

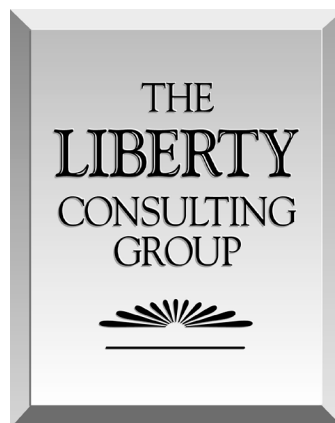
**Sixteenth Quarterly Monitoring Report on the
Integration of Power Supply Facilities to the
Island Interconnected System**

Presented to:

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

Presented by:

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I. Purpose of this Report

This report examines second quarter 2022 scheduled and performed activities undertaken as part of completing the Lower Churchill Project (LCP) assets and integrating them into the province’s electrical system. It also examines the results and implications of circumstances pending as the third quarter began - - analysis by Hydro of the results of yet another Factory Acceptance Test (FAT), this one following two second quarter tests that failed to move the Labrador Island Link (LIL) forward in reaching critical completion milestones.

This report also continues to discuss progress in addressing converter stations, synchronous condenser, overhead dc line, and sea electrode issues raised in previous reports, as well as what has remained a considerably smaller set of Muskrat Falls generating unit issues. It also provides a summary of progress in completing the activities transferred from the responsibility of the Transition to Operation (TTO) organization as 2021 ended.

The steps we undertook to address second quarter 2022 activities proceeded as follows:

- Review of Hydro’s monthly LIL update reports
- Identification of recurring and emergent matters related to LCP completion and presentation to Hydro of a list of questions (issued on July 11) for response prior to meeting with its personnel by teleconference
- Review of the responses to those questions (received July 19)

- Follow-up questions to Hydro (sent July 21)
- Teleconference between our monitoring team and Hydro's management team (July 22)
- Follow-up questions to Hydro (sent July 26) and responses to those questions (received August 1).

We received Hydro's August LIL monthly update during the final stages of completing this report. We followed that receipt with an August 15 teleconference with Hydro to address issues raised regarding LIL software testing following the close of the second quarter in June. We summarize what we learned from that report and teleconference, but caution that we have not yet addressed its contents in the detail that accompanies our regular quarterly reports.

II. Major Observations

Overall LIL Progress: It remains speculative to consider the LIL as having materially advanced toward completion this past quarter. Two major setbacks in this period left it at quarter end nominally where it stood at quarter start - - without control software suitable for supporting full-scale operation or the final commissioning stages that precede commercial operation. We continue to consider it prudent to anticipate a continuing failure to reach commercial operation before or during this coming winter, and perhaps well after. Nevertheless, the LIL continues to appear capable of carrying energy in amounts that can make a material contribution to serving customer loads this coming winter, albeit at far less than its designed capacity and without providing a source on which Hydro can reliably depend for planning purposes.

Second Quarter LIL Operation: As it has before, the current state of the software has produced a 450MW power transfer limit. The NLSO has continued to limit LIL operation, when available, to a lesser maximum of 320MW. This restriction seeks to ensure that trips will not result in under frequency load shedding. The LIL operated at lower levels and with a number of forced and planned outages during the quarter.

Electrode Sites: Upgrades identified for the breakwater protecting the L'Anse aux Diable sea electrode site remain scheduled for 2022 completion. A study commissioned to address the Dowden's Point Grounding location on the Island's Avalon Peninsula has an expected completion date of fourth quarter 2022.

Alert Fatigue: Management has streamlined data required for assessing continuing numbers of alerts and has not yet addressed a plan for controlling the operator fatigue such circumstances can create.

Synchronous Condensers: Two material issues continued through this second quarter - - the long-standing vibration issue and the status and implications of the Synchronous Condenser Unit 1 bearing failure and remediation activities. The bearing failure described in our last report has been addressed temporarily with the use of replacements and controls on unit operations. GE continues to analyze testing results, which it believes will likely identify further modifications to all units. Not much has changed with respect to the long-standing vibration issues; Hydro remains unwilling to accept GE's position that elliptical bearing modifications sufficiently addressed those issues. Commercial resolution continues to appear a likely outcome.

Muskrat Falls Generators: All Muskrat Falls Units remain released to operations. Unit 2 remains limited to a constant 140MW power level as investigations of vibration issues commencing last year continue. There remains no firm schedule estimate for completing the analysis of those issues and any resulting need for modifications.

Staffing, Training, and Procedures: Staff openings and incomplete training sessions have reached minimum levels and Manitoba Hydro no longer provides contract support for operators. Procedure development is well advanced, but a matter noted in our last report remains open.

Procedures and Training Implications of the Most Recent LIL Trip: We plan to continue to monitor progress in establishing an ongoing program for testing familiarity with and ready executability of key operating procedures.

Muskrat Falls Site Emergency Response Guidelines and Maintenance Manuals: Substantial progress has been made in development and review of O&M manuals and management anticipates imminent completion of final site emergency guidelines.

Open Agreements: With the CF(L)Co board reportedly approving an amended MPPA in May 2022, it appears that execution of it and the IOA are approaching. The Andritz services agreement remains the last open major contract, with plans anticipating finalization during the third quarter of 2022.

III. Second Quarter Events and Circumstances

a. The LIL

1. Commissioning Progress

Two more setbacks occurred this quarter, each associated with a continuing series of Factory Acceptance Tests (FATs) exhibiting a multi-year history of failure. These tests have continued to expose defects that prevent reliable, full-scale LIL operation. The LIL must operate for 30 days in bipole mode without interruption to pass the critical Trial Operations milestone. Thereafter, final adjustments should lead to placing it into commercial operation. Many past deficiencies have kept the LIL from readiness for or success in completing Trial Operations. Continuing discovery of software issues (including in this quarter through an FAT initially deemed successful, but not lastingly so) underscores the propriety of continuing pessimism regarding near term achievement of either commercial operation or a status that warrants firm reliance on LIL delivery availability.

This quarter's first FAT-related failure, described in our last quarterly report, came following an FAT whose results General Electric and Hydro evaluated in early April. The two mutually agreed on April 8 that the FAT demonstrated the unsuitability of the software for release to the site for use in dynamic commissioning in preparation for the commencement of Trial Operations.

It would take the whole of the quarter to address the software deficiencies identified sufficiently to support another FAT. A subsequent, June 2022 FAT initially appeared more successful, producing a decision to install the tested software version, considered capable of warranting another attempt to achieve Trial Operations. However, despite the reported FAT success, operation

under this new software version soon led to significant disruptions, demonstrating again that nominally successful FAT completion here has remained a poor indicator of software readiness. The tested version has been removed and replaced by the interim version previously in use, while another series of corrections commenced.

The start of the third quarter has brought yet another FAT on this further corrected control software version. Hydro's August 5, 2022 *Reliability and Resource Adequacy Study Review – Labrador-Island Link Monthly Update* reserved judgment on its results, pending review of results. We learned on August 15 that corrections to the software had introduced a new flaw in software components addressing pole compensation - - critical to LIL operation. An FAT to test a software version addressing the newly introduced flaw began on August 15. The version undergoing this test has four other known flaws not at this time considered critical. If released to the site, the version now undergoing an FAT will support LIL operation for an expected two-to-three weeks of dynamic commissioning activities that will precede commencement of a 30-day Trial Operations period.

Nominally, however, the LIL thus remains where it stood at second quarter start - - with no control software suitable for advancing toward commercial operation. This newest version may bring more sustained progress, but there is poor basis for confidence that it will, given continuing stumbles experienced over the multiple years spent trying to correct it. It remains sound to consider commercial operation before this winter speculative. As before, we believe that more extended delay needs to be considered for planning purposes. In other words, as has been true for some time, the LIL appears no closer, in terms of milestones achieved, to commercial operations now than it has for a number of quarters.

Nevertheless, we also continue to believe that the LIL appears likely capable of delivering material energy through this winter, although not in a manner that would make it proper for planners to depend upon it. Moreover, the continuing inability to provide a means for supporting full scale operation makes it appropriate also to question whether it will, within any calculable time window, prove practicable to bring the LIL to a state that will support operation fully consistent with the capabilities its design intended.

2. Second Quarter LIL Operation

The Newfoundland and Labrador System Operator (NLSO) continued to apply a 320MW limit on operation of the LIL during the second quarter. Following the April 2022 FAT, the LIL operated at relatively low power, with attention given to the risk of trips and the avoidance of resulting load shedding. Its typical operating loads ranged between 45 and 200MW, with a very short period of operation in excess of 300MW. Recent operating experience underscores the importance of the caution shown. The LIL experienced six forced outages resulting from unexpected events triggering protection system operation that produced trips of one or both poles. Investigation of these trips and other issues produced an additional 12 outages taken deliberately for testing, evaluation, and corrective measures. The six second quarter forced outages included:

- A measuring device (DC Current Transducer, or DCCT) produced “noise” which caused a protection scheme to trip Pole One
- An error in the restoration of protection blocking on Pole Two

- Replacement of a failed VBE card during a planned outage was followed immediately by a Pole Two trip on re-energization due to the incorrect insertion of the VBE card
- Another DCCT noise event caused a trip on Pole One
- The opening of a neutral bus switch under load during dynamic commissioning caused a protection scheme to trip Pole One
- Inability of Pole Two to deblock due to block discrepancy produced extended outage.

Operators also took a number of planned outages to carry out investigations, perform testing, and take corrective actions, including:

- Correction of interlocking issues
- Runback testing to ensure correct shut down performance during operation
- Corrective actions to address DCCT circuit issues noted above
- Safety stand-down issues to correct errors made during the previous outage
- Runback testing to ensure correct shut down performance during operation
- Replacement of failed VBE card (noted above as producing a forced outage on re-energization)
- Test of increase in Maritime Link exports while operating at monopole limit
- Making changes in General Electric's (GE) telecommunication equipment to enable network configuration,
- To replace the High Voltage DCCT on Pole 1 after electrical interference issues noted above
- Bipole outage to install and complete software static checks
- Software dynamic commissioning, varied availability of LIL due to testing requirements
- Planned corrective actions for the Synchronous Condensers required the LIL to be offline, given no other large unit available on the Avalon Peninsula.

3. Electrode Sites

The Tiller Engineering Inc. (TEI) "Labrador Island Link Limited Partnership Root Cause Analysis Report – L'Anse au Diable Grounding Station Phase 2 Breakwater" included design review and an updated wave study. The study found that the washouts experienced at the site in December 2020 resulted from a breakwater insufficiently high to protect against extreme conditions. The report's recommended use of a larger design wave, produced recommendations for changes intended to withstand worst-case wave and breakwater crest heights, specifically:

- Performance of nearshore wave/period modeling considering site geometry, wind generated surge and potential sea level rise for 100 years
- Raise breakwater crest height to an elevation determined using the results of the modeling
- Re-assess the breakwater's armour stone sizes and internal geometry
- Inspect the structure to verify limited or no deformation and evaluate construction quality.

Hydro instructed TEI to proceed with the recommendations. Detailed engineering and planning of the changes has commenced, Hydro expects physical work to begin this year, and a completion schedule should come by the fourth quarter of 2022.

Design review of the Dowden's Point Grounding Site location on the Island's Avalon Peninsula has commenced under the direction of an outside consultant. It will include a wave study similar

to that completed for the Labrador Site and will be evaluated to continue the sufficiency of the breakwater's original design. Hydro projects a fourth quarter 2022 study completion date, after which it will assess next steps.

4. Alert Fatigue

Our previous report noted a large number of alerts (alarms and automatic notifications) occurring. Management could not last quarter segregate the data in ways material to assessing impact on and numbers that require operator recognition, acknowledgement, or response. Nominally, the numbers provided far exceeded what good practice considers appropriate in preventing "alarm fatigue," which diminishes timeliness and effectiveness of operator response to alerts requiring confirmation or action. This quarter brought more granular treatment of the numbers, but as yet no description of the standards by which management will assess their operator impacts. As we noted in our previous report, operational readiness should include standards, metrics for applying them, and actions to respond to high numbers. We will continue to monitor progress in development of a program to control operator alerts.

b. Synchronous Condensers

Synchronous Condenser (SC) units 2 and 3 have remained available for service. Our last report addressed a SC1 bearing failure and resulting damage. Replacement of SC1 bearings with spares has been completed, with the unit now undergoing commissioning. GE has performed tests to determine the impact that oil pressure and oil temperature have on the ability of the High Pressure Oil Injection System (to provide the required lift for the bearings). Planning further analysis of the results, GE anticipates a need for revising its preliminary report of SC1 failure root causes, but has yet to provide a date for that revision. Hydro's third party expert will review that report when available from GE.

In the meantime, GE proposed interim corrective actions that included controls modifications to prevent operation below 500 RPM during a unit shutdown in circumstances where oil temperature exceeds a pre-determined setpoint. Additional logic controls seek to keep the High Pressure Oil Injection System in service for a prescribed duration after a unit has stopped. Further corrective actions, while expected, have yet to be identified. Hydro does not believe that the long-standing synchronous condenser vibration issues have any connection with SC1's failure.

GE continues to maintain that the elliptical bearing modifications have adequately addressed the SC vibration issue, leaving the machines fit for purpose. Steady state vibration levels remain within specification requirements per ISO 7919-5. However, expert analysis of vibration signatures remains unchanged regarding specification non-conformances relating to the critical shaft speed, foundation size, and resonance.

Hydro reports an insufficient amount of data to draw conclusions regarding vibration issue trends at this time and continues to collect vibration monitoring data from a newly installed vibration trending software system. It remains important to assess risk and likely consequences of long-term consequences in determining how best to apportion risk and responsibility.

Hydro has described detailed information regarding the underlying issues as confidential due to contractual reasons. The underlying issues of non-conformances to critical shaft speed, foundation

size, and resonance continue, as we reported earlier, to create an unknown, non-quantified risk of long-term implications (e.g., outage rates, repair needs, early unit retirement), whether or not they provide Hydro (on the basis of its current knowledge) a basis for immediate change from the current configuration.

c. Muskrat Falls Generators

After Unit 2 experienced multiple unit trips due to high vibrations during power reductions and following an interim assessment by the installation contractor, the unit returned to service on October 14, 2021. It did so restricted to constant operation at 140MW, pending further investigation. Andritz completed in July 2022 an internal inspection of the unit’s runner hub; its findings and recommended corrective actions remain under Hydro review. A root cause analysis (including susceptibility of the other units to vibration issues) remains in progress, but without a reported completion date expectation.

d. Closeout of Transitioned TTO Work Activities

The 24 items remaining open last quarter from the tasks transferred by TTO to Hydro in December 2021 dropped to 18 through this quarter.

1. Staffing, Training, and Procedures

Changes to the organization remained the responsibility of Hydro’s Human Resources organization. The next chart shows vacancies by organization.

Vacancies

Organization Title	No.
Transmission Operations Work Mgmt. & MF	0
Transmission Operations Soldiers Pond	0
Power Supply Production & Energy Mktg	0
Engineering Services	0
Engineering Services Operations Support	0
Engineering Services Project Execution Gen.	0
Eng. Services Business Services	3
Portfolio Asset Mgmt.	0
Totals	3

Five operations’ apprentices have completed the two-year apprenticeship program and Hydro has placed them into full time operator roles. Manitoba Hydro no longer provides support to the operator positions now filled by Hydro personnel. Hydro has, however, engaged a contractor to provide mentoring support to the new operators. Hydro reports the two previously open positions in the Soldiers Pond Transmission Operations area as now filled. Six training sessions remained outstanding at the end of the first quarter - - two for load management systems, two for fire and protection systems, and two re-runs of turbine and generator sessions. The fire protection, fire detection turbine and generator sessions have all been completed. Management has deferred the two remaining, load management systems sessions, scheduling them now for November.

Management reports all O&M manuals are complete with three, as was the case in the last quarter, under review. Contractor review continues for 18 manuals, down from the 27 of last quarter. Our last report described an operator error that led to an extended outage of both poles following the



February 20, 2022 Pole 1 valve hall fire alarm (eventually determined to have been caused by a faulty sensor, rather than an actual fire). We noted that management planned to supplement plans to prevent recurrence through communication and training, but not incorporation of the need for visual confirmation of equipment configuration into written procedures. We continue to consider changing the documented procedures a matter for attention as overall project needs may permit.

2. Procedures and Training Implications of the Most Recent LIL Trip

We observed in our last report the importance of supplementing sound procedures and base training in their application and execution with: (a) establishment of a test bed of key procedures warranting periodic testing of at-hand knowledge and immediate understanding of where to turn for details, and (b) efficiently executable tests of the ability to react quickly and properly to unexpected circumstances. We will continue to explore progress in this area, particularly with staffing, procedures and manuals, and base training now well advanced.

3. Muskrat Falls Site Emergency Response Guidelines and Maintenance Manuals

Site Emergency Response responsibilities have continued since late 2021 on an interim basis. A 12-month contract continues to provide for consulting support for the voluntary team having responsibilities. Long-term plans call for continued use of volunteers, phasing out contractor support over time as the internal volunteer team becomes trained. Schedules call for near-term completion of all operating guidelines (third quarter 2022) and training of the volunteer team (fourth quarter 2022).

Hydro reports all 238 O&M manuals required for generation and transmission assets as completed, with 3 still under review and 18 returned to the contractor for comment. Hydro reports continued progress in the development of O&M manuals.

e. Open Agreements

Hydro has reported the reaching of agreement between NLSO and CF(L)Co on an amended Multi-Party Pooling Agreement (MPPA), with CF(L)Co Board approval on May 18, 2022. This amended MPPA has been circulated to the other signing parties for signature after final review. Hydro does not expect any changes to result from that review. The Interconnection Agreement (IOA) has, as reported, been described as completed for some time, with its final execution contingent upon finalizing the MPPA.

As reported previously, the Regulation Service Agreement with Emera remains open and scheduled for completion in the first quarter 2023.

All 56 transmission O&M contracts included in the TTO plan are complete and turned over to operations. Sixty of the 61 generation O&M service contracts are complete, with the Andritz O&M Services Agreement remaining open. The Andritz service contracts' terms and conditions are now in legal review - - a final step in the contracting process. Management expects a contract in place in the third quarter of 2022. An interim arrangement with Andritz covers any emergent services that may prove needed in the meantime.