

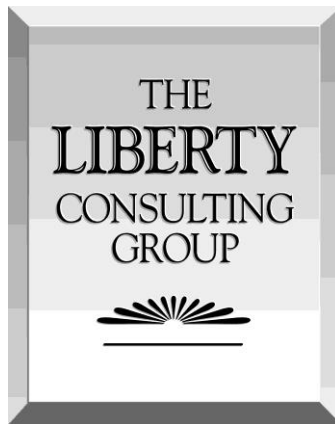
**Sixth Monthly Monitoring Report on  
Integrating LCP Facilities into the IIS  
and Hydro Preparations for Winter**

**Presented to:**

**The Board of Commissioners of Public Utilities  
Newfoundland and Labrador**

**Presented by:**

**The Liberty Consulting Group**



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**1451 Quentin Rd Suite 400**  
**#343**  
**Lebanon, PA 17042**

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### **1. Report Background and Purpose**

This sixth report following the change from quarterly reporting addresses the progress and status in 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.

### **2. Report Summary**

#### *a. Control Software*

The Interim B version of the software has now passed the Factory Acceptance Test (FAT), GE installed it at the sites on October 23, 2020. Commissioning of Pole 1 has resumed using this version. Work on the Final LIL control software has commenced, and delivery to site of this version has been scheduled as May 31, 2021.

#### *b. Commissioning*

Commissioning of Pole 1 recommenced on November 28, 2020, employing the temporary solution identified for correcting beam problems associated with the August flashovers in the valve halls for both poles of the LIL. At the time of our meeting Pole 1 was operating at 45MW. Commissioning of Pole 2 and bipolar operation; *i.e.* operation of Pole 1 and Pole 2 together, is expected to be completed on February 15, 2021. Following that completion, the Trial Operation period requiring 30 days of uninterrupted power transmission will commence - - anticipated on February 15, 2021, if bipole commissioning ends as expected.

#### *c. Valve-Hall Flashover*

GE has finally determined inadequate beam curing during manufacturing as the root cause of the August flashovers. GE has now replaced all Pole 1 beams with cured beams from Pole 1 and Pole 2, as a temporary measure to permit a resumption of LIL commissioning. We continue to lack access to sufficiently detailed information about temporary beam replacement to comment on its propriety. However, our inquiries of Nalcor showed that GE has been attentive to ensuring that commissioning resumption will occasion minimal risk of catastrophic failure.

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Eventually, these recured beams will undergo replacement by new beams supplied from the secondary manufacturer. That secondary manufacturer's beams did not experience the problem with those supplied by the primary manufacturer. Nalcor reported an expectation that those replacement beams will be manufactured by the end of the first quarter of 2021. There remains no firm plan and schedule for installing those replacement beams under the complex process and in the confined spaces involved. Nalcor expects such a plan and schedule in January 2021. Neither beam manufacturing and delivery or installation dates are firm, but Nalcor does not expect either to be on the critical path for LIL commissioning under the Final software version.

*d. Our Expectations for LIL Operation this Winter*

Successful operation of Pole 1 with 45MW being transmitted from MF to the IIS represents a significant forward step. We still consider completion of LIL Trial Operation at 225MW before April possible, but relying on that date continues to be overly optimistic. Achievement of reliable LIL operations may well extend beyond April. A new complication arose in early December, with a major damage-causing breach of the lagoon protecting the LIL's Sea Electrode in Labrador.

*e. Washout of the LIL's Labrador Sea Electrode*

We learned on December 4 of damage to the sea electrodes, caused possibly by waves generated during a recent storm. Nalcor began with high-resolution satellite imaging to examine and monitor the site. Nalcor reported, however, that detailed inspection of the site remained to be conducted before damage can be fully assessed and repair needs and schedule determined. Pending repairs, loss of the sea electrode requires that current commissioning activities rely on the other pole conductor as a metallic return path. Onsite inspection results should be becoming available about now, but weather conditions may delay the repair of the electrode site.

Photographic images from Nalcor indicate unknown but potentially substantial damage to the sea electrodes and the lagoon protecting them. The images indicate that some large boulders have moved, soil/sediment infiltration may have occurred, structural elements may have been damaged, and that lagoon water level is surprisingly low. We have not had occasion to draw firm conclusions on the event, but there appears a substantial probability that significant repair time will prove necessary. Moreover, unless evidence emerges that a storm of historic proportions caused the damage, it may well be that the lagoon will require redesign to provide assurances against post-repair repetition.

Bipole commissioning will require availability of at least part of the sea electrode. Subsequently, it will take full completion of repairs to permit commissioning at full power. For the interim, Nalcor has stated that it believes it can make corrections needed to support the current schedule for commencing bipole commissioning. We consider it premature to agree, given the potential extent of the damage, the potential need for site redesign, and the need for making repairs in harsh climatic conditions.

*f. Final Software Delivery and Commissioning*

Nalcor anticipates delivery of the Final software to site by the end of May, 2021. It is speculative to assume LIL completion of Trial Operation or the status of permanent beam replacement as of

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that date. Nalcor expects LIL commissioning under the Final software version by July 31, 2021. We consider that date overly optimistic, given the uncertainties inherent in commissioning, magnified here by the history of problems and delays that have delayed LIL progress for a very long time. This history makes it appropriate to caution that full power LIL operation may extend into the fall of 2021 or later.

*g. Synchronous Condenser Progress Continues as Expected*

SC2 and SC3 now both operate synchronized to the grid and with the use of hydrogen-system cooling. GE has tested them up to 120 MVAR (70 percent load rejection testing). Noise and vibration data continues to be collected as the units operate during testing. Both GE and experts independently retained by Nalcor continue to analyze measurements of vibrations. GE has indicated that it finds the remaining vibrations acceptable. Nalcor's expert, however, has as yet some unresolved concerns about the implications of the vibration data for long-term operation. Plans call for meetings between GE and Nalcor's expert to address concerns about the implications of the vibration data, hopefully leading to a consensus with GE by the end of this month.

In the meantime, work is ready to commence on the foundation solution, should it prove necessary. Nalcor has advised that this solution, while it remains the accepted alternative, involves uncertainty as well. Expectations for its success depend on the validity of the modeling that supports it. Nalcor continues to view the SC unavailability as posing no threat to LIL commissioning.

*h. Muskrat Falls Generation*

Unit 1 having completed testing, returned to service on December 3, and has been turned over to the Energy Control Center. Mechanical conditioning issues have arisen during Unit 2 testing. With cleaning and repairs underway, Nalcor expects to complete overspeed testing by December 25. Successful completion of that milestone will support placing the unit back online by early February for commissioning. Unit 3 commercial operation, a trigger for power delivery obligations into Nova Scotia remains slated for May 2021- - essentially contemporaneous with Nalcor's expectations for completion of LIL Trial Operations. Muskrat Falls generation continues to appear sufficiently advanced to satisfy LIL commissioning needs this winter, absent future setbacks.

Power deliveries from the west through Labrador therefore continue to appear unnecessary. Progress remains elusive in restarting discussions regarding the MPPA/IOA. They still have not resumed, with the parties currently exchanging proposals for their restart. Efforts are now underway to find a source of mediation to get CFLCo signed on. Nalcor reported an expectation that the matter may come before the CFLCo board in January or February. While not apparently needed to support LIL commissioning, the continuing inability to make progress on this front is a matter of increasing longer-term concern.

*i. Overall TTO Progress*

Our monthly reports have focused on high-level reviews of progress and delays in meeting the overall TTO schedule, which includes many detailed activities. Last month, our more detailed, quarterly review showed that, despite important progress made, long-standing, significant gaps in completing many activities required and in developing and delivering training remained. Progress continues to be made, but a number of gaps persist.

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*j. LIL Restarts*

We also continue to monitor progress in Hydro's efforts to address the conclusions of an outside expert that automatic LIL restart attempts following a temporary HVDC double line fault could produce underfrequency load shedding, absent restrictions on exports to Nova Scotia over the Maritime Link (ML).

*k. Hydro's Readiness Preparation Continues to Make Good Progress*

Hydro reported continued water supply levels that exceeded minimum targets, approached 20-year averages, and exceeded those experienced at this time last year. Management's updates regarding previously-reported issues at Bay d'Espoir indicate no concerns for the immediate term. Hydro has completed work on the four Holyrood capital projects, and a previously deferred inspection item. Hydro reported that it remains on track to complete the annual work plan activities, with 100 percent of planned winter readiness activities already completed. Hydro has reported no outstanding significant risks to generation for the winter 2020-2021 period.

### **3. LIL Status**

*a. Control Software*

It has long been the plan that Final LIL control software would not become available until after commissioning and successful completion of Trial Operation using the interim version; *i.e.*, in mid-2021. Only the Final software version's successful installation and operation will permit LIL operation at its maximum rating (900MW) with all specified functionality. After significant delay and continuing problems, the Interim B version of the software has now passed the Factory FAT. GE installed it at the sites on October 23, 2020, followed by restart of Pole 1 commissioning on November 28, 2020. Nalcor advised at our December 4 meeting that Pole 1 was transmitting 45MW from Muskrat Falls to Soldiers Pond, in the midst of an expected two-hour transmission. This power flow represented the first using the Interim B software.

*b. Commissioning*

At the time of our December 4 meeting, GE had made substantial progress on its temporary beam replacement program to address the problems discovered following the August flashover events affecting both LIL poles. GE had replaced all Pole 1 beams that showed inadequate resistance, using Pole 1 and Pole 2 beams that it has subjected to a recurring process. Some beams required to support Pole 2 commissioning had not yet completed the new heat curing process. Nalcor reported progress on them at levels supportive of the current schedule for Pole 2 commissioning restart.

Nalcor advised that GE had secured testing of all replaced beams before restart of Pole1 commissioning, to ensure their continuing suitability to withstand the electrical stresses anticipated. Nalcor also stated that testing of the beams would continue at regular intervals, to ensure that they remained usable.

On December 4, GE testing of power transfer at the minimum power level of 45MW commenced, with Pole 1 transferring this power level then for 1.5 hours - - with expected disconnect after 2 hours. Achieving first transfer of sustained power comprises a significant step. GE hopes to

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complete commissioning of Pole 1 before December 25, followed by commencement of Pole 2 commissioning on or before the January 2021 target date. Recommencement depends on completion of the replacement of all beams required for Pole 2.

Nalcor stated that they hoped to be able to import power on Pole 1 during the Christmas period. The power level would be set relatively low, so that a trip of the Pole 1 would not result in any Under Frequency Load Shedding. Any such arrangement would require agreement from Hydro, but informally the import of an agreed level of power, the loss of which would not cause UFLS did not seem to be an issue.

Commissioning of Pole 2 and bipolar operation; *i.e.* operation of Pole 1 and Pole 2 together, is expected to be complete on February 15, 2021. If this is achieved, the Trial Operation period of 30 days uninterrupted power transmission could start on February 15, 2021.

*c. Valve-Hall Flashover Events*

As causal testing and analysis matured, GE and Nalcor for some time believed that a manufacturing defect in support beams in the Pole 1 and Pole 2 valve halls caused the August flashover events. GE has now formally concluded that inadequate curing in the manufacturing process employed by the larger of the two beam suppliers involved did in fact cause those flashovers. The manufacturer involved provided 90 percent of the total beams. GE also determined some time ago that the second manufacturer's beams did not suffer that defect. The plan for addressing the beams involves replacement of all of the beams supplied by the 90 percent supplier. Those permanent replacements will come from the 10 percent supplier.

We continue to lack access to sufficiently detailed information about the temporary beam replacement process to comment on its propriety. However, from what we have been told, GE does seem to be taking appropriate precautions to ensure that a repeat of the flashover issue will not result in extensive damage to the thyristor valves or other components. This includes re-testing at regular intervals of the beams, lower settings of the protections, and even the use of a 10 percent lower operating voltage applied to the valves, and therefore the beams. Our inquiries of Nalcor showed that GE has been attentive to ensuring that commissioning resumption will occasion minimal risk of catastrophic failure.

Permanent replacement will not occur prior to the second quarter of 2012, at the earliest. Meantime, GE has been proceeding to recure enough defective beams from Pole 1 and Pole 2 to provide a sufficient number to permit recommencement of Pole 1 commissioning, which is already underway. The beams have been heat cured under a process that GE has verified as sufficient to permit such use. That verification process includes continuing retesting of recured beams to ensure that they retain capability, combined with tighter environmental conditions in the valve halls, to support the commissioning underway. GE is continuing to heat cure the remaining affected beams on Pole 2 to enable recommencement of Pole 2 commissioning, hopefully in January 2021. All recured beams used temporarily will be replaced with beams from the 10 percent supplier prior to final commissioning of the LIL at full power next year.

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GE has in hand for testing and eventual approval a prototype of the beam proposed for permanent replacement. Nalcor expects completion of replacement beam manufacturing by the end of the first quarter of 2021. That schedule remains tentative, but Nalcor does not believe the process threatens full-power LIL commissioning. Whether to ship the permanent replacement beams together or in batches remains open, pending further developments in areas that include addressing space limitations at the site, progress in commissioning now underway, and progress in completing Trial Operation at low power.

The valve hall design did not consider the disassembly/reassembly needs occasioned by the massive beam replacement project. Determining how most carefully yet expeditiously to address space constraints comprises a major reason why no firm replacement plan and schedule yet exist. Nalcor expects final plan availability in January 2021.

*d. Our Expectations Regarding LIL Operation this Winter*

The schedule - - particularly for LIL completion this winter - - remains, as it has for many months, highly uncertain. Mid-March has become the earliest date by which the LIL can successfully complete Trial Operation. GE completed replacement of the affected beams on Pole 1 in a relatively short time, which increases the confidence that it can repeat this success with Pole 2. Successful Pole 1 transfer at 45MW from Muskrat Falls to the IIS also comprises an encouraging event.

Completion of commissioning as rapidly as Nalcor has reported remains subject to great risk. Moreover, as we explain below, December has brought yet more disruption and uncertainty, with the apparent failure of the lagoon protecting the LIL's sea electrodes in Labrador (addressed immediately below). Pending completion of investigation and analysis of the causes, effects, and remediation of the failure, one cannot put high confidence in a date for bipole commissioning. Hopefully, with maximum power required of 225MW for low power commissioning, the lessened sea electrode capacity may be sufficient for that commissioning.

Issues and uncertainties we have been addressing for some time, combined with the sea electrode issue recently arising, cause us to consider completion of LIL Trial Operation at 225MW before April possible, but not one engendering significant confidence. Achievement of reliable LIL operations has a significant probability of extending beyond April 2021.

Nalcor confirmed that they would be working closely with Hydro during the commissioning and trial operation of the LIL. This is important, because poor LIL performance during commissioning: *e.g.* trips or other unexpected events, could have consequences on the grid, particularly during the winter period, when the network is otherwise most stressed.

*e. Sea Electrode Washout*

The LIL requires availability of sea electrodes in Labrador and in Newfoundland to operate in bipole mode. Sea electrode configurations for HVDC scheme like the LIL typically consist of many electrodes suspended from a non-metallic platform, and always immersed in the sea. Artificial lagoons created by using large boulders typically protect sea electrodes from water

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turmoil (from storms and wave action, for example). Lagoon design incorporates dimensions necessary to protect life in the sea from electrical harm.

When operating in normal bipole mode, the LIL's high voltage conductors will carry the current from Muskrat Falls to Soldiers Pond. Normal operation will produce very little current along the neutral return path. Low voltage conductors between the converter station and the electrode sites in Labrador and in Newfoundland create that path.

With one pole not carrying current (temporarily or longer-term), the return path for current transmitted across the high voltage conductor becomes the low voltage conductors to the sea electrodes. Unavailability of this return path will cause both poles to trip in the event of problems affecting either one.

We learned on December 4, 2020 of a "washout" at the Labrador sea electrode site. It affected operation of the sea electrode, requiring commissioning of Pole 1 of the LIL to employ the metallic return path (the Pole 2 HV conductor).

Inspection of the site had not yet by then occurred, but Nalcor has since provided two photographs showing site conditions. We describe above the typical design characteristics of sea electrode configurations, but have not yet had an opportunity to learn about the specifics of design and construction at this site. Artificial lagoons, built using large boulders, typically protect sea electrode sites from wave incursion. Design of these facilities seeks to ensure that maximum current flows would not harm life outside the lagoons.

The photographs provided by Nalcor appear to show dislodgement of some boulders from the artificial lagoon and possible destruction of the bridges from which the individual electrodes are suspended. They also show a surprisingly small amount of water in what appears to be the lagoon. Soil shown in the photographs indicates that wave action may have swept soil into the lagoon.

More inquiry is needed, but the photos indicate potentially major damage, possibly involving movement of some of the large boulders and major damage to the electrode rods and their suspension arrangements. The lagoon's remote location likely means considerable time to repair this damage.

Repairs of at least part of the electrode will need to be done before bipole commissioning can proceed. Only part of the electrode needs to be serviceable during initial bipole commissioning (low power transmission results in low electrode current). Nevertheless, Nalcor will need to account for events (*e.g.*, commutation failures and line faults), that could cause short term over currents. It would appear that, beyond simple repair, it may prove prudent to strengthen at least the boulder barrier, which has failed to protect the electrode from the sea. Nalcor will need to complete final repairs before commissioning at full power. In the meantime, Pole 1 commissioning continues, using metallic return. Nalcor expects final repairs in time to support the current schedule for commencement of low-power bipole commissioning.



*f. Final Software Delivery and Commissioning*

Nalcor considers progress on Final software development satisfactory; however, they did not provide a firm schedule for its completion. Nalcor reported that it has observed no problems recently in its development. Lessons learned from use of the Interim B software for commissioning will inform required rectifications in the Final software, and in the Interim B version if necessary to continue to support commissioning activities already underway.

Two significant uncertainties surround the Final version software at present. First is the date when it will eventually complete FAT (Factory Acceptance Testing) successfully. The second concerns the timing of the availability of the final replacement beams. Nalcor considers delivery of the replacement beams early in the second quarter of 2021 likely. Delivery will commence another period of disassembly/reassembly of some 300 beams, as compared with the 93 involved in the present round of replacements. Lessons learned from this first replacements, will hopefully result in a safe and faster replacement process.

Delivery of the Final software to site is expected by Nalcor to happen by the end of May 2021. If the commissioning with Interim B goes well and if the Trial Operation with this software goes well, this might leave a suitable time window for the replacement of the defective beams with the final version of the beams.

If the final software is not ready until after the beams have been replaced, GE may re-commission the LIL with the Interim B software. This would mean that the full functionality of the LIL will not be available, but some power could be transmitted. Nalcor expects more firm plans in this regard in January.

When the beams have been replaced and the final software has been delivered, commissioning of the LIL at power up to 900MW and the additional bipolar functions have to be tested. Nalcor's schedule, which has dates later than those expected by GE, can be seen below:

<b>Item</b>	<b>GE Schedule</b>	<b>LCP Schedule</b>
Final Software to Site	May 20, 2021	May 31, 2021
Dynamic Commissioning Complete	June 28, 2021	July 31, 2021
Trial Operations Commence (at available power)	June 29, 2021	August 1, 2021

Nalcor's schedule is more cautious than the one proposed by GE, which is not surprising given GE's past performance. However, it may still not be achievable:

- The commissioning of Pole 1 and 2 at up to 225MW may identify issues and delay the commencement of the Trial Operation
- The Trial Operation at up to 225MW may have to be restarted if any trips or other issues arise
- All beams provided by the original main beam supplier will have to be replaced, which will be a difficult and time consuming task, given the limited space in the valve halls and the need to maintain a clean environment
- The Final software will have to pass the FAT, after the new software features have been integrated in the Interim B software, which may cause issues and delays to the FAT

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- Constraints that will be placed on the final commissioning of the LIL, in particular tests at high power that could put the IIS at risk if the control response fails or is incorrect. To minimize the risks, such testing is likely to be permitted only during specific operating conditions, which will slow down the commissioning progress
  - Trial Operation at up to 900MW, which may have to be re-started in the event of trips and other issues
  - Commissioning and Trial Operation may also need to be performed without the support of the synchronous condensers if the remaining vibrations necessitates foundation work; *i.e.* the commissioning will take place at lower short circuit level than specified for the design.

These uncertainties inherent in commissioning and Trial Operations and the history of problems and delays that have delayed LIL progress to date make it appropriate to caution that full power LIL operation may extend into the fall of 2021 or later.

#### 4. Synchronous Condensers

We have been reporting for some time on continuing efforts to address binding, corrosion, and vibration issues affecting completion of the three Soldiers Pond synchronous condensers important to long-term LIL operation at its full capability of 900MW. We have been reporting no reason to question Nalcor's view that binding and bearing-corrosion issues continue to appear effectively resolved. Some doubt now exists, following observations about vibration data from SC2 and SC3 during November.

SC2 and SC3 now operate with the use of hydrogen cooling. Air-based cooling had been used pending modifications to the hydrogen-based systems. Both have undergone testing up to 120 MVAR (70 percent load rejection testing) while synchronized to the grid and tested. Next steps call for testing at up to 100 percent load rejection. GE has continued noise and vibration data collection during testing. Audible noise has decreased, but, like vibrations, differs between the two units. SC2 continues to employ the 4 Lobe bearing originally intended, while SC3 has been equipped with an Elliptical (2 Lobe) bearing that GE has proposed to install (subject to effectiveness confirmation) on all three Soldiers Pond synchronous condensers to address vibration issues.

Both GE and experts retained by Nalcor have been examining recorded vibration data over the past month or so. GE considers the remaining vibrations acceptable, but Nalcor's expert has yet to be convinced. Among the concerns of Nalcor's expert are long term impacts on equipment. A mid-December meeting between GE and Nalcor and their experts plans to address the vibration data and differences in views about the significance of that data. The current plan is to seek common resolution.

In the meantime, personnel and equipment required for work to commence on the foundations have arrived in Newfoundland, with personnel completing self-isolation requirements. Thus, Nalcor has continued to provide for prompt commencement of the foundation alternative, if necessary. Nalcor has reported that the foundation alternative, while it remains the preferred option if vibration issues remain, will not necessarily prove fully successful. Its success depends on the

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validity of modeling results that support its use. Moreover, while not clearly threatening, the foundation work does create the normal construction risk of damage to existing building foundation elements.

Nalcor continues to conclude that unavailability of the SCs pending resolution of the vibration issues will have no negative impact on the progress of LIL commissioning. Operation of the Soldiers Pond SCs will, however, strengthen the transmission system, thus permitting higher power transmission with lower risk. We plan to discuss the potential for long-term SC unavailability as power levels increase during LIL commissioning and for the period immediately following full-power LIL operation.

## **5. Muskrat Falls Generators**

Unit 1 completed its 72-hour operation test. It required some post-operations testing, since completed, with the unit returned to service on December 3. It has been turned over to the Energy Control Center and continued to operate at or above 180MW through December 4. Management discovered some mechanical conditioning issues during overspeed testing of Unit 2. Cleaning and repairs are underway, with the expectation of completing overspeed testing successfully by December 25. If successful, management expects to place Unit 2 back on line by early February for commissioning.

Unit 3 commercial operation, a trigger for power delivery obligations into Nova Scotia is slated for May 2021 - - essentially contemporaneous with Nalcor's expectations for completion of LIL Trial Operations. Nalcor has reported the scheduling of talks with Hydro Quebec in the next several weeks, but Muskrat Falls generation appears sufficiently advanced to satisfy LIL commissioning needs this winter, absent future setbacks.

## **6. Temporary LIL Faults**

Our last report addressed the potential for automatic LIL restart following a temporary HVDC double line fault to produce a bipole outage that should activate restrictions of exports over the ML. Absent such an ML runback, underfrequency load shedding could result, depending on the number of synchronous condensers in service. Hydro management agreed to examine means to avoid this result. We reviewed a technical report Hydro provided (HVdc Transmission Line Insulation Coordination Study). The details of that report still remain under discussion with Hydro.

## **7. Overall TTO Schedule Performance**

Overall TTO activity progress has regularly and significantly fallen below expectations since we began our monitoring efforts in early 2018. That gap continues, but no new threats have been identified over the last month.

## **8. Hydro's Preparations for Winter**

We continued to review Hydro's efforts to prepare its supply resources for reliable winter operation.

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*a. Water Availability*

Management reported a substantial supply of water facilities this month, with a storage level 493 GWh above the minimum target. The storage level amounted to 1,838 GWh at the end of November - - 238 GWh more than last year and slightly below the 20-year average. Hydro, therefore, continues to see minimal risk with regard to energy in storage.

*b. Bay d'Espoir Penstocks*

Hydro's completion of the planned, Level 2 inspection of Penstock 2 included interior and exterior portions of Penstock walls and examined previous weld repairs and selected new wall areas. The inspection and testing reportedly found no conditions degraded from those observed in 2019 inspections and no new conditions of concern that would negatively affect the winter readiness of these units. A detailed report of inspection results is now expected in late December.

No new risks to Bay d'Espoir were reported this month.

*c. Holyrood Capital Projects*

We continued to review the status of four Holyrood projects scheduled for completion prior to the coming winter:

- Unit 1, 2, and 3 boiler assessment and repair
- Overhaul of Unit 3's main boiler feed pump
- Overhaul of the Unit 2 main generator
- Overhaul of the Unit 2 turbine control valves.

Hydro has completed the planned work on the four projects. Hydro continues to report no observed issues that pose significant risk to generation for the coming winter.

*d. Corrective and Preventive Maintenance*

Hydro continued this month to operate under its integrated annual work plan (IAWP) for O&M activities. Hydro presented a detailed view of progress made in accomplishing activities planned under the IAWP. The total number of activities complete as of December 11, 2020 per the integrated annual work plan was reported to be 92.3 percent - - ahead of plan for this time. Hydro reported all IAWP items on track for completion by December 31, 2020.

*e. Winter Readiness Checklist*

As of December 11, 2020, 100 percent of the winter readiness planned activities were complete for all generating assets. Just one contract remains unfilled at this time, and Hydro reports it to have no impact on winter readiness. Management reported the supply of critical parts and equipment to be at 98.9 percent of items now in stock with about 13 items remaining to be ordered or received. Eight of the 13 items are scheduled to be delivered in December 2020. The other 5 items are scheduled for 2021 but are reported to be low risk to winter readiness.

*f. Other Risks*

We discussed with Hydro two additional risks to generation. The first concerned the Holyrood Unit 1 Boiler Feed Pump West. Hydro experienced a failure of the feed pump on October 25, 2020.

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An inspection revealed that the pump shaft had seized, with damage to the motor. Preliminary indications of the cause of the event pointed to operator error - - manually shutting the wrong valve. Hydro sent the pump to its original manufacturer, Flowserve, for repairs, expecting it back on site in February 2021. Hydro also sent the motor off-site for repairs, and expects it back on-site in January of 2021. A root cause investigation by Hydro staff remains under way, employing assistance from the manufacturer. Hydro placed completion of the root cause report at 90 percent presently. The root cause analysis has focused on determining:

- Event causes
- Why protective design features did not prevent damage to the motor and pump
- Why the spare motor was not configured properly
- Corrective actions.

We will continue to track the progress of the root cause for this event.

The second additional risk reviewed involved an issue that arose with Holyrood's Unit 3 Circulating Water Seal Pit Discharge Piping. In February 2020, a sink hole appeared over the stage 2 (Unit 3) circulating water discharge line from the seal pit to the outfall to Holyrood Bay. This was confirmed to be a leak in the circulating water discharge line. A repair plan was subsequently developed but could not be implemented because it was deemed unsafe for a diver to enter the water to install a line plug for the work. Consequently, Hydro engaged an engineering firm to review the issue. The firm classified this leak as a low risk to generation presently, concluding that the unit could continue operations. Hydro reports that should the pipe fail, Unit 3 would become unavailable until repair completion, estimated by Hydro at seven days duration.