

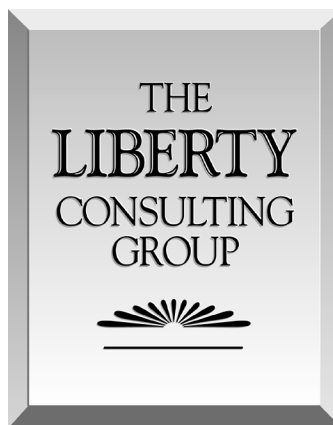
**Thirteenth Quarterly Monitoring Report on the
Integration of Power Supply Facilities to the
Island Interconnected System**

Presented to:

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

Presented by:

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1. Purpose of this Report

This report examines third quarter 2021 scheduled and completed activities undertaken as part of the Transition to Operation (TTO) organization’s role in getting the Lower Churchill Project (LCP) assets integrated into the province’s electrical system. It represents the third quarterly report following resumption of that cycle, which had been replaced, starting in May of 2020, by monthly reviews. COVID-19 restrictions continued to foreclose in-person interaction with Nalcor and Hydro personnel in the preparation of this report.

We reviewed each of Hydro’s monthly reports filed since the conclusion of our previous quarterly report as well as portions of the RFI responses filed in the reliability and resource adequacy study to the extent that they had relevance to this effort. We sent to Nalcor a detailed list of agenda items for discussion and further supplemented it with the receipt of the monthly report covering September activities. We participated in an October 14 meeting to discuss our agenda items with Nalcor representatives. TTO provided written materials responsive to our agenda items and to topics that emerged at the meetings. After reviewing the materials we requested and received further information from Nalcor on November 9.

2. Summary of Major Observations

LIL Progress: GE completed converter-station valve-hall beam replacement in early August, with no reported problems with the replacements. The LIL transferred power for most of September, delivering 119 GWh net of losses, and going offline on September 25 to support static checks associated with the control software. After returning to operation on October 15, the LIL has been energized intermittently to permit dynamic commissioning tests. LIL operation requires at least two Muskrat Falls generating units to be in service.

Control software development, as it has for several years, still delays LIL completion. Long-overdue successful completion of Final Acceptance Testing (FAT), slated for August completion last quarter, remained pending through early November. Nalcor now expects completion of Trial Operation (a last key step in reaching commercial operation) in late March 2022 - - three months beyond the current GE schedule. Nalcor's date already takes completion to the end of the winter; history and the continuation of critical bug discovery and clearing suggest that Nalcor's date is too optimistic. However, if it proves true that the LIL can operate through this winter at up to 325 MW, it can make a substantial contribution to supply availability this winter. Getting through the winter will then provide significant time for the LIL to reach full power operation before the winter after this one.

Synchronous Condensers: All three Synchronous Condensers (SCs) have now become available, with the addition of the last one - - SC1. All have been fitted with the elliptical bearings intended to reduce vibration levels, which have reportedly remained within limits. The modifications made to address vibrations have diminished the vibration levels to within limits, as so far monitored. They do not, however, alter the resonant frequency of the foundation and they have altered the dynamics of the shaft and its alignment. Factors like these, which appear still to raise questions to Nalcor's outside expert, raise possible implications for long-term operation. Nalcor does not have current concern about operation under the revised configuration, but plans to assess impacts of the current configuration and continuation of the root cause of the vibration issues on long term operations. Additional vibration monitoring equipment installed will continue to produce data. Nalcor considers it likely but not certain that any latent defects will manifest themselves within the warranty period or after a major inspection due after 40,000 operating hours.

A September 1 trip of two Synchronous Condensers caused a trip of both LIL poles at Soldiers Pond to trip. Trips of multiple SC units due to a single cause can threaten widespread Island power loss due to over-voltages, making it important to eliminate the risk of such multiple SC trips.

Storm Event Repairs: Following last quarter's completion of repairs following last winter's weather conditions in Labrador, a drone-supported inspection has confirmed management's belief that no significant repair/replacement issues remain. Delivery issues delayed completion of planned anti-galloping devices on southern Labrador spans. Risks of similar exposure at other locations remain under investigation, with plans to address those exposures as part of the Reliability and Resource Adequacy Study. Plans continued for the securing of 24/7 road clearing resources and for adding access to additional line contractors to expand resources for responding to line failures.

Repairs from 2020 storm damage at the L'Anse aux Diable Electrode Site were completed in May, with an outside expert's root cause, design review, and wave analysis report due imminently. Construction to an updated design is slated for 2022. In the interim, an absence of regular monitoring of this remote site will leave it exposed to unrecognized damage having the potential to cause underfrequency load shedding (UFLS) in the event of a fault producing a LIL bipole failure.

Muskrat Falls Generators: All units have been released to operations except for unit 4, where the approaching completion of final commissioning activities indicate a release for service this month. Modifications to address issues summarized in our last report advanced substantially. Nalcor expects Unit 1 to return to service in the middle of this month, following clean up and remediation following an October pit flooding incident. Unit 2 has returned to constant power following a vibration incident, while root cause analysis continues.

Overall TTO Schedule Status: TTO activities continued to progress toward completion at a reasonable pace. Late October overall completion reached 98.4 of planned 99.9 percent completion. Only four of the original 32 TTO scheduled milestones remain open, and only 3 of the remaining detailed TTO activities associated with those milestones are critical to achieving the closure of all milestones.

Staffing and Training: Management has decided not to fill the only position open from the 141 included in its original plans. Human Resources has responsibility for filling positions under the current plans, which comprise approximately 200 positions. It has filled all but 17 of the positions called for by current plans. MHI personnel continue to fill five Hydro Operations positions under a services contract and a hiring freeze pending Nalcor/Hydro restructuring has place a hold on the other 12. Nalcor reports completion of all training associated with asset release for service (Phase I) and adequate progress on Phase II with follow-on, detailed maintenance program programs and activities training (Phase II).

Muskrat Falls Site Emergency Response: The Muskrat Falls generation team still operates under the plan of the LCP, which remains responsible for the site. The Soldiers Pond site teams continue to operate under an interim ERP, with the final version under review. Several activities scheduled for completion this year show low completion percentages; we will continue to monitor progress on those important for turnover to operations.

Maintenance Programs Build Out: Nalcor reports completion of work on the preventive maintenance activities that require frequent (daily, weekly, or monthly) performance. Nalcor expects completion of work on low frequency activities by the end of the month. Progress so far appears to support that date, but we propose to inquire again about status at the end of the next quarter. Their low frequency of occurrence provides some leeway in their completion.

MPPA/IOA Progress: It appeared last quarter that progress on IOA negotiation had resolved high-level issues, leaving for discussion technical issues likely to be addressed in reasonably short order. That observation appears less certain with news that the issues remaining now include the addition of agreement parties, and presumably their rights and obligations vis-à-vis already-planned parties.

That issues beyond technical ones appear now to be in play, creates doubt about meeting the planned January 2022 completion date.

Other Agreements: All transmission and most generation O&M contracts reached completion, with turnover to operations. Remaining contracts for inventory spares and establishment of long-term warehousing will likely complete outside the TTO schedule, but we did not find that problematic. However, a lag in completing the open Andritz maintenance contract, on hold pending resolution of commercial issues, bears continued monitoring. The only activity open with respect to Emera agreements concerns the Regulation Service Agreement, nearing completion and scheduled for close out this year.

3. Detailed Findings

a. LIL Progress

The LCP reached a significant milestone with completion of valve-hall beam replacement (on Pole 2 on July 23 and on Pole 1 on August 8). No problems have been reported with the replaced beams, but GE's performance of several tests following the beam replacements and of the control system produced very limited time available for power transfer before the beginning of September.

The LIL transferred power for most of September (from the 3rd through the 24th). Transfer reached a maximum of 325MW, with one converter loaded at higher power than the other. Successful operation at this level resulted in permission to operate continuously at up to 325MW.

The LIL went offline on September 25, 2021 to allow static checks intended to identify site issues requiring resolution in the next software version. Total transfers from July 1 to September reached approximately 146 GWh from Labrador to Soldiers Pond, with 119 GWh delivered and the remainder comprising losses. Maximum one-day power transfer from Muskrat Falls reached 325 MW.

The LIL went back online on October 15, 2021, after returning a second Muskrat Falls unit to service, satisfying the minimum number required to permit LIL operation. Since its return, intermittent energization of the LIL has permitted dynamic commissioning tests.

The control software continues to plague LIL completion, now pushing commercial operations well into or past the coming winter. Final Acceptance Testing (FAT) produced the discovery of "critical" software bugs - - a result that should no longer appear surprising but does run counter to the optimism expressed by Nalcor management before commencement of that testing.

GE reportedly will address only critical bugs before delivering another version, which, while hopefully addressing all critical bugs, will nevertheless contain non-critical ones. We do not find that expectation encouraging, given past history and yet further discovery of bugs critical to successful operation. In any event, it now appears that the next software version will include all functionality but will not comprise the final control software.

As of November 4, Hydro reported GE as still in the process of addressing the critical bugs required to be cleared before commencing dynamic commissioning and trial operations thereafter. GE had indicated that it might deliver the final, Full Function software to site in mid-November 2021. We considered that possibility unlikely in October, even before learning that bug clearing continued into November.

Management's reported last quarter expected, successful FAT completion by August 13. By early November, its assessment places that date three months later. With GE now scheduling Trial Operations completion by December 31, 2021, Nalcor places a possible late March 2022 date more realistic. Even this much later date, which already places LIL commercial operation at the end of the coming winter, should be viewed as optimistic. However, it does appear that the software in use in the meantime has the potential for supporting LIL power transfers at up to 325MW from Muskrat Falls to Soldiers Pond.

GE plans regression testing before the next FAT - -seeking to verify that corrections made do not cause further problems. We have in the past questioned and continue to question the employment of just a subset of the full set of tests, given that successive testing after problem correction has identified yet more issues. Past testing has been repeatedly and significantly unsuccessful and appears to continue to reveal new issues. A more comprehensive approach, however, has been rejected because additional testing may delay availability of the Final software. With continuing testing identifying more problems, some of them now labeled "critical" by management, we find unconvincing the position that proceeding to the next FAT with lesser levels of testing will produce the shortest course to fully functional, error free Full Function Software.

We noted in our last quarterly report that we found full operation with all functionalities of the LIL highly unlikely until at least January 2022. Even further delay now appears likely- - now clearly in play considering continuing testing disclosure of new flaws. Completion of LIL commissioning will include six weeks of dynamic commissioning of the LIL Bipole (using the Full Function Software) to test the full LIL functionality. In principle the LIL will have the capability to operate at up to 900MW under the Full Function software, when successfully deployed. Whether commissioning of the LIL at 900MW will take place, however, may depend on the availability of power in Labrador, and assessment of black out risk that commissioning may create. It remains possible to complete commissioning before the end of the third quarter of 2021, but continuing problems in successful FAT completion put that date at risk. It remains the case, however, that the LIL can operate with the interim software at power up to 325MW.

b. Synchronous Condensers

Two Synchronous Condenser units (SC2 and SC3) were available in October for immediate service, with the handover of SC1 in progress - - all fitted now with the elliptical bearings intended to bring vibration levels to acceptable levels. Hydro reported on November 4, 2021 completion of completed dynamic commissioning and trial operation for all three units. Each is now in operation, prepared to support LIL power transfer, and in the process of turnover to Power Supply

Nalcor reported lateral steady state vibration levels within requirements. Operation with the elliptical bearings has reduced critical rotor speed to 700 RPM and reduced the transmission of the

vibration to the foundation, as a result of higher horizontal bearing clearance, lower horizontal bearing stiffness and higher damping. However, this modification has not altered the resonant frequency of the foundation. The modification also altered the dynamics of the shaft and its alignment. The current foundation design remains sensitive to the changes of unbalance response.

GE views the overall impact of the changes as positive, but Nalcor plans to assess impacts of the current configuration and continuation of the root cause of the vibration issues on long term operations. Nalcor does not at present find the overall vibration levels under elliptical bearing vibration troubling, but considers diligence to two potential issues pertinent:

- Resilience in the event of faults
- Long term effect of abnormalities associated with vibration signatures.

Management has reported that the configuration, while bringing vibration levels to within requirements, nevertheless entails operation that continues to produce vibration signature anomalies. LCP's technical, outside experts appear not to have expressed confidence that the elliptical bearings have solved concerns expressed about synchronous vibration following its discovery. Nalcor has not had success in quantifying the risks that those anomalies create for long-term, reliable operation of the units. Additional vibration monitoring equipment installed on the units will continue to produce data for observation and analysis. It has been reported as likely, but not certain, that any latent defects will manifest themselves during the warranty period or in major inspection due at 40,000 operating hours.

We cannot obtain any further data; the reports are confidential at least until the resolution of commercial issues with GE. The available data supports three observations:

- Vibration levels now remain within the ISO standard
- The elliptical bearing contribution to those levels came not from eliminating the source of the problem but in mitigating its effects
- Nalcor's experts remain unconvinced that the resolution is effective long-term
- Nalcor has not been able to rule out long-term adverse consequences, but considers it likely that any will become apparent while recourse for addressing them remains.

Two Synchronous Condenser units tripped out of service on September 1, 2021, causing both poles of the LIL at Soldiers Pond to trip. The LIL trip resulted from the tripping of ac harmonic filters due to over-voltages. It is not clear if the third unit was in service, but that seems unlikely. This event is concerning as it caused both poles to trip. The possibility of the tripping of two (or more) SC units due to a single event must be eliminated, because of the potential for widespread Island power loss.

c. HVDC OHL

We reported last quarter that management had completed all repairs required to restore power transfer capability to the LIL overhead transmission line (OHTL) in Labrador and conducted a drone-supported inspection. Repair and inspection work has disclosed no significant issues. Delivery issues have delayed completion of the installation of anti-galloping devices in the southern Labrador spans considered at risk. Management continues its longer-term investigation

of the risks of similar exposure at other locations and means for addressing any found across the line's full length, for consideration as part of the overall Reliability and Resource Adequacy Study.

Management plans to secure 24/7 availability of additional road clearing resources to expedite access to repair locations. Nalcor also has under preparation a solicitation designed to secure by this coming October access to resources from an additional line contracting company that can provide power line technicians, engineering expertise, heavy equipment, and tooling to expand resources available to address line failures.

d. Sea Electrode Issues

Repairs to address the damage at the L'Anse aux Diabie Electrode Site following the December 2020 storm were completed in May. Management expects in November an outside expert's report providing a root cause analysis, a design review of the site, and a wave analysis. The evaluation of design criteria will include the application of local data, including wave height return periods. It will determine the nature of the failure that resulted in the electrode outage.

The procurement and construction of the updated design for the L'Anse au Diabie site is included in the Lower Churchill Project plan and is slated for the 2022 construction season.

In the meantime, an absence of regular monitoring of this remote site leaves it exposed to damage that may not be recognized. Should that be the case, Hydro risks the possibility of underfrequency load shedding (UFLS) should a monopolar LIL fault lead to a bipole failure, because of an unknown issue with the electrode.

e. Muskrat Falls Generators

The third quarter witnessed continued progress in modifying the Muskrat Falls generating units to address design issues summarized in our last report. The head cover modifications and additional welding are completed for the Muskrat Falls generating units. All units have been released to operations except for unit 4, where the approaching completion of final commissioning activities indicate a release for service this month.

Unit 1 experienced an oil release in September during the securing of oil samples. During the water-up of the unit, the turbine pit became flooded. The unit was not returned to service, pending an assessment of the event. Unit 1 is expected to be out of service for several weeks with no forecasted return to service at this time.

Unit 2 experienced multiple unit trips due to high vibrations during power reductions. The installation contractor completed an interim assessment of the event, and the unit returned to service on October 14, with operations restrictions in place until the vibration issued is fully understood and resolved. The contractor has not provided a date to complete the root cause analysis of the vibration issues. The root cause analysis will also address the likelihood of the other units' susceptibility to the vibration issues of unit 2. This issue warrants careful monitoring as vibration issues can range from minor in nature to matters of significance.

The average Muskrat Falls reservoir level since steady state operation was 38.89 m from September 7, 2019, to October 21, 2021, compared to a low supply level of 38.5 m to a full supply level of 39.0 m. The minimum water level during the same period was 38.56 m. Water storage levels are equal or greater than storage levels from last year.

f. Overall TTO Schedule Status

We continued to measure overall schedule status using activity progress and an overall cumulative percent complete metric. The table below depicts cumulative progress of the TTO project on a percent complete basis (actual percent complete versus planned percent complete). TTO activity completion as of October 27 was at 98.4 percent, compared with last quarter's quarter 97.3 percent and a planned 99.9 percent for this quarter. The following table summarizes this planned vs. actual status by work stream.

| Work Stream | Planned | Actual |
|--------------------|----------------|---------------|
| BTPO | 100 | 98.0 |
| RFI | 100 | 99 |
| RFCI | 99.4 | 98.7 |
| Total | 99.9 | 98.4 |

TTO has completed 974 of 1,044 activities. Only four of the original 32 TTO scheduled milestones remain open. Detailed TTO activities associated with those milestones now number only 14, with most of them tied to full power accomplishment of Muskrat Falls generation. Only three of the remaining 14 activities are critical to achieving the closure of all milestones.

g. Staffing

As reported last quarter, the original TTO staffing commitment called for:

- Transmission O&M Staff: 58
- Generation O&M Staff: 28
- Engineering Services Staff: 41
- Support Services Staff: 14.

From this original plan total of 141 (excluding BTPO staff), only one position remained unfilled (a Muskrat Falls contract administrator). This last remaining position will not be filled, and the vacancy will be closed.

Subsequent changes to the organization fall under the responsibility of the Human Resources organization. The next chart shows complements and vacancies using the current Nalcor organization structure, alignment, and positions that Human Resources is addressing.

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| Organization Title | Complement | Vacancies |
|---|------------|-----------|
| Transmission Operations Work Mgmt. and MF | 25 | 0 |
| Transmission Operations Soldiers Pond | 42 | 5 |
| Power Supply Production & Energy Marketing | 38 | 8 |
| Engineering Services | 5 | 0 |
| Engineering Services Operations Support | 25 | 0 |
| Engineering Services Project Execution Gen. | 27 | 1 |
| Eng. Services Business Services | 26 | 3 |
| Portfolio Asset Mgmt. | 12 | 0 |
| Totals | 200 | 17 |

Management still records five Hydro Operations positions as vacancies (these show in the Power Supply Production & Energy Marketing total above). Manitoba Hydro International (MHI) personnel have filled these operations positions under a services contract. Five hydro operations' apprentices have completed the two- year apprenticeship program and now have an opportunity to apply for permanent operator positions at the MF station. The remaining twelve open positions remain on hold as a result of a hiring freeze pending the announced restructuring of Nalcor/Hydro. The number of vacancies remained the same from that of last period. We did not find the vacancy numbers unusual or troubling under the circumstances.

h. Training

Phase I encompasses training associated with asset release for service and Phase II with follow-on, detailed maintenance program programs and activities. Nalcor has indicated that it has completed all Phase I training, except for two sessions. Recent specific accomplishments include:

- There was no change to remaining GE HVDC training courses this quarter. Eleven of 13 planned courses are complete, with the remaining two required to wait because they entail hands-on training after full systems commissioning
- The TTO ATCO's delivery of dc operations training is now complete
- All five TTO synchronous condenser courses are complete
- All six Phase 1 turbine and generator sessions are complete
- All phase I turbine and generator training and 1 of the 3 phase II sessions are complete.
- No change to MF BOP courses this quarter. Fourteen of 16 phase I sessions complete and 12 of 16 phase II sessions complete.
- All MFG spillway intake and gate systems courses are now complete.

We did not find concerning the status of training activities.

i. Muskrat Falls Site Emergency Response Plans and Guidelines

The overall site Emergency Response Plans (ERPs) remain divided into two parts: one for Muskrat Falls and one for the LIL. The Muskrat Falls plan focuses on the generation site and it includes

some remote sites. The LIL plan focuses on Soldiers Pond, but also covers some remote sites. The Muskrat Falls generation team is still operating under the LCP ERP because the LCP project team still “owns” the site and provides management of emergency response services. The Soldiers Pond site teams continue to operate under an interim ERP, with the final version under review for acceptance at full project completion. Several ERP schedule activities continue to show a low percent complete with a scheduled completion by the end of the year. We will continue to monitor progress in this area as it is important for turnover to operations.

j. O&M Contracts

All 56 transmission O&M contracts within the TTO plan are complete and turned over to operations. Sixty-one generation O&M service contracts were expected to be completed by the end of the third quarter, however, only 54 are completed. The remaining contracts relating to inventory spares and the establishment of the long-term MF warehousing will likely complete outside the TTO schedule. We do not see a major issue with these contracts’ extensions as they relate to inventory issues. One of the remaining open contracts, the Andritz maintenance contract, is the open contract of concern. We understand that this contract is on hold pending resolution of ongoing commercial issues.

k. Emera Agreements

One activity, the Regulation Service Agreement is open. This activity is 95 percent complete and scheduled for completion by the end of year.

l. Build Out of the Maintenance Programs

This category of activities consists largely of preventative maintenance (PM) activity scope and equipment check list activities. TTO divides the work into two categories to support prioritization of the more critical activities. The higher priority addresses PMs that must be performed frequently, with the second priority on PMs repeatable over a longer cycle. The high frequency PMs comprise those typically performed on a daily, weekly, or monthly basis. Lower frequency PMs may occur on cycles of perhaps once a year, or less frequently. Nalcor has reported all high frequency PMs as complete. Substantial progress was made this quarter in the completion of low frequency PMs. The low frequency PM completion now stands at 70-90 percent complete with a scheduled completion date of November 30 for all low frequency PMs. Liberty will continue to focus on these activities to completion, although we do not see an immediate operation concern in this area.

m. MPPA/IOA Progress

Addressing potential impacts on CF(L)Co interests, and particularly the rights of Hydro Quebec related thereto, continued as a barrier to finalizing the MPPA and IOA agreements. Following reported high-level agreement, a number of months ago on outstanding IOA issues reported as major, work continues on addressing what Nalcor had described as more technical matters. However, Nalcor has now reported that the issues under discussion now include the addition of agreement parties, indicating that more than technical matters remain for resolution.

Nevertheless, Nalcor continued to consider the agreements on track of January 2022 IOA completion followed by MPPA execution as well. That parties to the agreement (and therefore presumably their rights and obligations thereunder) remain in contention does not support optimism in meeting this date.