NEWFOUNDLAND AND LABRADOR

BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

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2020-08-31

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Dear Sirs/Madam:

Re: Newfoundland and Labrador Hydro - Reliability and Resource Adequacy Study Review - The Liberty Consulting Group Second Monthly Monitoring Report on Integrating LCP Facilities into the IIS and Hydro Preparations for Winter

Please find a copy of The Liberty Consulting Group *Second Monthly Monitoring Report on Integrating LCP Facilities into the IIS and Hydro Preparations for Winter.*

If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

Cheryl Blundon
Board Secretary

CB/cj

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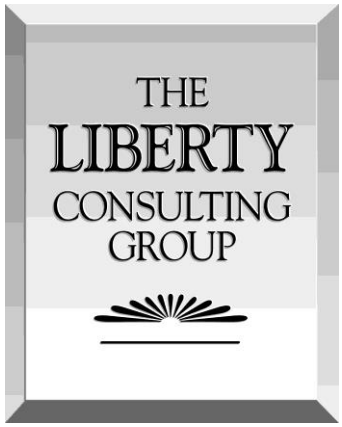
Second Monthly Monitoring Report on Integrating LCP Facilities into the IIS and Hydro Preparations for Winter

Presented to:

The Board of Commissioners of Public Utilities
Newfoundland and Labrador

Presented by:

The Liberty Consulting Group



August 27, 2020

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1. Report Summary

This second monthly report following the transition from our quarterly reporting addresses the transitioning of Lower Churchill Project (LCP) assets to operation and Hydro's progress in planned activities to optimize availability of its supply resources for the coming winter. Prospects for bringing the Labrador Island Link (LIL) into reliable service for the fast-approaching winter season have remained a primary focus of our monitoring efforts. The month since our last report has continued to produce progress and somewhat improved prospects for near-term LIL operation, but substantial remaining challenges leave LIL availability in the immediate term still uncertain. Hydro has continued to remain on track to complete capital and O&M work designed to make its supply resources ready for winter operation. Significant work still remains, especially on Hydro's capital projects.

Successfully completing Factory Acceptance Testing (FAT) has posed a significant barrier to LIL commissioning. Since our last report, Nalcor, the Independent Third Party, and General Electric (GE) have agreed that the results of the second FAT completed on July 24, 2020 support proceeding with commissioning. Some 41 issues ("punches") have been designated as requiring resolution before the LIL passes a next major commercial operations milestone - - 30 days of continuous operation without a trip. GE has not proposed a specific schedule for commencement of Trial Operation, but Nalcor postulates a date in late October. Leading up to that date, development of a new interim software version (Release B) will continue in parallel with other activities. Plans call for Release B to undergo testing to verify resolution of the 41 punches before Trial Operation commencement. Should October commencement occur, the LIL may reach commercial operation immediately before the December 1 commencement of the winter season, Only marginal - - if any - - time remains for a delay in commencing Trial Operation or for restarting the 30-day continuous-run duration, should the LIL trip.

The decision to proceed with LIL commissioning activities appeared until August 25th to have increased the chances of its availability for all or most of the coming winter. Hydro reported on the 25th a Pole 2 equipment failure that had occurred about two weeks earlier - - on August 13th, followed by a determination that Pole 1 faces the same issue. Commissioning work on both poles

has halted, pending root cause analysis. The failure occurred on the very first Pole 2 dynamic commissioning tests. Moreover, Pole 1 had already been operating in 2019, apparently without indication of the issue. Hydro's August 25th report provides no useful information for assessing the cause or implications of the failure and Nalcor did not inform us about it as part of the monthly monitoring activities then underway.

These circumstances do not inspire confidence that LIL schedule prospects have improved. Instead, pending Nalcor's provision of even basic information about the August 13 event, it appears that the opposite (further delay) has become more likely. The number of remaining activities and milestones to complete commissioning and the issues that have beset the LIL to date continue to compel a conclusion that operation at the start of or even well into this coming winter is more likely not to happen.

As we reported last month, however, full satisfaction of commissioning activities, such as successful Trial Operation, will not necessarily preclude the LIL from delivering a useful level of power transfer capability (between roughly 100 and 225MW) even before the completion of Trial Operation. Much needs to be accomplished, however, even to support that contribution.

Commissioning of the three synchronous condensers being installed at Soldiers Pond also continues to face material uncertainty. The units are important to long-term operation of the LIL at its rated full capacity, but the continuing availability of generation at Holyrood can replace them in the immediate term as a source of support needed to continue LIL commissioning activities.

As reported last month binding and corrosion issues appear resolved. Progress has also occurred in addressing the third issue discussed in our last monthly report - - vibration during operation. Synchronous Condenser Unit 2 vibration levels measured during recent operation in August have exceeded specifications, but have not reached "alarm" levels. A modified Synchronous Condenser Unit 3 has arrived at the site and is undergoing an installation process expected to last roughly through September. That date would support operation in October, which would provide a source of data for assessing success in reducing vibration levels. Planned analysis of operating data accumulated through October is intended to inform a determination of whether the post-remediation vibration levels demonstrate effective immediate- and long-term operability at design levels.

GE continues to pursue the much more substantial and lengthy foundation work identified as an alternative solution, should measures taken to date not resolve the vibration issues. Design work on that solution has now proceeded to a point that will support October mobilization of resources to perform the physical work involved. That work, if required, would certainly extend well past the coming winter, but will likely reach completion before the following (2021-2022 winter season start). However, the work's schedule remains subject to sufficient uncertainty to create some risk of delay into or past the start of the 2021/2022 winter season

Our last monthly report addressed the small, but potential risk that generation at Muskrat Falls would not be available for LIL commissioning. Failing that availability, another source of supply will be required to provide the 225MW needed for LIL commissioning. Progress this past month

in addressing delays at Muskrat Falls Unit 1 has given Nalcor confidence that Unit 1 will be commercially available in September and Unit 2 in November of this year.

If needed, excess recall power from Churchill Falls remains an option, but one that will diminish as cold weather causes Labrador to consume ever more of the 300MW of recall power. No progress has been made in securing the out-of-province reviews and agreements necessary to secure the other two options addressed in last month's report - - transmission access through Quebec and use of other-than-recall power from Churchill Falls. Again, however, the potential need for them, small last month, has been further reduced by progress in bringing Muskrat Falls units on line.

We will not provide a more detailed review of TTO schedule progress until the next (quarter-ending) month. However, as we reported last month, significant gaps have continued through this report in completing what we have been describing as bulk (S-curve) activities and in training program development and delivery. Progress has, however, been made in securing generation-related O&M contracts and Muskrat Falls site emergency response plans.

Hydro has continued to take appropriate actions to address major generation risks for the coming winter season. Hydro has made substantial progress on its major generation capital projects, on which work has advanced considerably since our last monthly report. However, we plan inquiries into the justification and potential consequences of deferring some work items and into the causes of the bent Unit 3 boiler feed pump shaft (an unusual occurrence in our experience). Progress in completing preventive and corrective maintenance, winter readiness, and required contracting activities remains on track without known risks to completion before the onset of the winter season.

2. Report Background and Purpose

This report, like its predecessors, examines the TTO organization's scheduled and completed activities undertaken to secure the integration of LCP assets into the province's electrical system by planned in-service dates. We gathered information through a series of information requests and teleconferences, the last of which we held with Nalcor and Hydro on August 13, 2020. Follow-up information to address questions raised in those discussions was provided through August 21, 2020.

The Board recently changed our reporting cycle from quarterly to monthly, in order to: (a) provide more current information about readiness of the LIL for the coming winter, and (b) review Hydro's efforts to prepare its supply resources for availability this coming winter. This second of the monthly reports addresses activities through mid-August. The end-of-quarter versions of these monthly reports will provide greater details on the broad scope of TTO activities. Interim ones, like this one will focus on what we have observed as more critical near-term issues - - those associated with bringing to the Island electricity from Muskrat Falls.

The scope of our monitoring efforts prior to the initiation of the monthly reporting process generally excluded a detailed review of Muskrat Fall's construction activities, although we have considered the impacts of the scheduling of those activities on the availability of power supply via the LIL. Nalcor reports of delays in completion of Muskrat Falls generation, however, have made a review of its status material, given its anticipated role in support of LIL commissioning. Our

monthly reports thus will address the implications that potential added delays in completing generation have for LIL commissioning.

All challenges facing management in the LCP transition to reliable operation necessarily take on added importance as the months remaining until the onset of winter elapse. LIL control software and synchronous condenser vibration issues remain unresolved; they continue to impose significant risk to LIL availability and operation this winter and beyond, making them a particular focus of our monitoring inquiries this past month.

3. LIL Status

Our last report described GE's then recently-completed reperformance of the FAT on July 24, 2020. A successful FAT marks a major milestone in getting the interim software ready. Nalcor expressed optimism about the results of this second FAT, but cautioned at the time of our last report that deciding whether to proceed with commissioning needed to await then pending detailed analysis of test results.

Nalcor has now advised that the results of the second FAT do justify proceeding with commissioning, despite the continuing existence of a list of software issues requiring correction. Nalcor has reported the existence of a particularly important list of software issues ("punches"); *i.e.*, those that require correction before the LIL can undergo "Trial Operation" - - another major milestone in reaching commercial operation. We reported last month that successful completion of the post-commissioning, Trial Operation phase requires 30 days of uninterrupted LIL operation (*i.e.*, no trips). This 30-day run must happen within an overall 90-day window. Any trips would require investigation, correction of the causes discovered, and then commencement of a new 30-day run period. Successive 30-day Trial Operation periods would follow, should enough of the overall 90-day period for successfully completing Trial Operation remain.

While not yet formally scheduled, Nalcor anticipates that Trial Operation may begin in the last third of October of this year. In the meantime, therefore, commissioning activities will address correction of the software punches. Nalcor reported 41 such issues, which have affected an unknown number of the tests the second FAT included. As was true following the first FAT, a number of less critical issues, not affecting reliable LIL operation, also remained pending, but were not deemed critical to Trial Operation, and in many cases, early commercial operation as well. We did not find the number that do require pre-Trial Operation correction encouraging, given what we have learned about the numbers of issues the first FAT disclosed, which ordinarily one would expect to have been resolved before a second FAT. We did learn that Nalcor and the Independent Third Party monitoring work on the software do not believe that the outstanding issues threaten damage to the LIL equipment or the networks. Nevertheless, management's recognition of the need to resolve the issues before Trial Operation makes their resolution a schedule risk, with winter fast approaching.

We asked Nalcor for specific information about the issues requiring correction before Trial Operation, but management declined to do so, citing GE concerns about confidentiality. In order to gain some understanding about potential schedule and reliability consequences of the 41 "punches," we asked for a phone conference with a Nalcor representative who possessed detailed

understanding of them. Management declined to arrange this call, instead offering the following categorization of the punches:

- Alarms
- Event Logging
- Filter Switching
- Hardware
- HMI
- Lane Changeover
- Power Regulation
- Protection
- Telecommunications

The level of detail that Nalcor agreed to provide is clearly insufficient to provide a basis for assessing the schedule required to close out the issues or to assess the significance of operational risk without correcting them. The categories suggest essential control, protection and communication functions, and do give reason for concern (or at least further inquiry of the kinds that Nalcor has declined to permit) about the potential for line trips, incorrect actions when diagnosing and responding to operations issues, erroneous information to operators, and interference with change-overs between the redundant control and protection systems. Without more information than Nalcor is willing to provide, we can only observe that the categories offered appear to bear directly on changes relevant to a successful 30-day Trial Operation run and ensuring commercial operation.

Declining to provide information about the 41 "punches" and about the actual test failures precludes a well-informed view on the likelihood of their resolution in time to support late-October commencement of Trial Operation. Lack of access to important information makes factors like the following material in assessing the likelihood of achieving LIL commercial operation during the coming winter:

- A lack of even basic information about the issues that GE must successfully address to permit the commencement of Trial Operation, successful completion of which requires 30 consecutive days of operation without a trip within an overall 90-day time window.
- Trips before completing Trial Operation reset the 30-day clock; even if commencement begins in late October, virtually no time remains to reset the clock before December 1
- The now long history of GE's failure to produce acceptable FAT results does not inspire confidence in its ability to eliminate the kinds and numbers of material issues that two separate FATs have already identified.

Nalcor has agreed to the performance of LIL site commissioning activities concurrently with work at GE's U.K. offices to address the 41 software punches. Site commissioning activities commenced at the end of July, using an interim control software version designated as Release A. The inception of Pole 2 dynamic commissioning was imminent in mid-August. Starting with minimum power flow of 45MW between Muskrat Falls and Soldiers Pond, commissioning activities will include power transmission at levels up to 225MW. Activities will include recommissioning of Pole 1 operating alone and commissioning of bipole operation.

Another interim software version (Interim B) will incorporate correction of the punches. Interim B is planned for use in completing LIL commissioning activities and for controlling its first period of commercial operation. It does not appear that firm dates for completing this "Release B" version exist. It will require regression testing at GE's U.K. offices to validate that the punches have been

closed out without introducing additional issues. Successful testing will then permit delivery of Release B software to the site for use in LIL commissioning.

Regression and other testing scope for Release B remains unfinalized, but Nalcor believes that witnessing by its project team and the Independent Third Party will provide a strong basis for deciding what commissioning retesting will be required after Release B software delivery to the site. With first generation at Muskrat Falls approaching, avoiding the need to spill water (due to LIL unavailability) will be considered in making Release B testing scope and schedule decisions.

We learned through a Hydro report filed with the Board on August 25th of an event that may have significant schedule implications. Commissioning of Pole 2 began on August 13. That very day, upon energization an equipment failure in the Soldiers Pond Pole 2 Valve Hall caused the LIL to trip. Commissioning on both poles has been suspended pending root cause analysis. Pole 1 formerly operated for a material length of time, begging questions about why operation was possible then:

- Whether the scope and quality of testing both planned and actually performed before Pole 1 began its operation in 2019 were sound
- Whether equipment degradation has affected Pole 1 since it ceased operating some time ago
- Whether software changes preceding the second FAT introduced flaws not existing when Pole 1 went into service in 2019 - - new flaws that regression testing failed to identify
- Whether the scope and quality of testing both planned and actually performed for the second, July FAT were sound.

Given the timing and nature of the August 13th event (a date on which we held our baseline information gathering session with Nalcor) we found it surprising not to learn of the event until examining a report Hydro filed with the Board well later - - on August 25th. We have had no opportunity to discuss the circumstances, without materially delaying this report further. Moreover, Hydro's August 25th report offers no detail useful in assessing their nature or potential consequences. What we do have at present is the context that history offers in addressing the significance of the Pole 2 trip. Even before the August 13th event, that context justified very significant concern about the ability get the LIL software to a sufficiently functional state on a timely basis. This recent, "out-of-the-gate" failure in Pole 2 commissioning further diminishes confidence in now very long efforts to correct software deficiencies and to ensure that those fixes are benign with respect to already developed and essential software capabilities. August 13 may not prove a consequential date in LIL completion, but what we know of it now increases rather than diminishes pessimism about reaching commercial operation by or shortly following December 1.

Thus, there remain a range of uncertainties surrounding LIL commissioning at 225MW and subsequent Trial Operation:

- Pole 2 has undergone only static commissioning, meaning that that its converter valves have not operated while functioning as a converter

- It does not appear that a reliable date exists for delivery of the Release B software needed for commencing Trial Operation.
- Pole 2 experienced the August 13th, equipment-caused trip at the very first stages of commissioning using the latest (Release A) software
- Commissioning will include tests of the two poles, operating individually and in coordinated bipole operation
- Bipole testing will include trips of each pole separately, to verify the capability of power transfer to the other pole
- The LIL has not yet operated at greater than 175MW
- Bipole commissioning will occasion the first operation of the electrode lines and sea electrodes at high power levels.

Continuing struggles to produce a usable software version continue to delay Trial Operation, previously expected to commence on September 14, 2020. With no firm commencement date yet available from GE, Nalcor has postulated an October 21, 2020 commencement date. Nalcor does not expect to be able to offer firm dates until late September. At best, October 21 commencement of Trial Operation and an ensuing 30 days of uninterrupted operation will enable the LIL to deliver commercial power from Labrador in late November. However, extremely little time exists to get work back underway following the August 13th Pole 2 trip, let alone to address other issues that may lurk among remaining activities and milestones.

Release B will eventually be followed by development of "Final" control and protection software. The Final software's added features will give operators important flexibility that neither Release B nor any previous version offers. For example, upon the failure of one pole, the overload capability of the remaining pole will support the LIL's transfer of power, while operators take immediate actions needed to start any generation needed to prevent under frequency load shedding. Pending installation of the final software, Hydro must apply operating restrictions to avoid system collapse and UFLS (under frequency load shedding). The lack of the ability to provide frequency control offers another example of the need for operating limits pending installation of the final software.

Work on the Final version has commenced, but most of GE's resources are focusing on Release B, which will form the core of the Final version. The Final version's expected availability has not yet been scheduled. At a minimum, we understand that no attempts at commissioning the Final control and protection software will occur through the current winter season.

We continue to lack direct access to sufficient information that would enable us to assign probabilities to a December 1 LIL operation date. Moving forward following the second FAT is somewhat encouraging, but the lack of firm, credible Release B availability dates makes it appropriate to temper optimism until the hoped for, late-September establishment of firmer expectations about Trial Operation commencement. The late-October date postulated by Nalcor for Trial Operation commencement leaves time for only a week or so delay in commencement, even assuming the first 30 days produce no trips. We continue to believe that there is less than a 50 percent chance that Nalcor will successfully complete Trial Operation period before the upcoming winter period commences.

4. Synchronous Condensers

We previously reported that work in completing the three Soldiers Pond synchronous condensers, critical to long-term LIL operation at its full capability of 900MW, has encountered three material problems - - binding, corrosion, and vibration. Commissioning the synchronous condensers by the beginning of this winter remains at high risk. However, retaining generation availability at Holyrood should substantially mitigate the consequences from any continuing unavailability of these three synchronous condensers, permitting LIL commissioning activities to continue at power transfer levels up to 225MW.

This month has brought no reason to question Nalcor's belief that the first issue (binding) has been resolved, but it remains important to confirm resolution by observing operation as commissioning continues through the remainder of this year. Similarly, the second issue (bearing corrosion) affecting Synchronous Condenser Unit 3 (SC3) continues to appear resolved.

Work continues on the third issue - - vibration observed on SC3 and SC 2. As we reported last month, should remedial actions already planned prove insufficient, more substantial work to address the units' foundations will take well past the current winter to complete, and may extend into the following winter season beginning in late 2021.

Synchronous Condenser Unit 2 (SC2) remains the most advanced of the three, undergoing a successful July test while connected to the grid. SC2 has operated in support of LIL testing since August 3. Such operation increases the short-circuit level and reduces the step changes in voltage during switching of transformers and ac harmonic filters. SC2 unit has continued to operate with air cooling, pending final resolution of corrections to its hydrogen-based system. Air operation has limited reactive power range to 45Mvar. Nalcor expects to re-engage the hydrogen system through a several-day process whose completion it expects before the end of August. Hydrogen cooling will enable SC2 to operate at higher levels of reactive power support (up to 175Mvar).

During August operation, lateral vibrations on SC2 have exceeded specified levels, but have remained below alarm thresholds. How those levels will affect synchronous condenser commissioning schedules and decisions about the need for the more substantial and longer duration foundation work remain uncertain.

Work on SC 3 has advanced during the past month. New SC3 bearings, modified to incorporate an elliptical design, arrived at Soldiers Pond on August 19. Nalcor expects a six-week installation period that will permit commencement of SC3 commissioning in early October. During commissioning, GE will operate the unit at various loads and collect vibration data. Observation, measurement, and analysis will inform decisions about conformity of vibration levels with design limits and good operating practice.

Meanwhile, work on designing the foundation solution to the lateral vibration issue has progressed to a 25 percent, design-review stage. A more firm view of schedule, should foundation work prove necessary, now exists. Three alternate ways of sequencing work have produced these projected implementation times:

- 21 to 25 weeks to complete work for all three synchronous condensers simultaneously

- 41-60 weeks to complete each in sequence
- 31 to 46 weeks to complete one unit first and then work simultaneously on the remaining two.

Nalcor has identified Option 3 as the preferred solution for the present. It offers a compromise between rework risk and schedule length. Option 1 creates the risk that reworking will prove necessary at all three units, should the solution not prove effective enough. Option 2 takes the longest time, potentially by a substantial margin. Nalcor expects to reach a 60 percent design-review milestone in September. Testing of SC3 after installation of the new bearings may permit reliable measurement of resulting vibration levels in October. When analysis of vibration data can take place, a further assessment of the need for foundation work will occur, with mobilization to commence work on it as soon as October, if deemed appropriate. Nominally, this start date would allow all three foundation sequencings to make all three synchronous condensers available by the start of the 2021/2022 winter. However, the schedules for the three options have a wide range and much design and other pre-construction work remains, giving them a substantial uncertainty factor.

5. Muskrat Falls Generators

LIL commissioning has anticipated the availability of generation from first Muskrat Falls units. Last month we reported that recognized delays in first Muskrat Falls unit availability, while not yet threatening, warranted consideration of alternatives to providing 225MW of power for transfer over the LIL.

The issue arose when testing identified Unit 1 equipment redesign and weld improvement needs. As we reported last month, the identification of remedial work moved Muskrat Falls Unit 1's Ready for Operation date from August to September of this year. The Unit 1 work has been performed, some testing is underway, and inspection is expected to be completed imminently. Progress to date supports September availability. We also reported last month the discovery of concrete debris in Unit 1's water passage. Nalcor expects to complete remediation of this issue during the outage taken for the inspection. Completion of the equipment installations and weld improvements on Unit 2 has commenced; Nalcor expects commercial operation in November, with Units 3 and 4 to follow.

Progress in the past month has reduced concern about Muskrat Falls support for LIL commissioning, but some level of uncertainty remains. The option of using a portion of the Churchill Falls 300MW block of recall power remains the one least encumbered by the need for agreement with out-of-province interests. That option will remain available until November or so, depending on the size of Labrador loads.

The other two options identified in last month's report continue to require use of Hydro Quebec's transmission system or power from Churchill Falls, which remains subject to review by plant management and ownership. Nalcor reported no progress this month on either option, but the most recent information about Muskrat Falls generation availability has diminished further the likelihood that they may prove needed.

6. Temporary LIL Faults

A TGS Report, "Operational Considerations of LIL Restarts and ML Runbacks," has shown that automatic LIL restart following a temporary HVDC double line fault should not be attempted, because doing so can produce a bipole outage. An automatic restart process follows detection of a fault on the HVDC line, typically a few hundred milliseconds (200ms or more) after the fault, energizing the line to enable power flow. TGS observed the following about the Maritime Link (ML) in such an event, "ML runback needs to occur immediately after the infeed from the LIL is lost." It appears that ML run back activation will be activated only on the trip of a LIL pole. Therefore, the ML will still continue to export power to Nova Scotia after loss of both LIL poles. Continuing ML export will produce a rapid frequency decline, resulting from the combination of the loss of power from Labrador, the IIS system load and the continuing export to Nova Scotia. Such a decline will likely produce underfrequency load shedding (UFLS), depending on the number of synchronous condensers in service. The number of bipole outages would increase significantly, because lightning strikes affecting the conductors of both LIL poles will happen.

We have asked Hydro management about examining two alternatives:

- Modifying the control and protection system to send a signal immediately to the ML to order a runback in the event of a strike to both conductors
- Immediately tripping one pole in the event of a double-pole strike in the event that it is not permissible to run back the ML without the trip of a pole.

An immediate trip would place the remaining pole into its designed-for overload mode, as required. The tripped pole could be restarted within a few seconds, if automated, or several minutes if manual. If feasible, fewer bipole outages would result. Another, more expensive solution might be to increase the number of synchronous condensers to slow the rate of frequency decline.

Hydro management agreed to consider options of these types.

7. Overall TTO Schedule Performance

We have in all our quarterly reports and in the first monthly report observed that actual TTO activity progress has regularly and significantly fallen below expectations. That gap continued this past month. We will only receive detailed TTO schedule information quarterly, which will defer our more-detailed schedule review until the quarter-ending month of September. Nalcor did, however, provide this month a high-level progress update on TTO activity progress; its highlights include:

- *Limited MPPA/IOA progress*: CFLCo discussions continuing, no reported progress on the IOA (the MPPA is a precondition to the IOA)
- *No Integrated Project Schedule updates*: continuing to gather information with next update expected by September end
- *Continued lag in bulk work progress:* slow pace continuing, major focus has been on completing generation-related items including spare parts identification, balance-of-plant training, asset plan development and operating procedure development with Manitoba Hydro International (MHI)
- *Progress on contracts:* 61generation-related O&M contracts: 29 addressed, 5 ready for tender, and 27 still in development.

- *Progress on Muskrat Falls emergency response plans*.
- *Continuing HVDC training development and completion lag:* continuing lack of full GE resource availability and performance, and no progress this month, with 24 percent of HVDC operator training and 40 percent of synchronous condenser training courses not completed.

8. Hydro's Preparations for Winter

We added to our monthly reporting process an assessment of Hydro's efforts to prepare its supply resources for reliable winter operation, given continuing issues affecting completion of the additions that the LCP will bring. We conducted a teleconference with Hydro and we reviewed a series of documents Hydro provided in response to requests we made at or following that meeting. We focused on the status of four principal components of those preparations for Hydro's supply resources:

- Specific major capital projects
- Completion of planned corrective and preventive maintenance work items (CM and PM)
- Planned winter readiness activities
- COVID-19 work restrictions and needs.

We and Hydro held a supply resource readiness preparations call on August 11, 2020 to discuss action-item status. We reviewed the scope and content of Hydro's plans and schedules to prepare certain generation assets for winter readiness and the status of key activities.

a. Water Availability

As we reported last month, water availability comprises an important determinant of the contribution that hydro generation makes in serving winter loads. Management reported a healthy supply of water for these facilities last month. July inflows fell below average, causing a decline in total energy storage - - from 369 to 326 GWh greater than calculated needs. Hydro therefore continues to see minimal risk with regard to energy stored at this time.

Nalcor Energy Marketing continues to remain engaged in planning water use for generation at Hydro's units. We plan to discuss in more detail the precise demarcation of roles, after reviewing the Reliability and Resource Adequacy Study Review RFI responses to which Hydro directed our attention.

b. Bay d'Espoir Penstocks

We discussed last month the history of penstock failures and the risks they pose to unit availability. Our inquiries this month focused on the frequency of penstock inspections. Hydro last performed an inspection of Penstock 1 in July of this year and has scheduled the next one for 2021. Hydro plans a Penstock 2 inspection this October and a Penstock 3 in 2021. Inspections will address previously repaired areas and other selected areas. With Penstock 1 having experienced greater problems, we question the use of the same cycle for inspecting all three. Hydro historically scheduled the penstock inspections on six-year cycles, reducing them to one year based on Penstock 1's failure rate. Hydro placed Penstock 2 and 3 on the same one-year cycle that now applies to Penstock 1 because those other two are experiencing similar weld deterioration. We

found this an appropriately conservative approach given the connection between weld deterioration and actual failure.

c. Holyrood Capital Projects

We continued to review the status of four Holyrood reliability projects Hydro has scheduled for completion prior to the coming winter: Unit 2 boiler assessment and repair, overhaul Unit 3's main boiler feed pump, overhaul of the Unit 2 main generator, and overhaul of the Unit 2 turbine control valves.

Hydro has completed the Unit 2 boiler inspection. Hydro has deferred the completion of two work items (internal borescope inspection of the economizer inlet header and condition assessment of the air heater) to 2021 because of COVID-related delays resulting from 14-day isolation requirements. Hydro has completed work on the other eight work items, either finding no issues requiring remediation, or correcting those needing repair or replacement.

Hydro has also completed the Unit 1 and Unit 3 boiler inspection. Hydro deferred completion of five work items into 2021 (inspection of the main steam terminal at Units 1 and 3, the condition assessment of the air heater Units 1 and 3, and the assessment of the forced draft fan at Unit 3) due to resource limitations resulting from COVID circumstances. Hydro has completed work on the other seven work items, either finding no issues requiring remediation, or correcting those needing repair or replacement.

An outside firm with extensive experience has visually inspected or reviewed records of the Unit 1 and Unit 3 systems and equipment that the deferred items address, concluding that existing condition supports operation through the deferral duration at an acceptable level of failure risk. We plan to secure additional information to validate the basis for determining that deferral does not impose undue risk.

Hydro has also completed the overhaul of the Unit 3 boiler feed pump, with its inspection finding a bent pump impeller shaft requiring replacement. Hydro has scheduled completion of the replacement work by November 2. Normal operation does not produce bent shafts. We consider it unusual to encounter bending of this particularly robust piece of equipment in a generating unit. Hydro needs to address the cause, in order to ensure that no near-term risk of recurrence exists during times when unit availability will prove critical. The cause of the bent shaft should be determined to ensure that going forward another major issue does not occur with this pump during operation when needed.

Work on the other two major projects, overhaul of the Unit 2 main generator and turbine valves has progressed, but work remains to complete them. Hydro anticipates completion of the Unit 2 main generator overhaul by September 18, with work to date identifying no issues threatening availability for the winter season. Turbine valve disassembly, inspection, and refurbishment are continuing, again, with no major findings reported so far and an expectation that Hydro can complete the required work by September 20.

d. Corrective and Preventive Maintenance

Hydro continued this month to operate under an integrated annual work plan that includes all O&M work activities. Management reports plan completion at 88 percent this month versus 85 percent at the time of our last report. Work continues to remain on schedule and subject to a system for regular statusing, risk ranking, and prioritizing of remaining maintenance items.

e. Winter Readiness Checklist

We again inquired into the status of Hydro's winter readiness work plan. Hydro reported that work completion moved from 89 to 90 percent complete since our last report, remaining on schedule. Hydro last month had placed 103 of the 106 planned contracts critical to winter operation; none of the other three were executed since then, but remain on schedule. Reported supply of critical parts and equipment also continued to remain on track.

f. Our Plans for Next Month

We plan to secure the following as part of our inquiries for the coming month:

- Status summaries for the four ongoing Holyrood capital projects, including milestone information regarding the Holyrood boiler assessments and detailed information about exceptions produced by the turbine valve and main generator inspections
- Copies of any interim or final vendor inspections reports for the Holyrood Capital projects as they become available
- Support for the assessment that deferral of identified Holyrood work (Unit 1 economizer and air heater and the Unit 3 main steam turbine terminal, air heater, and forced draft fan) will produce acceptable risk
- Determination of reasons for any reductions in original work scope associated with Holyrood tracking crack growth and growth rates (Unit 1 economizer), main steam turbine terminal inspection to monitor creep and wall thinning (Unit 3)
- Causal analysis of Unit 3 boiler feed pump bent shaft.