that the planned shoreline rehabilitation is no longer the least cost alternative. Therefore, the capital project was canceled in the second quarter of 2019. The shoreline erosion will continue to be monitored and any required remedial work will be undertaken as an operating expense.

6) Replace Pump House and Associated Equipment - Bay d'Espoir

Original Budget:	545.2	**Forecast to Completion:**	1,049.7	**Variance:**	504.5

This is a two-year project (2015–2016) that carried over into 2019. The forecast variance in total project expenditures is attributed to higher than expected construction costs. Construction was originally tendered in 2016, but was not awarded since tendered prices were significantly higher than the budget. A reassessment of the design and execution strategy was undertaken, but did not result in any anticipated material savings. Replacement of the pump house became critical after damage sustained from flooding during Hurricane Matthew in 2016. The work was retendered and construction began in the summer of 2018. Delivery of the prefabricated pump house building was late in 2018 resulting in carry over of the final construction activity to 2019. The project is substantially complete.

2.2 Thermal Generation Projects

7) Overhaul Unit 3 Turbine Valve – Holyrood

Original Budget:	3,290.5	**Forecast to Completion:**	2,690.5	**Variance:**	(600.0)

This is a one-year project that commenced in 2019. The original project budget was based on historical valve overhaul costs. The extent of work required for a valve overhaul can only be determined after the valve is removed from service and disassembled for inspection, during the project execution. In this case, the extent of required refurbishment following valve disassembly was less than originally estimated.

8) Condition Assessment and Miscellaneous Upgrades – Holyrood

Original Budget: 1,968.8 **Forecast to Completion:** 3,207.8 **Variance:** 1,239.0

This is a one-year project that commenced in 2019. The original project scope of work, determined at the time of budget preparation, was based on best available asset condition information. Additional information was determined through inspections completed during generation unit outages in 2018. These inspections revealed that additional scope of work is required for the continued safe and reliable operation of the plant. The additional scope is primarily related to the air heaters, stack breeching, and economizer. Details regarding the additional scope are provided in Table 1. The forecast variance in total project expenditure is attributed to this additional scope.

2.3 Gas Turbine Generation Projects

9) Gas Turbine Equipment Replacement and Refurbishment - Hardwoods and Stephenville

Original Budget: 1,427.2 **Forecast to Completion:** 1,280.8 **Variance:** (146.4)

This is a two-year project (2018–2019) that commenced in 2018. The forecast variance in total project expenditures is attributed to lower than estimated tendered prices for the exhaust stack work.

10) Increase Fuel and Water Treatment System Capacity - Holyrood Gas Turbine

Original Budget: 11,842.6 **Forecast to Completion:** 6,814.2 **Variance:** (5,028.4)

This is a two-year project (2018–2019) that commenced in 2018. The forecast variance in total project expenditures is attributed to lower than estimated tendered prices for the fuel tank construction. At the time of budget preparation, Hydro requested contractor budget pricing, but the estimates were not received in time for inclusion in the project estimate prior to submission of the 2018 Capital Budget Application. In lieu of current contractor estimates, Hydro used historical cost data from the original plant construction.

2.4 Terminal Station Projects

11) Implement Terminal Station Flood Mitigation – Springdale

Original Budget: 974.0 **Forecast to Completion:** 1,270.4 **Variance:** 296.4

This is a two-year project (2018–2019) that commenced in 2018 and will be carried over into 2020. During engineering design, it was determined that the original project alternative to construct a retention berm outside of Hydro’s property would cost significantly more than originally estimated. Further evaluation of project alternatives in 2019 demonstrated that the construction of a retention berm along the perimeter of the terminal station could also effectively achieve the desired level of flood mitigation and is the least cost alternative. The change in project alternative resulted in a revised project estimate and carry over of the project construction into 2020, to allow for design and environmental assessment in 2019.

12) Replace Substation – Holyrood

Original Budget: 1,198.0 **Forecast to Completion:** 798.2 **Variance:** (399.8)

This is a two-year project (2017–2018) that has carried over into 2019. During project engineering, connection of a power supply from Newfoundland Power was identified as a viable alternative. This new alternative was estimated and determined to be the least-cost solution compared to the original project scope to construct a new substation. A new project scope and schedule was developed in coordination with Newfoundland Power, which includes construction activity in 2019. The forecast variance in total project expenditures is attributed to the change to the lower cost project alternative.

13) Terminal Station Refurbishment and Modernization (2017-2018) - Various Sites

Original Budget: 27,382.1 **Forecast to Completion:** 18,644.2 **Variance:** (8,737.9)

This is a two-year project (2017–2018) that commenced in 2017 and has carried over to 2019. The project includes a number of consolidated program-type terminal station projects across several sites. The forecast variance in total project expenditures is primarily associated with the refurbishment or replacement of power transformers and disconnect switches, for which a portion of the work was executed for less that originally estimated. As well, there was some scope reduction as new asset condition information became available. The following scope has been deferred and will be executed as part of the 2018-2019 Terminal Station Refurbishment and Modernization project, which has sufficient budget for this work:

- Bushing replacements for Holyrood Transformers T5 and Bay d'Espoir Transformer T10;
- Transformer dehydrators for Happy Valley Transformer T3 and Oxen Pond Transformer T2;
- Replacement of four disconnect switches at Western Avalon, Sunnyside, and Holyrood, due to system outage limitations;
- Construction activity for the breaker failure protection at Berry Hill and Peter's Barren, due to a review of alternatives for the telecommunications requirements of the project; and
- Grounding system upgrades at three terminal stations, due to more complex designs required to address exceptionally high ground potential rise at these locations.

14) Install Breaker Failure Protection – Various Sites

Original Budget: 277.0 **Forecast to Completion:** 761.6 **Variance:** 484.6

This is a two-year project (2016–2017) that has carried over to 2019. The forecast variance in total project expenditures is attributed to higher than estimated engineering, procurement, and construction costs. During the design phase of the project, revisions to Hydro's design standard for breaker failure protection were required. The changes to the standard were made to address lessons learned from system events. The updated standard significantly impacted the overall design for breaker failure protection. This increased the engineering design effort on this project and resulted in increased procurement and construction costs due to the requirement for additional components to adhere to the new standard. A requirement for additional telecommunications cabling was identified for the work at Howley, Indian River, and Deer Lake.

2.5 Rural Generation Projects

15) Additions for Load - Isolated Generation Systems

Original Budget: 2,182.5 **Forecast to Completion:** 2,622.0 **Variance:** 439.5

This is a two-year project (2019–2020) that commenced in 2019. This project involves the construction of a new vertical fuel storage tank and associated earth dyke upgrades in Makkovik. The forecast variance in total project expenditures is primarily attributed to an increased quantity of earthwork required to complete upgrades to the existing dyke, identified during engineering design. As well, tendered prices for mobilization and the tank construction were higher than originally estimated. Prior to contract award, an updated net present value of project alternatives was completed and it was confirmed that this alternative remains least cost.

16) Diesel Plant Fire Protection (2019-2020)

Original Budget:	1,917.4	**Forecast to Completion:**	0	**Variance:**	(1,917.4)

This was a two-year project (2019-2020) for Black Tickle that has been canceled. An updated risk ranking for diesel plant fire protection, to reflect changing demographics in the community of Black Tickle, resolved that the project is no longer justified at this time.

17) Inspect Fuel Storage Tanks - Gray River

Original Budget:	203.1	**Forecast to Completion:**	323.1	**Variance:**	120.0

This is a single-year project that commenced in 2019. The internal inspections of two fuel storage tanks in Grey River were completed in 2019 as planned, in accordance with the provincial Storage and Handling of Gasoline and Associated Products Regulations, 2003 under the Environmental Protection Act (O.C. 2003-225). One tank did not pass inspection and could not be returned to service and the second tank was recommended for replacement within one year. The project scope was revised to include the replacement of both tanks in 2019. The forecast variance in total project expenditures is attributed to this new scope.

18) Inspect Fuel Storage Tanks - Black Tickle

Original Budget:	818.7	**Forecast to Completion:**	1,042.2	**Variance:**	223.5

This is a one year project that commenced in 2018 and has been carried over into 2019. The internal inspections of two fuel storage tanks in Black Tickle were completed in 2018 as planned, in accordance with the provincial Storage and Handling of Gasoline and Associated Products Regulations, 2003 under the Environmental Protection Act (O.C. 2003-225). The inspection for one of the tanks revealed that minor refurbishment was required and this refurbishment was completed in 2018. The inspection of the second tank revealed that a complete tank bottom replacement was required. Materials were ordered and the tank bottom replacement has been scheduled for 2019. In 2018, it was estimated that there was sufficient budget remaining in the project to complete the tank bottom replacement. In the first quarter of 2019, the work was publically tendered and the tendered price was higher than the estimate. The forecast variance in total project expenditures is attributed to the additional scope to replace the tank bottom for one of the tanks.

19) Replace Secondary Containment System Liner – Nain

Original Budget: 3,089.6 **Forecast to Completion:** 4,594.6 **Variance:** 1,505.0

This is a two-year project (2018–2019) that commenced in 2018. The planned scope was to relocate all four existing fuel storage tanks to facilitate replacement of the secondary containment system liner. A constructability review of the planned scope was completed early in the project design phase, identifying a risk to cost and schedule. The risk associated with the work required to move the tanks during liner replacement warranted consideration, given that three small tanks are 45 years old and had unknown refurbishment requirements. Instead of removing, refurbishing, and reinstalling the three old tanks, there was an alternative to remove the three tanks and construct a new vertical fuel storage tank. Both alternatives were studied and it was concluded that the estimated cost is not materially different, but the risks to project cost, schedule, and asset integrity were materially higher for moving, refurbishing, and reinstalling the old tanks, compared to the alternative to construct a new tank. A decision was made to proceed with the alternative to construct a new tank.

The forecast variance in total project expenditures is due to higher than estimated cost for civil construction. With the completion of the geotechnical study and detailed design in 2018, it was determined that significantly more earthworks would be required to replace the dyke liner and provide the required foundation support for the tanks. This additional work is required regardless of the decision between the replacement or refurbishment of the tanks. Additionally, publically tendered pricing for the construction was higher than estimated.

2.6 Properties Projects

20) Construct New Facilities - Various Sites

Original Budget:	1,456.1	**Forecast to Completion:**	1,117.5	**Variance:**	(338.6)

This is a two-year project (2017–2018) that commenced in 2017 and has carried over to 2019. The project scope consists of the construction of storage buildings at the Makkovik and Charlottetown Diesel Plants. The Charlottetown storage building was constructed in 2017. The Makkovik storage building construction has been rescheduled from 2018 to 2019, to be completed in conjunction with a diesel plant building and yard extension. The diesel plant building and yard extension is part of the scope of a separate project, approved in Board Order No. P.U. 43(2017), to replace a diesel generator set. Completing these projects together will optimize the use of available space on the property, reduce the risk of design conflicts, and possibly result in cost savings.

2.7 Supplemental Projects

21) Penstock Condition Assessments - Bay d'Espoir

Original Budget:	1,120.6	**Forecast to Completion:**	1,906.3	**Variance:**	785.7

This is a one-year supplemental capital project that was approved in 2018 and carried over into 2019. The requirement to complete unforeseen work on Penstock 3 (a separate project under the Allowance for Unforeseen Items) led to a revised generation outage schedule, which resulted in the field work for this project being completed later in the year than originally planned. The field work was completed and Hydro collected operational data through the fall and winter of 2018–2019. The engineering reports, that are the final deliverable of this project, will be produced in 2019. The forecast variance in total project expenditures is attributed to higher than expected contract tender prices for the field work completed in 2018.

Table 1: Condition Assessment and Miscellaneous Upgrades – Holyrood Thermal Generating Station

Item	Description	Cost ($000)	Scope of Work and Justification
1	Refurbish east and west air heater guide bearing assembly, Units 1, 2 and 3	452.0	In 2018, there was a failure of an air heater guide bearing trunnion shaft and a separate failure of a guide bearing pot. Following these failures, it was determined that all air heater trunnion shafts, seals, and pots should be replaced and rotors balanced, for the air heaters on Units 1, 2 and 3. Failure of an air heater bearing could lead to a forced unit outage.
2	Replace vertical stack breeching expansion joint and flanges, Unit 2	297.0	In 2019, Unit 2 stack breeching was inspected and the expansion joint and flanges were determined to be deteriorated. Replacement in 2019 is required.
3	Replace economizer skin casing and refractory, Unit 1	189.0	In 2018, gas leaks were identified on the Unit 1 economizer. A temporary repair was completed in 2018 and replacement of the deteriorated components is required in 2019.
4	Replace east & west forced draft fan inlet screens and dampers, Unit 1 and Unit 2	130.0	In 2018, fan inlet screens and dampers were inspected and determined to be corroded and impeding movement of the inlet dampers. This results in air flow reduction, which could lead to a forced unit outage. As well, corroded pieces could fall down into the air duct causing damage or disruption to the operation of the fan rotor or variable inlet vanes. Replacement of the screens and dampers is required in 2019.
5	Replace air heater gas inlet fabric expansion joints, Unit 3	101.0	In early 2019, the Unit 3 air heater gas inlet fabric expansion joint was inspected and determined to be deteriorated. Replacement in 2019 is required.
6	Replace fuel oil anti-freeze pot piping, Units 1 and 2	32.0	In 2018, fuel oil anti-freeze pot piping was inspected and found to be partially plugged with debris. Replacement of plugged sections of piping is required in 2019. This piping is connected to instrumentation used for fuel oil pressure control. Failure could result in fuel oil being emitted from stacks.

Item	Description	Cost ($000)	Scope of Work and Justification
7	Inspection and condition assessment of forced draft fans, Unit 1	26.0	In 2018, FM Global, Hydro's insurance provider, conducted a site review and recommended inspection of the Unit 1 forced draft fans by the original equipment manufacturer in 2019. Hydro accepted this recommendation.
8	Replace air heater water wash header and nozzles, Unit 2	12.0	In 2018, it was discovered that the air heater water wash header and nozzles were not functioning properly. A header with a different type of nozzle will be installed in 2019 to correct the problem.
Total		**1,239.0**	

2.8 Terminal Station In-Service Failures

Original Budget: 1,000.0 **Current Projects (Table 2):** 1,161.0

Table 2: Terminal Station In-Service Failures

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Circuit Breaker B3T5 Replacement, Bay d'Espoir Terminal Station 1	625.0	Unit 5 at Bay d'Espoir was being prepared for synchronization with both sides of circuit breaker B3T5 being energized. Before automatic synchronization was initiated, the system experienced a B Phase voltage dip of approximately 20 to 30 kV and Transformer T5 tripped an overcurrent relay. The overcurrent relay then commanded breaker B3T5 to open, but it was already in the open position. As a result, breaker failure protection operated and cleared Bus 3 (1.3 seconds later) which included both Unit 5 and Unit 6. Upon further review of the fault records it was determined the breaker had passed current on phase B indicating an internal flash over. Further Doble testing, SF_6 gas quality testing and follow up with the original equipment manufacturer's engineering team confirmed there was an internal flashover of phase B and the breaker required replacement.	Breaker B3T5 was replaced. The original equipment manufacturer will refurbish the failed circuit breaker at a cost to Hydro for only the transportation to and from the factory. The refurbished breaker will serve as a spare.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Station Service Transformer SS2 Replacement, Wabush Terminal Station	306.0	Station Service Transformer SS2 failed due to an internal fault. The fault resulted in damage that open-circuited phases of the winding. This station service transformer requires replacement in order to restore station service transformer redundancy and also provide a grounding source for Bus 15 and Bus 16. In the Wabush Terminal Station, with one station service transformer out of service and the grounding source removed from Bus 15 and Bus 16, the tie breaker must be closed resulting in only one Synchronous Condenser being operational. This in turn causes a reduction in the load that can be supplied to Labrador West and possible load restrictions to IOCC.	Replacement of Wabush Terminal Station Service Transformer SS2 is scheduled.
Purchase Spare Current Transformers, Churchill Falls	88.0	One spare 230 kV CT and one spare 230 kV CT/PT combination unit is required for the stand-by equipment pool due to the long lead time to acquire these units from the manufacturer. Acquisition of a replacement unit could take up to 18 months. This delay could result in long term outage to customers and reduced system reliability.	One spare 230 kV CT and one spare 230 kV CT/PT combination unit were ordered for the stand by equipment pool. The order for these long lead items was placed in late 2017 with delivery due this year.
Disconnect L12-1/L12-G1 Replacement, Bay L'Argent Terminal Station	50.0	138kV L12-1/L12/G1 disconnect has a damaged ground switch, which is unrepairable. The disconnect switch is 50 years old and replacement parts are not readily available. Replacement of this disconnect switch with a spare disconnect from the standby equipment pool is required.	Replacement of the 138kV L12-1/L12/G1 disconnect has been scheduled.
69kV Breaker Refurbishment, Hawke's Bay Terminal Station	50.0	B1L21 is a 69kV circuit breaker that has been identified as leaking SF_6 gas to atmosphere. This is an environmental concern as SF_6 is a potent greenhouse gas. As well, leaking gas could result in a flashover of the breaker or a	Refurbishment of 69kV breaker B1L21 has been scheduled.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
		catastrophic failure resulting in loss of service to customers and compromising the integrity of the electrical system in the area.	
X1 Surge Arrestor Replacement, Bottom Brook Terminal Station	15.0	Surge arrester X1 on Bottom Brook transformer T1 failed on June 19, 2019 causing loss of power to the entire station leaving customers in Burgeo, Doyles, and Stephenville area without power for approximately 4 hours. Transformer T3 was brought online to restore power to the affected customers. Immediate replacement of the arrester is required to get T1 back into service. There was no obvious reason for this failure. On review by Protection and Control Engineering, an appropriate overvoltage rating for the surge arrestors in this installation is 115 kV, existing arresters are rated for 98 kV. It was therefore recommended that all 3 surge arrestors be replaced (X1, X2, and X3) to avoid a repeat event on the other phases.	X1, X2, and X3 surge arresters on Transformer T1 were replaced.
Compressor Replacement, Grand Falls Converter Station	13.0	Grand Falls Converter Station Compressor A failed on January 10, 2019 causing extensive damage to itself. An assessment concluded that it is not repairable and must be replaced.	A direct replacement compressor was purchased and replacement has been scheduled.
Upper Salmon Terminal Station L34T1 A-Phase Current Transformer Replacement	8.0	During an outage to Upper Salmon L34T1 an oil leak was identified under L34T1 A-Phase CT. Immediate replacement was required to prevent equipment failure, customer outage and/or collateral damage to other equipment.	L34T1 A-Phase CT was replaced.
Deer Lake Terminal Station B1L39 A-Phase Current Transformer Replacement	6.0	B1L39 at Deer Lake Terminal Station is a 138 kV current transformer that was installed in 1977 and is identified as leaking oil. Immediate replacement is required to prevent equipment failure and possible outage and/or collateral damages to other equipment.	B1L39 A-Phase CT was replaced.

1 ## 2.9 Thermal Generation In-Service Failures

Original Budget: 1,250.0 **Current Projects (Table 3):** 1,566.0

Table 3: Thermal Generation In-Service Failures

Project Title, Location	Expenditure ($000)	Failure Identified	Project Scope
Overhaul Dump Valves, Holyrood Units 1 & 2	300.0	In 2018 Hydro refurbished the hydraulic system for unit 1 and unit 2 control valves as an in-service failure. The refurbishment of the hydraulic systems consumed all of the capital spares in the standby pool. A review of the component failure rate resulted in an update to the standby spare strategy to increase the required number of available spares. In addition, the dump valves, air dryers, and external filters required replacement but were not able to be completed in 2018.	In 2019, the dump valves were refurbished, air dryers were replaced, and external filter units were replaced on Units 1 and 2. Hydraulic servo valves for stage 1 turbine hydraulic system were ordered and will be received in 2019 to serve as spares.
Procure Capital Spares, Holyrood Thermal Generating Station	243.0	The planned scope for the In Service Failures project for 2018 included the procurement of the following spare components, which are expected to be received in 2019: • Unit 3 Excitation Transformer • Auxiliary Board Transformer • DC Lube Oil Pump Motor	The identified capital spares were ordered and will be received in 2019.
Replace Capstan Access Platforms, Holyrood Marine Terminal	130.0	Inspection revealed that the four capstan extension platforms on the Marine Terminal have deteriorated due to corrosion and must be replaced.	The four capstan access extension platforms will be replaced in 2019.

Project Title, Location	Expenditure ($000)	Failure Identified	Project Scope
Control Valve Failure, Holyrood Unit 2	110.0	On April 12, 2019 while reducing load on Unit 2, the unit experienced a load rejection of 50 MW, causing multiple unstable boiler conditions including a low drum level, causing the unit to trip. During the unit stabilization following the trip, it was observed that the Main Turbine Control Valves were open 39%; these valves should close automatically following a trip. The hydraulic system was tested and verified to be in proper operation. An attempt was then made to stroke the Main Turbine Control Valves to the open/closed positions, and the valves could not be closed more than 39%, indicating that there was a physical obstruction of the Main Turbine Control Valves or the Hydraulic Cylinder.	The main turbine control valve camshafts were refurbished and the camshafts bearings and hydraulic ram were replaced in 2019.
Variable Frequency Drive Cell, Holyrood Thermal Generating Station	106.0	Six variable frequency drive cells failed in service, with no impact on unit production. The variable frequency drive system is able to handle one cell failure per phase without affecting production. However, if two cell failures occur on the same phase, a voltage imbalance will negatively impact the torque and speed of the Forced Draft Fan motor, thus reducing the amount of combustion air to the boiler and potentially tripping the generating unit.	The six failed cells were replaced using available spares. Three of the failed cells were refurbished and added to inventory as spares. The other three failed cells could not be refurbished; three new cells were purchased to replenish the available spares.
Fuel Oil Return Line, Holyrood Marine Terminal	105.0	The Marine Terminal 4 inch return line was replaced in 2018 as an in-service failure. There was insufficient time in 2018 to replace the heat tracing and insulation.	Installation of heat tracing and insulation was completed in 2019.

Project Title, Location	Expenditure ($000)	Failure Identified	Project Scope
Synchro Drive, Holyrood Unit 3	86.0	During the fall of 2018, plant personnel were not able to restart synchronous condenser operation of Unit 3 following a scheduled shutdown. Troubleshooting determined that the Mark VI controller had failed. This controller is obsolete.	The Mark VI controller was replaced with a Mark VIII controller.
Forced Draft Fan Bearing, Holyrood Unit 1	72.0	On June 17, 2018 the Unit 1 East forced draft fan inboard bearing liner failed, which led to a forced outage on Unit 1.	In 2018, the inboard bearing liner was replaced with an available spare and the journal (the bearing surface section of the fan shaft) was refurbished. A new liner was ordered in 2018 and received in 2019 to replace the liner drawn from inventory.
Variable Frequency Drive Blower Reinforcement Kit, Holyrood Thermal Generating Station	70.0	The forced draft fans have experienced several blower failures since the Variable Frequency Drives were installed. Further investigation into the cause of the blower failures determined that the bearings of the cooling fan motors had been failing due to vibration. The original equipment manufacturer recommended a blower reinforcement kit to address the bearing issues.	Six blower reinforcement kits will be purchased and installed in 2019.
Replace Fire Water Piping Isolation Valves, Holyrood Fire System	70.0	It has been determined that one of the isolation valves of the fire system is passing fluid and requires replacement.	The isolation valve and connected piping will be replaced in 2019.
East Fuel Oil Pump, Holyrood Unit 1	62.0	In February 2019, it was identified that Unit 1 was unable to achieve full load due to the East Heavy Fuel Oil Pump failing to meet performance requirements.	Unit 1 east heavy fuel oil pump was replaced in 2019.

Project Title, Location	Expenditure ($000)	Failure Identified	Project Scope
High Pressure Feed Water Valves, Holyrood Unit 2	50.0	During Unit 2 operation, leaking gate, check, and safety valves were discovered on the Unit 2 High Pressure Feed Water line.	High pressure feed water leaking valves and connected piping will be replaced in 2019.
Mass Flow Meter, Holyrood Unit 1	46.0	Online testing revealed that the meter and transmitter on Unit 1 was reporting incorrect fuel flows.	The Unit 1 fuel oil mass flowmeter and transmitter was replaced with an available spare. A new flowmeter and transmitter was purchased to replace those drawn from the capital spare pool.
Turbine Generator Cooler Control Valve, Holyrood Unit 1	40.0	A high temperature alarm was received on the Unit 1 Turbine Generator Cooling System. Upon investigation, it was determined that the high temperature of the system is being caused by binding of the control valve.	The Turbine Generator cooler control valve and actuator will be replaced in 2019.
Relay Room Condenser, Holyrood Thermal Generating Station	30.0	The tubes of the relay room condenser of one of the stage 1 air conditioning units were leaking. With the condenser bypassed, the air conditioning unit is not adequately cooling the Stage 1 Relay Room.	The relay room condenser was replaced in 2019.
Boom Deployment Moorings, Holyrood Marine Terminal	28.0	Two of the three boom deployment moorings on the Marine Terminal failed during a tanker delivery. Upon inspection of the anchors, chains, and buoys and it was determined that the boom deployment moorings all required replacement due to severe corrosion of the chains and deterioration of the concrete anchor structures.	All boom deployment moorings were replaced in 2019.

Project Title, Location	Expenditure ($000)	Failure Identified	Project Scope
Potential Transformers Capital Spares, Holyrood Thermal Generating Station	12.0	On December 9, 2018, two of the six potential transformers on the generator for Unit 1 failed and required replacement. Following this event, a review of the failure rate resulted in an update to the standby spare strategy to increase the number of available spares from two to six.	In December 2018, the two failed potential transformers were replaced with available spares. Six spare potential transformers and associated fuses were ordered and received in 2019.
Battery Cell Spare, Holyrood Thermal Generating Station	6.0	A review of the reliability of the existing battery bank system concluded that a four-cell spare is required to mitigate the risk of failure. On each battery bank, the batteries are connected in series such that the failure of one battery could result in the entire bank going out of service. To return the bank to operation, the failed battery can be bypassed temporarily. However, the bank would have to be removed from service again to replace the failed battery. By installing an on-site charger and spare four-cell battery, the failed battery could be replaced immediately, thus maintaining the reliability level of the three generating units.	A spare four-cell battery and charger will be purchased and installed as a hot standby critical spare.

1 ## 2.10 Hydraulic Generation In-Service Failures

Original Budget: 1,250.0 **Current Projects (Table 4):** 636.9

Table 4: Hydraulic Generation In-Service Failures

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Capital Spares, Hinds Lake and Cat Arm	305.0	Purchases for the stand-by pool were undertaken to allow fast responsive action to future failures of long lead time equipment: • Hinds Lake Service Station Transformer ($111.0) • Hinds Lake Bearing Oil Cooler/Turbine Cooler/Generator Air Cooler ($82.0) • Cat Arm Excitation Transformer ($80.0) • Hinds Lake Circuit Breaker ($32.0)	The following spare components are to be procured: Hinds Lake Service Station Transformer; Hinds Lake Bearing Oil Cooler, Turbine Cooler, and Generator Air Cooler; Cat Arm Excitation Transformer; and Hinds Lake Circuit Breaker
Fire Pump Replacement, Hinds Lake	80.0	The pump has been in service since 1980. The internal components of the pump as well as the casing have deteriorated to the point where the pump is no longer viable for continued operation, thus requiring immediate replacement.	A new fire pump to replace the Hinds Lake Fire Pump #2 is to be procured and installed.
Crane Bus Bar Replacement, Paradise River	70.0	The powerhouse crane conductor bars warped out of shape and no longer provide a safe electric power distribution pathway for the entire overhead crane.	A direct replacement of the bus bar system is to be procured and installed.
Partial Discharge Analyzer Replacement, Bay d'Espoir	55.9	The current Partial Discharge Analyzer has been in service for approximately 25 years and has been identified to be faulty with a broken communication port. This Partial Discharge Analyzer is obsolete and discontinued by manufacturer.	A new Partial Discharge Analyzer is to be procured.
Fire Panel Replacement, Granite Canal	50.0	The current fire alarm system has been in operation since 2002. Replacement parts are no longer available and the system has been indicating sensor faults due to failing alarm system components.	New fire alarm panels and field devices are to be procured and installed.

Project Title and Location	Expenditure ($000)	Failure Identified	Project Scope
Maintenance Air Compressor Replacement, Bay d'Espoir Powerhouse 1	40.0	The air compressor used for maintenance and as emergency back-up has seized and become non-operational.	A replacement air compressor is to be procured.
Control Room Air Conditioning Unit, Cat Arm	36.0	The control room air conditioning unit failed due to corroded copper tubing and fittings.	A replacement air conditioning unit was purchased in 2018 and will be installed in 2019.

2020 Capital Budget Application
2015 and 2016 Average Rate Base

Newfoundland and Labrador Hydro
2020 Capital Budget Application
2015 and 2016 Average Rate Base
($000)

	2016	2015
Total Capital Assets	1,788,401	1,671,550
Deduct Items Excluded from Rate Base		
Work in Progress	(89,698)	(29,171)
Asset Retirement Obligations (net of amortization)	465	(14,381)
Net Capital Assets **(A)**	1,699,168	1,627,998
Net Capital Assets, Previous Year **(B)**	1,627,998	1,468,388
Unadjusted Average Capital Assets **(C)**[1]	1,663,583	1,548,193
Deduct		
Average Net Capital Assets Excluded from Rate Base	(16,676)	(10,730)
Average Capital Assets	1,646,907	1,537,463
Cash Working Capital Allowance - Return 8	5,304	6,995
Fuel Inventory - Return 10	35,473	44,052
Supplies Inventory - Return 10	32,146	29,279
Average Deferred Charges - Return 11[2]	166,019	129,519
Average Rate Base at Year-End - Return 12	**1,885,849**	**1,747,308**

[1] $C = \frac{(A+B)}{2}$

[2] Updated to reflect the Board of Commissioners of Public Utilities approval of the Amended 2013 Prudence Compliance Application in Board Order No. P.U. 49(2016) and the 2017 General Rate Application in Board Order No. P.U. 16(2019) resulting in an increase in average deferred charges of $98.3 million in 2019 and $61.1 million in 2018. The increase relating to the Amended 2013 Prudence Compliance Application in Board Order No. P.U. 49(2016) is primarily due to the final approval of the 2014–2016 Cost Deferrals. The increase relating to the 2017 General Rate Application in Board Order No. P.U. 16(2019) is due to the approval of the 2015–2017 Supply Deferrals.