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October 19, 2017

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

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

Dear Ms. Blundon:

Re: Newfoundland and Labrador Hydro – 2018 Capital Budget Application

Please find enclosed the original plus 10 copies of Hydro's Written Submission with regard to its 2018 Capital Budget Application.

Should you have any questions, please contact the undersigned.

Michael Ladha
Legal Counsel & Assistant Corporate Secretary

ML/bs

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

2018 CAPITAL BUDGET APPLICATION
FINAL SUBMISSION

NEWFOUNDLAND AND LABRADOR HYDRO

October 19, 2017

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

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

1 Introduction

Newfoundland and Labrador Hydro ("Hydro") filed its 2018 Capital Budget Application ("Application") with the Board of Commissioners of Public Utilities (the "Board") on July 27, 2017 seeking approval under Section 41 of the *Public Utilities Act* (the "Act") of $206.2 million in capital expenditures. Hydro filed certain reports inadvertently omitted from the Application on August 24, 2017, and Revision 1 and Revision 2 to the Application on August 30, 2017 and September 27, 2017 respectively (the "Revisions").

Hydro seeks approval of its 2018 Capital Budget projects and in support of that Application and the Revisions, makes the following submissions.

2 Legislative Framework

Section 37 of the Act requires Hydro to provide electrical service and facilities that are safe and adequate and just and reasonable. Section 41 of the Act also requires Hydro to obtain approval from the Board for its annual capital budget. In addition, Section 3 of the *Electrical Power Control Act, 1994* requires that Hydro provide electrical service that is efficient, that is provided such that its customers have equitable access to an adequate supply of power, and that is provided at least cost consistent with reliable service.

Hydro submits that all of its projects that are before the Board in this Application, with the exception of the project being withdrawn as per Section 3.2 hereof, are reasonably required to meet Hydro's obligations under the Act and the *Electrical Power Control Act, 1994* to provide power and service to its customers that is reasonably safe and adequate and at the lowest possible cost consistent with reliable service.

3 Specific Projects

Hydro notes that the intervenors have made submissions about a number of specific projects that are the subject matter of the Application and, in addition, have made several other general comments regarding the capital budget process.

3.1 Holyrood Gas Turbine Projects

Volume I, Page C-8 - Increase Fuel and Water Treatment System Capacity

In its submission, Newfoundland Power did not take issue with the proposed expansion of the water treatment system and submitted that this aspect of the project should be approved. Newfoundland Power supported "reasonable expansion of the onsite fuel supply for the Holyrood Gas Turbine"; however, did take issue with the quantity of fuel storage proposed for the Holyrood Gas Turbine (the "Holyrood GT") and submitted that the evidence does not establish that an additional 2.5 million litres of fuel storage is required.

In response, Hydro refers to its response to PUB-NLH-23 which points out that fuel delivery delays up to 48 hours have been experienced twice in the past, as have other fuel delivery delays. Hydro considers that the identified risks to fuel deliveries during a significant winter event, when the Holyrood GT may be called upon as a primary electrical source and thus running at full capacity, is a risk to supply. The expansion and amount of increased on site fuel storage are in direct response to mitigation of the identified risks in fuel deliveries. As stated at Volume I, Page C-9 of the Application, increasing the on-site fuel storage to 5 million litres will ensure, when the tanks are full, that the Holyrood GT can generate at full capacity for 5 days without deliveries, or, for 10 days assuming normal delivery schedules are maintained. Hydro submits that these capabilities are prudent to ensure the unit is available to supply emergency power during a significant winter event. These capabilities are also consistent with the operational capabilities of the Hardwoods Gas Turbine as configured (PUB-NLH-021).

In addition, once the Holyrood Thermal Generating Station enters Phase 3 of operation, the Holyrood GT will be the largest emergency back-up generation source for the Avalon at 123 MW, and may be required for extended duration running at rated capacity as a primary power source in the event of extended system issues.

Volume I, Page C-11 - Turbine Hot Gas Path Level 2 Inspection and Overhaul

Newfoundland Power has submitted that the Board should require that Hydro provide, with its next capital budget application, an updated equivalent starts forecast for the Holyrood GT, together with information regarding the impact of the updated forecast on the schedule for the planned hot gas path overhaul.

As stated in the response to NP-NLH-016 "The timing of this maintenance will be based on the actual and forecast operation of the unit and will be completed as close as possible to the threshold while ensuring the unit's reliability through the next winter operating season." As justification for timely project execution or deferral, Hydro commits to continue to analyze the actual and planned usage for the Holyrood GT, and will provide an update for the unit in the 2019 Hydro Capital Budget Application. Any deferral of the project will also be discussed in Hydro's Capital Expenditures and Carryover Report, issued March 1 annually.

Volume I, Page C-11 - Installation of Access Hatch

Newfoundland Power has not objected to the proposed installation of the access hatch, as the evidence indicates it is more cost-effective than the original design. However, Newfoundland Power has stated that it is not reasonable that customers bear the incremental cost of providing for deconstruction of a section of the building roof deck in the original construction in addition to the cost of the access hatch.

With respect, the issue of customers bearing incremental cost is not at issue or directly relevant to the approval of capital projects that are demonstrated to be prudent and cost-effective as part of the capital budget process. If and when such costs are recovered from customers is properly addressed as part of a general rate application or other cost of service proceeding. Hydro can confirm however, that when the building was originally designed, the roof construction arrangement allowed for a section to be deconstructed to provide short term access for major maintenance activities, and then reconstructed at minimum disruption to the roof structure. There was no identifiable or material incremental cost to the overall design and

construction of the building to provide that feature as compared to a fixed roof construction arrangement. Confirmation of this can be obtained from Hydro's consultant in charge of design of the building should the Board deem it necessary with respect to the inclusion of these costs in Hydro's rate base.

3.2 Volume I, Page C-13 - Install Plant Heating System – Holyrood Thermal Generating Station

Hydro appreciates and accepts Newfoundland Power's comments regarding additional detailed analysis of the all-electric space heating system for the Install Plant Heating System - Holyrood Thermal Generating Station project proposal. Hydro has completed further review, incorporating some additional information available since the project was originally estimated, and wishes to re-evaluate the proposed project to ensure it is recommending the least cost solution. Hydro therefore is withdrawing the "Install Plant Heating System - Holyrood Thermal Generating Station" from its 2018 Capital Budget Application. Given that a solution for plant heating will be required, Hydro will reanalyze all options, further optimize the final solution, and resubmit a project proposal in the near future under a Capital Budget Supplemental Project Application.

3.3 Volume I, Page C-Hardwoods and Stephenville Gas Turbine Projects

Newfoundland Power has stated that it is in support of Hydro's proposed 2018 expenditures on the Hardwoods and Stephenville Gas Turbines as necessary to maintain their operational reliability. However, Newfoundland Power has requested that the Board order Hydro to complete a comprehensive analysis of short and long term options for the Hardwoods and Stephenville Gas Turbines as soon as possible, including the options of repowering and replacing the existing units with modern, reliable gas turbine technology.

Hydro agrees with Newfoundland Power that a comprehensive analysis of the Hardwoods and Stephenville Gas Turbines is prudent. Newfoundland Power noted that in Hydro's *Gas Turbine Failure Analysis, Final Report*, filed with the Board on January 11, 2017, Hydro stated that it

expected that a review of these assets and options for their future would be completed as part of the Phase Two Outage Inquiry in which Liberty Consulting Group is heavily involved. That expectation has not changed.

Hydro points out that a broader analysis of appropriate planning criteria for the Island Interconnected System is ongoing, and will be communicated to the Board in 2018. Further, operational studies for the future interconnected system will also be complete in 2018. The outcomes of the planning criteria review and the operational studies will include an assessment of real and reactive power requirements for the Island Interconnected System. Should additional resources be required, a number of alternatives will be compared. This will include, but not be limited to, continuation of the Hardwoods and Stephenville Gas Turbines, including the options as suggested by Newfoundland Power, repowering and replacing the existing units with modern, reliable gas turbine technology. To that end, Hydro is actively gathering information, such as estimates for various generation options, to expedite decisions should a system requirement be identified.

Hydro respectfully submits that it would be not appropriate to perform an analysis as suggested by Newfoundland Power in isolation of the overall system studies and reviews that are ongoing. In addition, Hydro continually analyzes the operational reliability of the Hardwoods and Stephenville Gas Turbines, which is reported to the Board as part of Hydro's Near-term Generation Adequacy Report submitted every 6 months. Hydro remains judicious in its assessment of any capital work identified as required for the Hardwoods and Stephenville Gas Turbines balanced with the uncertainty surrounding the longer term requirements of these assets.

3.4 Volume I, Page C-44 - Muskrat Falls to Happy Valley Interconnection

Newfoundland Power has stated that "the existing gas turbine would not be required if a second 138 kV transmission line from Muskrat Falls to Happy Valley-Goose Bay was constructed, as envisioned under Options 4 and 5. System changes that would include these

savings have not been considered in the current planning study." With respect, Hydro submits that this statement is incorrect.

The execution of Option 4 and 5 would allow for the elimination of lifecycle costs associated with the Happy Valley Gas Turbine, L1301, the Churchill Falls 138 kV Terminal Station and Muskrat Falls Terminal Station 3 (MFATS3).

Reference NP-NLH-026, where Hydro responded that "the cumulative net present value of the lifecycle cost for continued operation of the existing 25 MW gas turbine for the study period is $21.3 million." The response to NP-NLH-025 indicates that lifecycles costs for the alternatives are reduced by approximately $5.5 million when L1301, Churchill Falls 138 kV Terminal Station and MFATS3 maintenance costs are eliminated.[1] The total benefit associated with the retirement of these assets is therefore calculated to be $26.8 M.[2]

In comparison, Table 2 of the Eastern Labrador Transmission System – Planning Report[3] filed with the Application indicates that the cumulative net present value of the preferred alternative (Option 2) is approximately $21.3 million. The cumulative net present value of the alternatives involving the immediate construction of the second transmission line interconnecting Happy Valley and Muskrat Falls are approximately $51.1 million (Option 4) and $66 million (Option 5). The cumulative net present value difference in these alternatives and the preferred alternative exceeds the total benefit associated with the retirement of assets, as discussed above.

On the basis of the analysis shown above, all of which is already on the record as part of the Application, the proposed alternative represents the least cost option when considering

[1] As compared to lifecycles costs presented in the Revision 1, Volume 2, Tab 13 Capital Budget Application - Eastern Labrador Transmission System – Planning Report, Table 2.
[2] Decommissioning costs for the assets are not considered in the analysis.
[3] Capital Budget Application, Revision 1, Volume 2, Tab 13.

lifecycle costs associated with the continued operation of L1301 and the Happy Valley Gas Turbine.

Hydro submits that removal of the net present value of continued operation of the Happy Valley Gas Turbine from the calculated net present value difference between Option 4 and Option 5 and the selected option would not change the outcome of the proposal, and would not trigger execution of the second interconnection at this time.

Hydro therefore submits that its preferred alternative (Option 2) should be approved as submitted.

3.5 Volume I, Page C-4 - Hydraulic Generation Refurbishment and Modernization

Newfoundland Power has submitted that the evidence filed in support of a number of the capital expenditure proposals included in the Hydraulic Generation Refurbishment and Modernization project do not meet the requirements of the Capital Budget Application Guidelines (the "Guidelines"). Newfoundland Power stated that the Board should not approve capital expenditure proposals included in the Hydraulic Generation Refurbishment and Modernization project where such proposals are not supported by evidence meeting the requirements of the Guidelines.

In reply, Hydro states that while Newfoundland Power has provided 2 examples (Turbine Major Refurbishments and Refurbish Surge Tanks), it has not identified which other specific proposals in the Hydraulic Generation Refurbishment and Modernization project that it believes do not meet the requirements of the Guidelines. Hydro disagrees that any such projects are not properly justified in the Application and do not meet the Guidelines and submits that this project should be approved as presented. However, due to the magnitude and importance of the Hydraulic Generation Refurbishment and Modernization project, and as Newfoundland Power has failed to identify, other than 2 examples mentioned, which proposals it specifically takes issue with, Hydro respectively submits that it is appropriate in the circumstances to put

on the record a summary of the evidence provided in support of this project in the Application. This summary is attached to this reply as Schedule A.

3.6 Specifically Assigned Charges re IC-NLH-11

In reference to the projects listed by Hydro in response to IC-NLH-011, the Island Industrial Customer Group (the "IIC Group") has not objected to any of Hydro's proposed expenditures for 2018. Rather, the IIC Group points out that for the four projects listed for future target years (2019 and 2021), the IIC Group reserves it right to make submissions regarding those projects in an applicable future Capital Budget Application. Hydro has no objection to this reservation by the IIC Group.

In addition, in relation to the projects listed by Hydro in response to IC-NLH-011, the IIC Group has stated that it does not accept that Hydro has provided a detailed or sufficient justification for the proposed specific assignment to an island industrial customer. With respect, and as the IIC Group itself has acknowledged, issues of specific assignments to members of the IIC Group, or any customer group, will be addressed as part of Hydro's 2017 General Rate Application, future general rate applications or cost of service proceedings. Again the IIC Group has reserved its right to make submissions regarding specific assignment of assets in any such proceeding to which Hydro has no objection.

Finally, the IIC Group has expressed concern with the amount of communication between Hydro and the individually affected members of the IIC Group regarding future projects and their proposed specific assignments. The IIC Group goes further in this regard and suggests that the Board should order Hydro, in its future Capital Budget Applications, to clearly identify and provide detailed justification for capital expenditures that Hydro proposes to be specifically assigned to its industrial customers. Hydro recognizes the concerns raised by the IIC Group, and, given that the specific assignments of proposed capital expenditures and their justification can be complicated, Hydro will commit to engaging further with the individual members of the IIC Group on this topic. Hydro proposes that this engagement include discussions with the

members of the IIC Group on the selection criteria for specifically assigned assets, and what assets are assigned to the individual members. As well, Hydro commits to itemizing and clearly identifying capital expenditures that it will be proposing be specifically assigned to its industrial customers in advance with the industrial customers, as well as in all future Capital Budget Applications.

4 General

Hydro notes that the Consumer Advocate, it its reply, other than a brief blanket statement that it takes no exception to the submissions of either Newfoundland Power or the Industrial Customers, has not made any specific submission on, or taken exception to, any projects proposed by Hydro in its Application. Instead, the Consumer Advocate has focused on themes of prudence, appropriate levels of foresight and affordability to which Hydro takes no exception and is aligned.

The Consumer Advocate has however stated that the capital expenditures proposed by Hydro related to the Holyrood Thermal Generating Station are problematic, but again has not specifically commented on any one such expenditure. In particular, the Consumer Advocate has stated that Hydro anticipates the **closure** of the Holyrood Thermal Generating Station following the integration of the Island Interconnected System. With respect, this statement is inaccurate and a misinterpretation of the long term plan for not only the Holyrood Thermal Generating Station, but the Island Interconnected System as a whole following completion of the Muskrat Falls Project. The short and long term plans for the Holyrood Thermal Generating Station are laid out in detail in the Application. At no time has the full **closure** of the Holyrood Thermal Generating Station, been suggested.

The Consumer Advocate has restated several legislative burdens placed on Hydro under both the *Public Utilities Act*, and the *Electrical Power Control Act, 1994* and reminded the Board of its responsibility to rigorously examine each and every capital expenditure proposed by Hydro. Hydro agrees that its capital expenditures require close scrutiny by the Board.

In summary, Hydro states that the capital works for which Hydro has sought approval in the Application are necessary to ensure that Hydro can continue to provide service which is safe and adequate and just and reasonable as required by Section 37 of the Act. Hydro respectfully requests that the Board approve Hydro's Application, as submitted with the Revisions and noted withdrawal of the "Install Plant Heating System - Holyrood Thermal Generating Station" project.

ALL OF WHICH IS RESPECTFULLY SUBMITTED at St. John's in the Province of Newfoundland and Labrador, this 19th day of October, 2017.

Michael Ladha
Counsel for the Applicant,
Newfoundland and Labrador Hydro
Hydro Place, 500 Columbus Drive
P.O. Box 12400
St. John's, NL A1B 4K7

Schedule A

For ease of understanding, the same numerical headings in the *Hydraulic Generation Refurbishment and Modernization (2018-2019)* document will be used to identify each individual project, starting with Section 2.1 Hydraulic Generating Units. Please note emphasis added, as appropriate, in the following text.

2.1.1 Turbine and Generator Six-Year Overhauls

From the *Hydraulic Generation Asset Management Overview,* Page 14, Lines 6 to 9, and Page 15, Lines 1-4, the following evidence was presented:

> ***The Six-Year Overhaul involves a partial dismantling the turbine and generator to inspect, test, clean, and refurbish the unit. This may entail replacing defective components and, as required, undertaking corrective refurbishment or replacement action.*** *The generator activities involve such activities as cleaning and inspection of rotor and stator assembly, electrical testing on rotor/stator assembly, and calibration and testing of turbine and generator protection devices. The turbine activities involve such activities as verification of bearing and seal clearances and testing and calibration of turbine protection, control, and monitoring devices. During these overhauls, due the dewatering of the unit, the draft tube and penstock are also inspected.*

From Hydro's response to RFI PUB-NLH-018, Page 2, Lines 3-11, the following evidence was presented:

> ***Turbine and Generator Overhaul****, commonly referred to as a PM 9, is a capital expenditure and is conducted normally on a six-year preventive maintenance cycle, but timing may be altered based upon available condition assessment information. A PM 9 consists of a partial dismantlement of the generating unit, with the generator rotor being removed to perform more in-depth condition-based inspections and rehabilitation of the unit. Details of the work undertaken in the PM 9 are provided in Section 2.1.1 - Turbine and Generator Six Year Overhauls presented later in this response.*

From Hydro's response to RFI PUB-NLH-018, Page 3, Lines 24-27, and Page 4, Lines 1-2, the following evidence was presented:

> ***A PM 9 Six-Year Overhaul is performed on the units with more detailed check sheets than those in a PM Annual Inspection.*** *The PM 9 Check Sheets incorporate the PM 6 items with additional recommendations from the OEM to ensure the long term reliability of the unit. Inspection of all major components (testing and/or repairs as may be required) on a six-year frequency will help avoid forced outages, forced deratings and unplanned maintenance outages.*

From Hydro's response to RFI PUB-NLH-018, Page 4, Lines 5-8, the following evidence was presented:

> *Upper Salmon and Bay d'Espoir Unit 2 are planned to undergo PM 9 overhauls in 2018. Previous annual inspections of the Upper Salmon unit have determined that* ***the rotor drive keys, which hold the rotor poles in place, have become loose and are protruding out of their slots causing interference with the shrouds****.*

As outlined below in 2.1.2 Turbine Major Refurbishment, Hydro has proposed to undertake a Turbine Major Overhaul for Bay d'Espoir Unit 2. From Hydro's response to RFI PUB-NLH-018, Page 2, Lines 12-20, with respect to Turbine Major Overhaul the following evidence was presented:

> *This procedure undertakes a major refurbishment of turbine components and to execute the work requires a complete unit dismantlement to refurbish turbine components*

Hydro proposed to coincidently undertake the Unit 2 PM9 Turbine and Generator Overhaul and the Unit 2 Turbine Major Overhaul preventive/refurbishment procedures in one outage rather than two separate outages.

2.1.2 Turbine Major Refurbishment

From Hydro's response to RFI PUB-NLH-018, Page 2, Lines 12-20, the following evidence was presented:

> ***Turbine Major Overhaul*** *is a capital expenditure and, while* ***normally scheduled to occur on a 25-year cycle, the actual timing is based on condition assessment information obtained through the operation, annual inspections, and six year turbine and generator overhauls. This procedure undertakes a major refurbishment of turbine components and to execute the work requires a complete unit dismantlement to refurbish turbine components*** *including the runner (as required, based on condition), turbine seals, wicket gate components, and other items that require attention based on their condition.*

From Hydro's response to the RFI PUB-NLH-018, Page 8, Lines 10-24, and Pages 9, Lines 1-13, the following evidence was presented:

> *One of the tasks in Hydro's Asset Management Program for hydraulic turbines is the measurement of the upper and lower primary seal clearances. The seal clearance are designed to ensure turbine efficiency, hydraulic balance, prevention of rubbing due to misalignment and imbalance, and for cooling between the runner and stationary wear rings. The actual design clearance depends on both the size and speed of the unit. Clearances should not change unless the wear rings deteriorate due to cavitation, corrosion, erosion, distortion, or the runner incurs axial movement due to bearing wear or misalignment. A failure of the turbine due to contact between the stationary and rotating seals would result in the generating unit being unavailable for six to eight months depending on the extent of the damage. During preventive maintenance, procedure measurements, including the seal clearances, are compared against previous measurements and the design clearances. Depending on the results of the measurements, Hydro may consult with external turbine experts to determine if intervention is required to correct seal clearances. In 2016 the lower primary seal clearance measurements taken on Bay d'Espoir Unit 4 revealed an unacceptable*

reduction in the amount of clearance between the stationary and rotating parts. As outlined in the June 2016 Supplemental Capital Budget Application 'Turbine Rehabilitation of Bay d'Espoir Unit 4' the Turbine Major Overhaul for Unit 4 was advanced by three years. Upon disassembly of the turbine, it was discovered the wicket gate bushings, discharge ring, and grouting had to be replaced. Based upon the state of deterioration of various components of Unit 4 and the fact that Bay d'Espoir Units 1, 2, 3, 4, 5 and 6 have the same design and manufacturer and have been subjected to the similar operating conditions, a decision was made to advance the Turbine Major Overhaul for the other units. Hydro completed the Unit 3 Turbine Major Overhaul in 2017, as outlined in the Supplemental Capital Budget Application 'Refurbishment of Bay d'Espoir Penstock 2 and Bay d'Espoir Unit 3 Turbine Major Overhaul'.

From the *Hydraulic Generation Asset Management Overview,* Page 15, Lines 7 -25, the following evidence was presented:

The Turbine Major Refurbishment occurs on approximately a 25-year cycle and involves completely disassembling, inspecting, testing, assessing the turbine mechanical components and, as required, carrying out corrective work to refurbish or replace components to maintain the turbine performance until the next major refurbishment. As the unit is dismantled for the turbine major refurbishment, this offers an opportunity to carry out, if required, other sustaining work on the unit, including:

- *Inspection and replacement, as required, of the head cover and bottom ring bushings;*
- *Inspection and, as required, replacement of the operating ring bearing;*
- *Replacement of wicket gate V packing;*
- *Replacement of various gaskets and seals;*
- *Refurbishment of runner due to cavitation damage;*
- *Machining of other unit surfaces, as required, based on condition assessments; and*
- *Testing and calibration of turbine protection, control and monitoring devices.*

In the past, concrete growth in the turbine foundation and the resulting erosion caused movement of the turbine lower primary stationary seal. This could cause contact between the stationary and rotating seals and require a full dismantling of the unit to correct. Therefore, as required, grouting and machining of the upper and lower primary seals is also included in the Major Turbine Refurbishment.

2.1.3 Replace/Improve Unit Metering, Monitoring, Protection, and Control Assets

From Hydro's response to RFI PUB-NLH-018, Page 12, Lines 20-24, and Page 13, Lines 1-6 the following evidence was presented:

*The existing system for Bay d'Espoir Units 1 through 5 use **Allen-Bradley equipment that has been discontinued, with spare parts no longer available** for some components. **Failure of one of the modules would mean losing a portion of data for the unit** associated with the failed module. Units 6 and 7 have up-to-date collecting equipment. The existing communications infrastructure for data acquisition uses an obsolete communication method, called DeviceNet. Should a component of the DeviceNet system fail, it is unlikely that Hydro would be able to obtain a replacement component, which would result in a loss of the ability to track and trend long-term data for a generator or turbine. **This data is required for investigating issues and identifying developing problems with the equipment**.*

From Hydro's response to RFI PUB-NLH-018 document, Page 13, Lines 9-19 the following evidence was presented:

*In Bay d'Espoir, there are control cables that have insulation that was manufactured with an oil-based compound. The control cables have been in service since 1967 and are approaching the end of their useful life. The cables are used for carrying signals for generator protection and control purposes. Staff have found **oily residue coming from the cables** into the junction boxes and on cable connections, which is an indication of break-down of the insulation. The associated junction boxes and terminal blocks are also full of this oil residue and require replacement.*

*As leaking continues, the **cables will dry out and the insulation will fail**. Such a failure may result in control equipment malfunction resulting in a forced outage of the generator.*

From the *Hydraulic Generation Asset Management Overview,* Page 17, Lines 6 -30, the following evidence was presented:

In 2016, the Bay d'Espoir Unit 7 vibration monitoring system was replaced to improve condition monitoring of Unit 7. The previously installed vibration monitoring system was unreliable. The new monitor has increased the diagnostic information available to asset management and maintenance personnel. Hydro plans additional work starting in 2018 to replace the other monitors on Bay d'Espoir Units 1 to 5 because the monitors are obsolete. The new monitors will allow long-term trending of data.

Hydro will replace protective relays, annunciators, human-machine interfaces, other metering, monitoring, protection, and control equipment as it becomes obsolete, fails or operates unreliably, to ensure reliable operation of protective devices.

In 2017, a multi-year project to install a new Asset Health Monitor System, for Upper Salmon, started. The new Asset Health Monitor System will gather diagnostic data from the generating unit and provide trending analysis for asset management and maintenance personnel. Hydro plans additional work starting in 2018 to replace obsolete monitoring devices on Bay d'Espoir Units 1 to 5.

In 2017, Hydro identified control cables in its hydraulic generating stations are leaking oil, which is contaminated with PCB's. In 2018 Hydro will start a five-year effort to replace the cables and, if required, associated infrastructure.

Hydro expects additional replacement of metering, monitoring, protection, and control equipment assets, including wiring, panels and other supporting materials and devices,

due to deterioration and obsolescence; and to provide more functional equipment. Work of this nature will be covered by this Program.

2.2.1 Install Protective Guards in Turbine Pits

From Hydro's response to RFI PUB-NLH-018, Page 15, Lines 2-6, and Page 16, Lines 1-5 the following evidence was presented:

Wicket gate linkages are below a grated platform to allow safe access to other equipment in the turbine pit, because the wicket gate linkages move frequently without warning when the unit is in operation. The heavy ***rotating turbine shaft and coupling in the turbine pit has no protective guard to inhibit accidental contact by personnel****.* ***Section 98 of the Newfoundland and Labrador Occupational Health and Safety Regulations states that "Where a worker may be exposed to contact with rotating parts, such as friction drive, shafts, couplings and collars, set screws and bolts, keys and keyways, and projecting shaft ends, the parts shall be guarded."*** *This regulation would be applicable Hydro's turbine pits.*

2.2.2 Replace Vent Chambers

From Hydro's response to RFI PUB-NLH-018, Page 17, Lines 2-20 the following evidence was presented:

The vent chambers were installed when the units were constructed and have been in use since they were commissioned between 1967 and 1970. In 2006, a crack was found in a weld on the vent chamber for Unit 2, which was repaired during annual maintenance.

As reported in PUB-NLH-018 Attachment 1 entitled 'Bay d'Espoir - Vent Chamber Assessment', Hydro conducted a condition assessment and engineering review of the operation of the air vent system for each of the generating Units 1-6 in 2016. The work included a ***detailed inspection and non-destructive testing (NDT) of the vent chambers and high pressure piping. The review has recommended the vent chambers be***

replaced due to the poor condition of the chambers*. The wall thicknesses of the chambers are deteriorated to an unacceptable level.*

If left unaddressed, the deterioration will result in the failure of a vent chamber. Such a failure would result in a high volume of uncontrolled high pressure water flow from a 4 inch pipe under 250 psig of pressure in to Powerhouse 1, resulting in a forced unit outage of the associated generating unit and possibly adjacent units. Water could also disrupt electrical and control systems in the area and potentially flood the lower levels of the powerhouse.

2.2.3 Replace Generator Bearing Coolers

From Hydro's response to RFI PUB-NLH-018, Page 19, Lines 3-26, and Page 20, Lines 1-16 the following evidence was presented:

If the flows to the cooler are not in the normal range of 50 liters per minute, then a closed loop cleaning system is attached to the cooler to clean out the tubes. Between April and May 2017, three of the six lower generator bearing coolers at the Hinds Lake Generating Station were isolated due to water leaks from the cooler tubes into the bearing oil. These isolations resulted in the unit requiring an additional full day of monitoring of the bearing temperatures. The time of the year permitted the unit to operate normally because cooling water for the unit was still cold; however, another cooler failure would have forced the unit offline because there would have been insufficient cooling to the unit. To address the situation, a four day maintenance outage was taken to ***plug a total of 12 leaking tubes****. These coolers had to be repaired to ensure reliable operation for the summer season when cooling water inlet temperatures increase with the warmer weather. While pressure testing was used to determine if other leaks were present, there are no tests which will allow Hydro to definitively determine the remaining life of the remaining active tubing.*

> ***Leaking cooler tubes are an indicator that the cooler is nearing the end of its useful life.*** *Water is continuously channeled through the 168 tubes in each cooler and this cyclic operation causes the material to degrade over time, which leads to failures.* ***As all six coolers are of the same vintage and operated under the same conditions, Hydro believes all six coolers are approaching the end of their useful lives and further leaks are anticipated.*** *If the unit remains on-line with water in the bearing from leaking coolers, the lubricating properties of the oil are at risk of being reduced to the point that the bearing will be destroyed, forcing the unit off line for an extended period.* ***Further leaks will result in additional forced outages*** *to repair leaking coolers.*
>
> *Prior to the recent failures, purchasing spare coolers was planned for 2020. However,* ***due to the recent leaks, six coolers are being purchased in 2017 under the 2017 Capital Spares project.***
>
> *Continuing to operate the unit with the existing deteriorating coolers would result in an increasing frequency of tube leaks, resulting in forced outages to the Hinds Lake Generating Station to repair the tubing. It would also risk damaging the generator lower bearing resulting in the loss of 75 MW of hydro generation for approximately six to eight months. Depending on the time of the year, if the accumulated total of plugged tubes is approximately 10-15%, Hydro would have to begin to derate the unit and this derating would increase as additional tubes failed. This ongoing cycle of forced outages and unit derating would continually decrease the performance and reliability of the Station.*

From Hydro's response to RFI PUB-NLH-018, Page 20, Lines 19-27, and Page 21, Lines 1-2 the following evidence was presented:

> *To address the situation, Hydro could replace all the lower coolers at one time or replace the coolers over a period of years. Hydro proposes to replace the six lower bearing coolers in 2018. It has adopted this approach to reduce the impact of additional leaks on performance and reliability and to mitigate the risk of damaging the generator lower*

bearing. This is also a lower cost approach as the design of the Hinds Lake Generating Unit requires that the generator be dismantled to replace the coolers. There are ***minimal additional installation costs to installing all six spare coolers as compared to only installing the three coolers that leaked.*** *The additional labour cost to install six coolers versus three coolers is estimated to be approximately $5,000, which consists of labour costs for a mechanical crew to remove the existing coolers and install the new coolers.*

2.3.1 Refurbish and Replace of Control Gates Infrastructure

From Hydro's response to RFI PUB-NLH-018 document, Page 22, Lines 23-25 the following evidence was presented:

This work is a continuation of a program to refurbish all hydraulic structures. The last submission to the Board, for this program, was in 2017 under the 'Control Structure Refurbishments - Various Sites' proposal.

From Hydro's response to RFI PUB-NLH-018 document, Page 23, Lines 15-24, and Page 24, Lines 1-26, and Page 25, Lines 1-27, and Page 26, Lines 1-24, the following evidence was presented:

The Hinds Lake Control Structure is 37 years old and the Bay d'Espoir Intake No. 1 is 50 years old. Neither of these structures has ever been refurbished. ***In 2016 assessments were performed on Hinds Lake control structure and Bay d'Espoir intake No.1*** *and identified the condition of the structures as follows:*

a. Hinds Lake:

Note that this is not a complete list of the deficiencies that were identified on the structure. For a ***complete description of the specific equipment condition, refer to the consultant report****, attached in PUB-NLH-018 Attachment 2 entitled 'Hind's Lake - Control Structure Assessment'.*

Hoist for Control Gates:

The gear box on the hoist has a leaky pinion seal and requires replacement to avoid the risk of an oil leak.

<u>Grounding System:</u>

*The assessment identified some **missing grounding** on the fence around the structure and bolt connections. The entry gates and a section of fence to the right of the gates are required to be grounded and there are several bolted connections missing on the fence, in the area near the building entry door gate.*

<u>Emergency Gates:</u>

*Since **the Emergency Gates are slide gates, they must be removed under balanced head conditions**. To remove the Emergency Gates, the current operating protocol is to open the watering-up valve to flood the gate well between the upstream Emergency Gate and the Control Gate. Subsequently, the Control Gate is slightly opened, which fills the gate well between the Control Gate and the downstream Emergency Gate. Once the head is balanced across the downstream Emergency Gate, it is lifted by the overhead crane before the upstream head increases beyond the downstream head. Currently, there is **no means in place to determine when the head is balanced** across the downstream Emergency Gate to let the operating personnel know when to lift the gate. A solution is the installation of a filler valve or gate in the downstream Emergency Gate. This filler valve or gate can be used to flood the gate well between the downstream Emergency Gate and the Control Gate, equalizing the head on the downstream Emergency Gate, allowing for its removal.*

<u>Control Gates:</u>

*The control gates are downstream sealing, fixed wheel gates fitted with side rollers, upstream rollers, steel side bumpers, a steel bottom seal, top J-seals, and side J-seals. The gate is hoisted by a sheave attached to a single lifting point consisting of two parallel pad eyes at the top center of the gate. The gates are original to the structure and are 37 years old and the assessment noted **deficiencies in roller wear**. A complete reference is listed in the assessment report in Section 3.9.*

b. Bay d'Espoir:

Note that this is not a complete list of the deficiencies that were identified on the structure. For a ***complete description of the specific equipment condition, refer to the consultant report, attached in PUB-NLH-018 Attachment 3 entitle 'Bay d'Espoir - Intake Inspection Report'****.*

Main Rollers:

All twelve (12) main rollers were inspected, with the majority of them being turned by hand. An average hardness of 400 HB was measured on the rolling face of the rollers. The ***majority of rollers are deteriorated*** *because of pitting corrosion to their rolling faces. The corrosion covers almost all the rolling surface. The pits on the surface have an approximate depth of up to 3 mm. The rollers condition is in general considered poor.*

Seals:

The anti-friction coating of the lateral and the lintel J-seals is worn*. The wear is more significant in the lower part of the lateral seals and there are areas where it is discolored and others where it is completely removed. The coating is an important feature of the gate and it must be in good condition to reduce friction and ensure the gate emergency closing. The anti-friction coating reduces the seal friction coefficient by up to 10 times.* ***The deterioration of the coating can also create an overload of the hoist****.*

Gate Coating:

Some small areas exhibit corrosion nodules.

Lifting Motor:

The amperage readings for the motor are over the motor electrical protection specified at 40 amps. The fuse size and type should be verified. The motor electrical protection should comply with CSA C22.1-12 Electrical Code.

Second Stage Concrete:

Second stage concrete is used after the first stage concrete to fill the space between the embedded parts and the first stage concrete. This process allows the attainment of precise tolerances for the alignment of the embedded part. Issues in second stage concrete were found downstream of the rolling face on the right side lateral guide. The

> ***holes are approximately 250 mm deep****. It could not be confirmed if water could leak through the holes since no links were found with the upstream side of the embedded parts.* ***A soft area in the second stage concrete was also found downstream of the right lateral guide*** *about 1 metre above the sill. The soft area has an approximate diameter of 250 mm and extends more than 200 mm deep.*

From the *Hydraulic Generation Asset Management Overview,* Page 20, Lines 10-11, and Page 21, Lines 1-6, the following evidence was presented:

> *Failure of subcomponents of control structures can result in safety hazards, equipment damage, or the inability to operate gates as required. The failure of the gate control system has resulted in the filling of the penstock too quickly, creating hazardous conditions, and the failure of gate heaters can result in mechanical components freezing, resulting in their failure to operate. Since 2009, Hydro has undertaken control gate refurbishments in Hinds Lake, Upper Salmon, and Bay d'Espoir for intake structures and at Salmon River, Victoria, and Burnt Dam for spillway structures. This work has included structural, mechanical, electrical, and control system work. Future refurbishment work will be executed through this Program.*

2.3.2 Refurbish Surge Tanks

From Hydro's response to RFI PUB-NLH-018, Page 27, Lines 24-26 the following evidence was presented:

> ***A program has been in place since 2014 to address the deficiencies on the surge tanks.*** *The first proposal submitted to the Board was titled, 'Refurbish Surge Tank 3 - Bay d'Espoir'.*

From Hydro's response to RFI PUB-NLH-018, Page 27, Lines 24-26 the following evidence was presented:

There is interior and exterior corrosion on Bay d'Espoir Surge Tank #1 indicating that the protective coating has failed.

Failure of the coating system leaves the steel vulnerable to corrosion, especially inside the tank where there is a cycling between wet and dry operating conditions. ***Corrosion in the surge tank and/or riser section can result in leaks and, if severe enough, structural failure of the metal and/or weld****s. A significant leak in this structure would require immediate repair. This repair effort would require the surge tank, as well as the associated penstock and units, to be taken out of service for an unscheduled outage which, depending on the magnitude of the problem and timing, could be four to eight weeks in duration. Leaks or structural metal failure would have an impact on Hydro's ability to meet the electrical demand of the Island Interconnected System.*

A cathodic protection (CP) corrosion system is located within the surge tank. It has been determined that the ***CP system is not functioning*** *properly, which is adding to interior corrosion of the surge tank. Analysis determined that with a protective coating this CP system would not be required.*

From the *Hydraulic Generation Asset Management Overview,* Page 21, Lines 9-14, the following evidence was presented:

Hydro carries out progressive inspections monthly and annually on surge tanks, and a major inspection every six years. Based on these inspections, Hydro determines whether corrective action is required. Over time, protective coatings degrade, resulting in increased corrosion which, if left unmitigated, may result in leaks or structural failure of the tanks. Failure of the cathodic protection and protective coating of the surge tanks resulted in corrosion on the Bay d'Espoir assets. In 2014, 2015, and 2016, Hydro completed projects to refurbish the surge tanks.

2.4.1 Upgrade Public Safety around Dams and Waterways

From Hydro's response to RFI PUB-NLH-018, Page 27, Lines 24-26, the following evidence was presented:

> *This work is a **continuation of a program started in 2011** to address public safety at all Hydro sites in a planned risk-based approach. The most recent project undertaken in this program was the 'Upgrade Public Safety Around Dams and Waterways BDE', which was approved in the 2017 Capital Budget Application.*
>
> ***Public safety risks are determined by completing risk assessments** in accordance with the Canadian Dam Association's Dam Safety Guidelines (2007), which includes guidelines for public safety and security around dams. Appropriate **control measures are then installed to reduce the safety risk** to the public. These measures include such items as signage, fencing, audible or visual alarms, booms and buoys, operational changes, and public education.*

From Hydro's response to RFI PUB-NLH-018, Page 30, Lines 20-25, and Pages 31, Lines 1-4, the following evidence was presented:

> *The current status of the program for Hinds Lake, Cat Arm, Burnt Reservoir and Victoria Reservoir includes:*
>
> - *<u>Hinds Lake</u>: Not currently started, budget for this project is the condition assessment.*
> - *<u>Cat Arm:</u> Condition assessment completed in 2016, control measures to be installed in 2018, including signage.*
> - *<u>Burnt Reservoir</u>: Second year of control measures, includes: 1 fencing with fencing signage, as well as boom and boom anchor design.*
> - *<u>Victoria Reservoir</u>: Second year of control measures includes: fencing with fencing signage, as well as boom and boom anchor design.*

From the *Hydraulic Generation Asset Management Overview,* Page 24, Line 7, the following evidence was presented:

> *Hydro has conducted seven (7) public safety projects since 2011.*

3.1 Diesel Fuel Storage Refurbishment and Replacement

From Hydro's response to RFI PUB-NLH-018, Page 32, Lines 5-10, the following evidence was presented:

> ***As per the Provincial Gasoline & Associated Products (GAP) Environmental Regulations, Hydro is required to reconcile fuel tank storage volumes using two independent methods****. For storage at the Victoria Control Structure, Paradise River, Granite Canal, and Bay d'Espoir Generating Stations,* ***storage volumes are currently determined using only manual tank dipping****. Therefore, Hydro is currently in non-conformance with the regulations.*

From the *Hydraulic Generation Asset Management Overview,* Page 26, Lines 10-13, the following evidence was presented:

> *Hydro will use this program to refurbish or replace tanks when deteriorated and to comply with Government regulations. Hydro has tanks in remote locations and since 2007 has installed remote monitoring on some of those tanks.*

4.1 Refurbish Accommodations

From Hydro's response to RFI PUB-NLH-018, Page 33, Lines 14-23, the following evidence was presented:

> *The current* ***Upper Salmon Cookhouse Trailer floor is beginning to rot and mold has been found in several places in the trailer. The trailer is undersized for a full maintenance crew*** *and lacks the necessary appliances (stove/refrigerator) to be used as a proper functioning kitchen. The* ***electrical supply is also inadequate*** *as the trailer is currently being supplied with power from a single extension cord running from the plant.*

The accommodations trailer is in good shape and requires a small amount of mold remediation and an upgrade of the electrical system and plumbing systems, so that a kitchen can be constructed.

5.1 Electrical Equipment Refurbishment and Replacement

From Hydro's response to RFI PUB-NLH-018 document, Page 34, Lines 23-25, and Page 35, Lines 1-17, the following evidence was presented:

For switchgear and other cabinet mounted electric distribution equipment, ***Hydro uses infrared (IR) inspections to identify hot spots and arcing*** *in energized switchgear and other cabinet mounted electric distribution equipment. These inspections allow Hydro to conduct condition-based assessments of the equipment while it remains in service.*

For switchgear and other cabinet mounted electric distribution equipment, which are not equipped with infrared view ports, personnel are required to de-energize the equipment, remove protective covers, reenergize the equipment, and wear heavy, warm arc flash resistant clothing to complete the infrared inspections. The previously described steps must be reversed to return the equipment to normal operations.

For switchgear and cabinets equipped with infrared view ports, personnel can conduct thermal inspections without being exposed to arc flash hazards and personnel are able to perform more testing for trending purposes *due to the easy of the visual inspection with these viewports. Hydro has had an ongoing program to install infrared viewports on equipment with the last submission to the Board being a two year project starting in 2015 titled 'Install Infrared View Ports - Various Sites'.*