

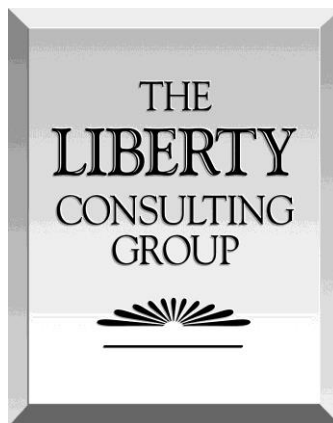
**Eighth Quarterly Monitoring Report on the  
Integration of Power Supply Facilities to the  
Island Interconnected System**

**Presented to:**

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

**Presented by:**

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*Table of Contents*

1. Summary.....	1
2. Introduction .....	2
a. The Purpose of this Report .....	2
b. LIL Readiness .....	3
3. Management’s Overall Perspective .....	4
4. Major Findings .....	4
a. LIL Schedule.....	4
b. Independent Third-Party Review .....	6
c. Converter Station Control Issue.....	6
d. Soldiers Pond Synchronous Condenser Vibration and Binding .....	8
e. Dynamic LIL Performance .....	8
f. Stage IV Power Studies .....	9
g. Securing Needed Personnel .....	10
h. BTPO Training.....	11
i. Emergency Response/Restoration .....	11
j. Long-Term Agreement for the Optimization of Hydraulic Resources .....	12
5. Summary of Actual versus Scheduled Activity Completion.....	12
a. Overall Third Quarter Schedule Progress .....	12
b. Key Third Quarter Milestones .....	13
c. Third Quarter Activity Progress.....	14
d. Completion S-Curves.....	15
6. Follow-Up Action Items.....	15

## 1. Summary

The past quarter has been a disappointing one across a broad range of fronts in the transition to operations (TTO) of the Lower Churchill Project (LCP). For a project whose schedule should be approaching completion, the persistence of long-standing problems, the emergence of new ones, and a continuing lack of work completion are troubling. Not only will the Labrador Island Link (LIL) that connects Muskrat Falls generation to the Island Interconnected System (IIS) fail to enter service this winter, but its operation for the next one is now becoming less certain. The observations that give us greatest concern this quarter include:

- Management expressed optimism last quarter that a two-month extension in interim General Electric software delivery would produce its delivery by now. Instead, that delivery is now scheduled for December, a date in which management again has expressed confidence.
- Even if that optimism proves well founded, subsequent LIL commissioning will delay reliable operation to some point past this coming winter. Continued optimism about dates that have continually slipped for long periods needs more of a foundation than management has provided to us.
- Management has been receiving independent third party (ITP) oversight reports of General Electric for about 6 months. The last one that management described to us indicated a large number of software problems requiring rectification had been found. Recognizing the potential for more problems to arise during testing and less comfortable with management's expression of continued confidence in ever lengthening dates for software delivery, we urged this quarter, as we did last, that the ITP reports be made available for our review. As before, management declined on the basis of General Electric confidentiality demands. The continued lack of full transparency on these reports as schedules lengthen is concerning.
- LIL delays have now come to have implications for commissioning and certain high power testing of generation at Muskrat Falls. In the absence of the LIL, power flows from the Muskrat Falls generators to the Hydro Quebec system will be necessary for some activities. Large power flows through the LTA facilities is of concern to Hydro, because a trip of one of the lines could overload the remaining line, which would then also trip. When the LIL is in service at high power there will also be events which can cause large power changes on the LTA facility, e.g. commutation failures at SOP or HVDC OHL faults which temporarily stops LIL power transmission, but these are unlikely to cause any significant issues for the Quebec system.
- A number of transmission technical concerns continue to remain open, leaving uncertain whether, even after operation of the LIL, contingencies on the transmission system will require substantial Avalon Peninsula generation to remain available to avoid underfrequency load shedding and rolling outages.
- Just-discovered LIL synchronous condenser vibration and binding issues threaten high-power LIL testing and operation. Causes remain uncertain, and potential remedies have only conceptual solutions identified (and no engineering to support their feasibility or to predict their effectiveness). Should these issues continue into next June, they may prevent or significantly restrict power flows over the LIL during commissioning, and could have an impact on the power flows during the 2020/2021 winter. Depending on severity of the

problem and corrective actions yet to be determined and confirmed, how long such limits on LIL power flows may continue is unknown.

- Success through the last quarter in filling positions has been supplanted by concerns arising from failure to have identified persons to fill the two top Muskrat Falls operating positions, one of them created by transfer of a key member of senior TTO management to another Nalcor position, coming at a critical time for the transition. There has also been turnover in the Manitoba Hydro International (MHI) contract resources retained in lieu of internal operating positions management has been unable to fill. Finally, even with most planned positions filled, management has observed that support for turnover activities has been impaired by overtaxed resources.
- Training expected from General Electric remains far behind schedule, and failed to show material progress in the last quarter or plans for delivery of the training.
- Despite our re-baselining two quarters ago of the schedule we have been using to measure progress, and despite the narrowing time windows left in the schedule to complete activities, activity completion has been far less than scheduled. Management failed in this quarter to achieve the progress called for by its measures. We track differently -- we use activities complete, while management tracks judgmentally determined percentages of work performed on activities that it acknowledges are not fully complete. As completion presumably nears, lack of activity completion has even more importance, as contrasted with judgmental measures about how much work is left to complete required activities, when made under ever increasing pressure to show progress.

In summary, these issues:

- Make achievement of LIL completion impossible for this winter and now make uncertain even full-scale operation by the next winter.
- Raise issues about the ability of the LIL and the IIS to operate reliably and as intended, threatening the need for underfrequency load shedding, and creating the potential for long-term and possibly very expensive transmission reinforcement or Avalon generation availability solutions to ensure adequate service reliability.

Implications like these, which do not limit themselves necessarily to placing the LIL into service, may best be addressed in coming proceedings involving system reliability.

## 2. Introduction

### a. The Purpose of this Report

This report examines scheduled and completed activities undertaken as part of the TTO organization's role in integrating the LCP into the province's electrical system by planned in-service dates. The scope of this monitoring effort has excluded Muskrat Fall's construction activities, although we have considered the impacts of the scheduling of those activities on TTO work. Muskrat Falls construction continued to proceed under its own plans and schedules; progress against those construction milestones have continued to bear on and have material linkages to the TTO work streams and their schedules.

The four work streams of the TTO, each of which operate under dedicated teams, consist of:

- BTPO (Building the Production Organization) - - focused on operations and maintenance strategy, organization design and staffing, training, securing needed services from outside sources, and the development of operations and maintenance plans, systems, strategies, and procedures for the integration between the IIS and the LCP
- RFI (Ready for Integration) - - focused on system planning inputs for design and operational requirements, development of reliability standards, support for operational readiness, and participation in testing
- RCFI (Ready for Commercial Integration) - - focused on commercial, legislative, and regulatory matters
- RFO (Ready for Operations) - - functional oversight of a variety of requirements (*e.g.*, safety and environmental), contractor deliverables, and turnovers to operations. The transition schedule contains no RFO activities, which are embedded in the LCP.

Our review of progress over the past quarter continued to focus on the five substantive areas we have addressed over the past twenty-four months:

- Sufficiency of BTPO, RFI, and RCFI work stream plans and schedules in providing a sufficiently comprehensive, well-defined, logically sequenced and connected set of activities
- Progress made in the last quarter relative to schedules for these work streams
- Management familiarity with schedule drivers
- Management's identification of measures to minimize schedule slippage
- Key measures, actions, and results for coming months.

#### **b. LIL Readiness**

The LIL went into "First Power" operation on June 11, 2018 on a monopole basis. Achieving 1<sup>st</sup> power marked the start of dynamic commissioning, and initiated a list of tests seeking to demonstrate specified performance prior to commercial operation. The first pole failed to meet the typical two month duration from First Power to complete commissioning, due primarily to problems with the General Electric-provided control and protection software required for operation. A surprisingly large number of software problems became apparent during the commissioning process, indicating inadequate Factory System Testing before shipment to site. The LIL did transmit recall power during the 2018-2019 winter period, but was removed from service in June, 2019. Efforts since then support bipole software development and commissioning. Already delayed at the time of our last quarterly report, that work experienced significant further delay this quarter.

The latest schedule for interim bipole software delivery makes clear that the LIL is no longer expected to be in operation this coming winter, despite hopes during last quarter that it might operate for winter's late stages. The current schedule, about which management again expresses optimism, calls for power flow over the LIL to resume in February, 2020, with a maximum power flow of 225MW. Software problems are still awaiting resolution, and have lingered well past the duration expected last quarter. Those circumstances, combined with the lack of "float" in the schedule for getting the LIL into commercial operation cause us not to share that optimism. Any additional delays will extend the schedule further. Given so many failures to meet schedule dates

for effective software delivery, we view the newly proposed dates as aggressive and therefore not supportive of optimism in meeting them. Further delay is more likely than not in our judgment.

### 3. Management's Overall Perspective

We received and reviewed management's customary detailed presentation describing TTO progress for the quarter. We continue to acknowledge management's support for our efforts. An overview of key accomplishments and risks presented in that report from management follows:

- Management estimates that dynamic commissioning of the LIL under the final Protection and Control software will be completed at available power by June 30, 2020.
- Further commissioning at higher power will be necessary when additional power becomes available from Muskrat Falls generation.
- Construction of all three synchronous condenser units is complete, but recently discovered vibration and rotor binding issues identified during commissioning present risks that they may not be able to support the IIS system until issue resolution. Management reports that a number of conceptual solutions have been identified, but root-causes are not yet certain, effectiveness of the conceptual solutions has not been verified, and no engineering or design of those solutions has occurred. Management is not prepared to rule out the risk that major work and extended delay may occur, but has expressed hope that neither will be required.
- Muskrat Falls water impoundment reached full supply level on September 4, 2019.
- The Muskrat Falls site risk assessment was completed and the Unit 1 Grid Energization Procedure was issued.
- Permanent staff recruiting activities have been principally completed, with 139 of 143 positions addressed. All operator apprentices and journey persons are in place and on site residency for journey person operators provided by MHI began in late August.

### 4. Major Findings

#### a. LIL Schedule

As planned, management removed the LIL from service on June 5, 2019. It remains out of service, as preparation for installation of bipole software continues. General Electric's delivery of the long-delayed interim bipole software continues to drive the LIL's schedule. At our second quarter meeting with management in July, Nalcor recognized an expected seven-week delay in the expected delivery date of the software - - from late August to late October. The delay was expected to push low-load testing back to January 2020. This quarter's meeting with Nalcor disclosed yet another delay, with delivery of interim bipole software now moved from late October to December 20, 2019. If General Electric successfully meets that date, Nalcor projects First Power for the bipole in early February, with completion of the ensuing low-load testing required by the end of February. A trial run period will follow completion of low-load testing.

In addition to the uncertainty as to when the LIL will make a dependable contribution to IIS reliability, the continuing and still extending delays also have implications for generating unit start-up activities. The schedule for Muskrat Falls first generation now leads that for LIL operation. The

LIL's unavailability to transmit initial power from Muskrat Falls will require Nalcor to secure a dependable delivery path for Muskrat Falls power across the LTA and into Quebec.

The interim bipole software will not include all features required by the contract. It is not clear to us which features will not be provided in the interim software, but it is understood that previously anticipated levels of over-load operation may not be included. Such operation was, however, an important element of original design in accommodating the loss of one LIL pole. We further understand that the interim software will restrict power transmission to a maximum level of 225MW.

We consider the scheduled February 28, 2020 completion date for low-load dynamic commissioning with interim software very ambitious and therefore doubtful. Pole 2 has not yet been dynamically commissioned, and cannot start its commissioning until the interim software has been installed at the site. Repeated past delays and schedule extensions would caution against optimism, even in the absence of such other factors.

There have already been at least three LIL software versions. The current schedule anticipates delivery of another, reportedly final version of the bipole software to the site on June 1, 2020. Further required testing and final commissioning of the bipole depend upon the software's effectiveness. Nalcor expects the next version to include all the features required for bipole operation, including automatic pickup of the load by the other pole and operation of the remaining pole at the specified overloads. Completion of low-load testing with the final software is scheduled for June 30.

The date of final, fully effective software deliver to the site will depend on the number of "bugs," defects and other issues found during the testing/commissioning of the interim software. Nalcor should expect all known issues with the software to be rectified and solutions tested before or as part of the final software Factory System Test (FST) and the Factory Acceptance Test (FAT) testing at General Electric facilities. General Electric should complete testing, issue resolution, and resolution testing prior to shipping the software to the site. We find the time estimated for commissioning of the bipole with the final software very ambitious, and therefore more likely than not to be further extended.

Required high-power testing must follow completion of low power testing. High-power testing will require availability of sufficient power from Churchill Falls and Muskrat Falls and the availability of the Soldiers Pond synchronous condensers. We explain below risks associated with synchronous condenser operation.

Experience from LIL Pole 1 software commissioning in 2018 indicates the potential for significant slippage, potentially extending coming commissioning activities considerably. Recent Nalcor communication with General Electric has produced optimism that General Electric now understands that providing a quality product has equal importance with meeting milestones. Of course such an understanding appears reasonable to have been expected at work inception. Across our two years of quarterly monitoring, management has expressed optimism about improved General Electric performance. The coming months will require close and detailed monitoring of

General Electric progress to accompany management's optimism, given circumstances that now implicate generator commissioning and begin to question the availability of the LIL even for the winter after the coming one.

### **b. Independent Third-Party Review**

Our last quarterly report observed that General Electric had agreed to employ an independent third party (ITP) to confirm satisfaction of system functionality requirements. Two firms have been monitoring General Electric's performance during the second and third quarter. Systematic was hired to assess software development progress and Amplitude was hired to assess conformance to HVdc functional requirements. We have been supportive of such a contribution - - particularly in getting at the root causes of delays and establishing more realistic dates for completion dates. Citing General Electric concerns, Nalcor declined last quarter to make the written report of the independent reviewers available, but did give us a verbal description of its contents.

Continuation of old problems and the emergence of new ones increase the importance and value of transparency. We therefore requested direct access to written reporting again, but again did not receive it. We therefore had to rely again on a Nalcor description. Management advised that Systematic and Amplitude visited General Electric's facilities in September for their monthly project status review. We understand their central finding to include:

- The current software is not stable or robust enough to enter into Factory System Test (FST), a pre-requisite to the Factory Acceptance Test (FAT)
- Software bugs are having an impact on core functionality.

Nalcor indicates that those performing the independent review consider December completion of the interim software FAT likely. Nalcor further advised that the latest reporting listed correction of 75 percent of bugs found in the interim software during Integrated System Testing (IST), which precedes the FST and FAT processes. Reporting also listed 70 percent of the 560 IST phase tests as successfully completed.

### **c. Converter Station Control Issue**

TransGrid Solutions delivered to management its High Power Study<sup>1</sup> this September. It led to identification of a potentially serious converter station control software issue. Potentially, the issue compromises the complete design of the converters. A converter's "firing angle" controls power flow; a reduction in firing angle increases power, by increasing the direct voltage and hence the power flow on the overhead-line component of the LIL.

The firing angle for the converters modelled by TransGrid can operate only within a constrained range (10° to 16°). We assume that General Electric or Nalcor provided this firing angle range. Typically, the capability exists to reduce the firing angle to much less (1° or 2°) when power requires rapid increase. It is during steady state operation, where power changes are typically slow, that firing angle remains within a small range (perhaps 10° to 16°, or a higher range as appropriate). Operation at higher firing angle increases power losses in the converter and the stresses on converter components. It is not known whether the converters have been designed only for the

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<sup>1</sup> Technical Note: TN1205.71.04, *Stage 4D LIL Bipole: Transition to High Power Operation*, September 25, 2019



smaller angle range, or for the worst case stresses with operation at higher firing angle, as required for the large and rapid increase in power specified for the LIL.

High-power LIL operation in bipole mode, requires that a trip of one pole permit the other pole to increase its power rapidly enough to compensate for power lost by the tripped pole, in order to prevent under frequency load shedding (UFLS). Effective use of high overload capability likely requires that the firing angle in normal operation be at a higher angle than  $16^\circ$  to ensure that the dc voltage can be boosted to provide the higher current.

The converter transformer's tap-changer keeps the firing angle in the required range. The tap-changer also allows compensation for changes to the ac system voltage, caused for example by line or other trips. Operation of the tap-changer, which typically requires five to seven seconds per step, cannot prevent load shedding.

The synchronous condensers play a vital role in avoiding UFLS following temporary faults (*e.g.*, from lightning strikes on the HVDC overhead line). The condensers slow frequency decline, temporarily providing real power to the ac system. LIL condenser design seeks to ensure that frequency on the IIS will not fall below 59Hz during temporary faults.

The designed 10 minutes overload capability of approximately 2pu overload capability should give system operators time to start additional generation in the IIS before frequency drops below 59Hz. Following a 10-minute overload period, however, operators have to ramp down the remaining LIL pole to an overload of 1.5 pu, at which level the remaining pole should be able to continue operating for as long as required.

Hydro advised earlier that the maximum overload power delivered at Soldier's Pond on the remaining pole will be significantly less than 2pu, because of the higher power loss incurred on the overhead line conductor and HVDC cable. This advisement, combined with the potential restriction of the firing range means that doubt now exists about the maximum level of power that the LIL can deliver to Soldiers Pond. Hydro has also stated that General Electric is aware of the small firing angle range, but could not provide any further information.

If the small operating range of the firing angle proves to create a limit only in the interim software version, impacts may prove manageable, but it is not yet clear that the final version will address the issue. Further, the converters have hopefully been designed to accommodate the additional stresses that will occur when using the required larger firing angle range. Again, however, that capability has not yet been established.

Should the final software continue to include the small firing angle range, or if converter design will not accommodate the additional stresses when operating in the required firing range, the number of UFLS event will increase significantly, unless lower operating constraints for the LIL are applied.

However, when the Maritime Link is in operation it may be able to provide assistance to the IIS by running back power exports, running up power imports, or providing frequency control. If so,

the Maritime Link may make the consequences of losing one pole manageable with just the support of the synchronous condensers. Further information is expected to be provided in the next TransGrid study reports, which management expects to receive shortly.

#### **d. Soldiers Pond Synchronous Condenser Vibration and Binding**

Nalcor reported successful synchronization of the Unit 3 Synchronous Condenser last quarter, with commissioning of all three units scheduled by the fourth quarter of this year. However, Unit 3 commissioning apparently has disclosed the existence of troubling vibration issues. Moreover, binding issues on Units 1 and 2 have prevented even their rotation. Little information is available at this stage of issue identification and response.

The operation of the synchronous condensers, which is not possible with the current uncertainties, is necessary to permit bipole commissioning testing at greater than low power levels. However, the Maritime Link may (although not yet confirmed) prove able to provide support during required bipole testing. However, protection of the Nova Scotia system appears likely to lead its operator to impose significant constraints on step changes and the frequency of occurrence in the Maritime Link power flow.

Investigation to determine the root cause of these issues has begun, but appears to be in early stages. Nalcor reported that conceptual “fixes” have been identified, but not yet supported by analysis and engineering or confirmed as effective. Management has not ruled out very extensive remedies that might require potentially very long durations. Management has, however, expressed optimism that, despite the great uncertainty surrounding the issue, it will have identified and implemented a solution that will permit condenser operation in June of 2020, as required to support testing. Nalcor reports active work with General Electric to develop the options further, expecting resolution in the spring of 2020. Some solutions under consideration (*e.g.*, foundation modifications) appear destined, if ultimately required to produce delay well beyond next spring. A delay into or past June of 2020, well within reason if interim solutions or a fairly expeditious longer-term fixes do not prove feasible, may prove very problematic.

#### **e. Dynamic LIL Performance**

Hydro Quebec’s (HQ) has raised yet-to-be-resolved concerns about the adequacy of LIL’s dynamic performance during fault conditions. LIL faults and trips of Muskrat Falls generators can significantly affect power flows on the 320kV lines heading west. The September Stage 4C: Labrador Transfer Analysis report provided LIL transfer limits designed to ensure satisfaction of over- and under-voltage planning criteria in Labrador (see section 4. f below). However, this report did not investigate the dynamic performance, apart from the determination of the data required for the out of step protection for the Muskrat Falls generator units.

It is not clear to us whether Hydro Quebec’s concerns about dynamic performance arise from system studies it performed using a Hydro model provided by Nalcor (*e.g.*, the model used by TransGrid; a generic HVDC model, but with the restricted small firing range) its own model, or one provided by General Electric. If the TransGrid model with the small firing angle has been used by Hydro Quebec, that may explain the concern, as the limited firing angle range will significantly affect dynamic performance. We found listed in the TTO Integration Report the studies already

performed and to be performed by General Electric. That list includes the RFI-025 Common - PSCAD™ Dynamic Performance Study Report, which we expect would use a detailed LIL model. This model would give an accurate indication of predicted LIL performance during faults and other dynamics. We have requested the report, shown as completed, because it may address some of the concerns surrounding LIL performance.

Nalcor stated that Hydro Quebec will monitor actual LIL performance, presumably by examining traces of the events at CF and at Muskrat Falls. Nalcor further stated that information received so far has not increased Hydro Quebec's concerns.

#### **f. Stage IV Power Studies**

Two transitional study reports related to the addition of Muskrat Falls generation issued in September of this year. First, the "Stage 4C: Labrador Transfer Analysis" focuses on the determination of LIL and other power limits resulting from system constraints, such as specified over and under voltage limits, that established planning criteria address. The report addressed a number of different events:

- Operation of the LIL with or without the 150MVAR reactor that has been installed to enable operation of the LIL without Muskrat Falls generation in operation (note that the reactor is expected to be removed, as it is not necessary when more than one Muskrat Falls generator is in service)
- Tripping of one (or both) of the OHL from Muskrat Falls to Churchill Falls (CF)
- Determination of the maximum angle separation at Muskrat Falls generators during systems faults
- Operation of the LIL, Muskrat Falls generation and Happy Valley loads whilst separated from the HQ ac network, i.e. with both of the lines from Muskrat Falls to CF out of service.

The study identifies a number of limits requiring operational management, particularly with only one generator in service. With the 150MVAR reactor expected to be removed from service after two or more Muskrat Falls generators have entered service, it may prove useful to consider retaining the Reactor, but adding a circuit breaker, allowing it can be switched in and out. This scheme may provide more operational flexibility, particularly when operating at low generator output or at low transfers on the LIL. At a minimum, management should evaluate the cost of the enhancement and the value of the potential increase in power flows and reduced wear on generators.

The second report, the Stage 4D LIL Bipole: Transition to High Power Operation, covers the period of operation before the control software has been changed to allow use of the specified overload capability of the LIL. It assumes the existing UFLS scheme. The report determines the LIL transfer limits considering loss of the bipole and loss of one pole. It assumes retirement of the Stephenville and Hardwood gas turbines, one or two of the synchronous condensers in service, and LIL operation without frequency control and without 2 pu 10 minutes overload capability. It is assumed that the Maritime Link can provide frequency control for the IIS (125MW from Nova Scotia and up to 60MW to Nova Scotia). Transfer limits are determined for the LIL and for the Maritime Link. LIL transfers are determined with and without Maritime Link frequency control, and always with run backs of the Maritime Link in the event of a trip of a LIL pole or the bipole.

Maritime Link transfer limits are determined with and without the use of LIL runbacks and run-ups.

As discussed above, the study recorded the restricted firing angle range for the LIL converter. This was the first time that this limit has been mentioned, and the studies included the limitations resulting from the reduced range, indicating that pole compensation is restricted in some cases due to the limited firing angle range. We have asked for further information to enable us to assess the implications of this potential design deficiency, which under certain operating conditions could result in possible load limitations and additional load shedding on the LIL. As mentioned in section 4.e, we have requested from Nalcor a key technical study ((RFI-025 Common - PSCAD™ Dynamic Performance Study Report) previously completed by General Electric, given the additional light it will shed on this issue.

The TransGrid report (Stage 4D LIL Bipole: Transition to High Power Operation) also addressed the potential need for additional power generation on the Avalon Peninsula, following the retirement of the Holyrood plant and conversion of one of the generators to synchronous capability. As mentioned earlier, this issue may best be addressed in coming proceedings involving system reliability.

Two additional reports from TransGrid remain pending. These are Stage 4D LIL Bipole: Update of Maritime Link Import and Export Limits and Stage 4D LIL Bipole: Update of transfer Limits in Newfoundland corridors.

#### **g. Securing Needed Personnel**

Progress has been made in addressing long-standing delays in securing personnel to operate LCP facilities. An agreement to contract for experienced Muskrat Falls operator positions to supplement apprentice operating staff had alleviated many of the concerns we have had with respect to the full range of personnel required to operate and support LCP assets after commissioning. However, it appears that turnover among the group selected has already occurred. Moreover, two top positions at Muskrat Falls (Manager Production and Supervisor of Operations) remain to be filled. We discussed in previous reports the importance of filling the Supervisor of Operations position, but only recently learned that the key position of Manager Production is about to become vacant. The candidate selected for the Manager Production, will be moving to another segment of Nalcor in December. He also plays a key leadership role in the TTO organization, making his departure at this juncture an added concern. It is essential these two key openings be filled in a timely order to ensure a smooth transition into commercial operation.

The following table shows third quarter progress in securing additional resources, most notably in generation. The additional generation staffing results from an agreement with MHI, which is currently providing eight power system operators to support start-up operations, and delivery of a mentorship program for power system apprentices.

We previously reported the risk occasioned by limits on start-up resources to support converging commissioning activities in the fourth quarter. That risk has somewhat dissipated with the commissioning of the LIL bipole and synchronous condensers moving into 2020. The elongated

**Eighth Quarterly Transition-to-Operations Monitoring Report**

schedule should provide additional time for completion of other transition related activities such as training or development of asset plans, which have been lagging or deferred into the future. Effective communication and coordination and aggressive action to fill positions resulting from employee turnover will be essential to avoid future schedule impacts on activities such as these. Moreover, frequent references to stressed internal resources in our meeting with management this quarter underscore the continuing difficulty in engaging resources on work activities under schedule threat.

<b>Overall Staffing Status as of September 30, 2019</b>							
	<i>***Total Planned</i>	<i>In Process</i>	<i>Hired-On-Board</i>	<i>Offers Accepted</i>	<i>*Total Secured</i>	<i>% Secured Third Quarter 2019</i>	<i>% Secured Second Quarter 2019</i>
Transmission O&M Staff	60	0	57	1	58	97%	97%
Generation O&M Staff	28	1	26	0	26	93%	71%
Engineering Services Staff	41	0	41	0	41	100%	98%
Support Services Staff	14	0	14	0	14	100%	100%
BTPO Staff/Contractors	13	1	12	0	12	92%	92%
<b>Total</b>	<b>156</b>	<b>2</b>	<b>150</b>	<b>1</b>	<b>151</b>	<b>97%</b>	<b>92%</b>
<i>* Secured = On-Board + Offer Accepted</i>							
<i>**In Process includes posted, screening, interview or offer stage</i>							
<i>***Total Planned reflects minor refinements to the Transmission, Generation and BTPO Resource plan since the fourth quarter, 2018.</i>							
<i>Note: Engineering Services reduced by 1 since last quarter</i>							

**h. BTPO Training**

Training remains an important concern, and another need affected by issues surrounding General Electric resource availability and performance. Unfortunately, no progress on training expected from General Electric occurred in the third quarter. Only 12 of the 21 identified HVdc Station’s General Electric Operator training courses in the TTO work plan have been completed. Only two of five General Electric training courses on the four Synchronous Condensers have been completed.

This training has been moved back to scheduled fourth quarter completion, with management expressing doubt that even this delay will prove sufficient. Delivery of the courses remains dependent on General Electric personnel currently involved on commissioning work and having higher priority. Management has turned to outside resources for some support of training development and execution as well. Management has established contingency plans to address course non-delivery. These measures seek to secure additional time to provide required training, by providing for operational coverage by General Electric until turnover, and by HVdc support services resources thereafter.

**i. Emergency Response/Restoration**

It appears that only limited third-quarter progress occurred in emergency response and restoration plans and exercises for the LIL’s long overhead line that runs through Labrador and the Island. In previous quarters, we observed (and management concurred), that 2019 has brought limited progress in developing the needed Phase II Long-term OHTL response Plan. We learned in our recent meeting with Nalcor that some progress has been made in the third quarter. In order to better assess the overall status of these plans, Liberty requested a more detailed overview of the OHTL Emergency Restoration Plan. Management agreed to provide the requested overview plan in November.

#### **j. Long-Term Agreement for the Optimization of Hydraulic Resources**

As discussed in prior reports, Hydro proposed a Pilot Agreement in an application to the Board last August, to accumulate the proceeds from such activities in a deferral account, pending a future application addressing disposition of resulting value among the participating Nalcor entities. The Board approved the Pilot Agreement on December 18, 2018, ordering deferral of filing the Long-Term Agreement, to allow time for assessing the effectiveness of the Pilot Agreement. Management indicated that delaying the Long-Term Agreement submittal would result in a need for rework on a number of affiliate and external contracts related to Muskrat Falls Units 1&2. Nalcor Energy Marketing (NEM) and Hydro management are drafting an amended and restated Pilot Agreement which was to be presented to the Board in August. Now, the agreement submittal to the Board will be delayed until December. This new interim agreement is intended to facilitate interim transmission access for NEM for exports prior to resolution of matters regarding the Long-Term Agreement.

### **5. Summary of Actual versus Scheduled Activity Completion**

#### **a. Overall Third Quarter Schedule Progress**

Nalcor made a large number of schedule additions and enhancement in the first quarter of 2019, mainly resulting from its detailed review of activities required to support operational transition of generation assets. The magnitude of those changes led us to the conclusion that stabilizing the benchmarks against which we measured schedule progress warranted a schedule re-baseline, which would make assessment of real progress more transparent. We were hopeful that this new baseline would bring greater stability to schedule-assessment metrics going forward, and enable us to better assess future progress and identify potential exposure issues

Nalcor re-baselined the TTO schedule as of May 01, 2019. Our last quarterly report indicated that substantial work on construction and bulk TTO activities appeared to occur in the second quarter, when compared to the new baseline. However, much of the improvement actually resulted from extending dates in the May re-baselining. A significant number of activities originally scheduled for completion in the second quarter, or even earlier, were shifted into the third and fourth quarters of 2019. Thus, we continued to have significant concern about the number of activities still awaiting completion. We believed that the third quarter would provide us with a better indicator of true schedule performance.

As nominally reported, third quarter progress has slowed and lagged baseline expectations, even as measured by management. Third quarter completion dates have continued to move out into the fourth quarter and beyond. Delays in completing a number of these TTO activities have largely been affected by General Electric's inability to meet schedule commitments and lack of dedicating sufficient resources to complete bulk work tasks. With the fourth quarter now upon Nalcor, little time remains to accomplish the much improved work rates needed to meet schedule. We continue to emphasize the need, with ever less time remaining to complete activities, to turn the "corner" in completing critical work. Construction delays and ensuing schedule extensions have given the TTO team added time to complete its work. However, the team cannot continue to rely on being "gifted" with additional time as a result of such delays.

**b. Key Third Quarter Milestones**

Key milestones extracted from the LCP construction schedule provide the foundation for TTO’s baseline integration schedule. These LCP milestones provide a framework for TTO planning, scheduling, and tracking of activities to prepare fully for operations. TTO schedule milestones identify linkages between construction and integration activities. Milestone dates tracked in the transition schedule represent the earliest date that the transition team can be ready. The TTO schedule milestones may differ with milestone dates released to the public or those contained in the construction schedule.

The chart below shows nominally reported milestone progress measured from the new May baseline schedule. Significant changes have occurred since the second quarter update; essentially all TTO milestones now show completion dates well beyond those of the baseline targets. We find particularly concerning significant delay in witnessing and verification activities for the Soldiers Pond Synchronous Condensers -- delays resulting from the vibration and rubbing issues described earlier in this report. Continuing delay in LIL bipole commissioning activities presents another primary concern. Timing and quality of General Electric bipole control and protection software drive this delay. On a positive note, Muskrat Falls full water impoundment was completed on September 4, 2019.

The following milestone chart illustrates at a high-level the status of TTO remaining activities related to power delivery to the IIS. The revised baseline dates as of the May 01, 2019 show in blue and actual/forecast dates in red (behind) or green (ahead). The dates shown reflect targets for completion of TTO team activities in support of related LCP completion milestones. Non-TTO activities, like those associated with bipole software are what actually drives LIL completion into 2020.

	Baseline 5/01/19	2019	2020
<b>Labrador Island Link Assets</b>			
SP Synchronous Condensers- Ready for Operations	10/25/19	▲	▲ 5/31/20
LITL 1 <sup>st</sup> Power Transfer Labrador to Newfoundland (Pole 2/Bipole) with Interim Software	12/11/19	▲▲	▲ 12/31/19
LITL Bi-pole Commissioning (Initial Low Load with Interim Software)	01/07/20	▲▲	▲ 02/28/20
<b>Muskrat Falls</b>			
Power House Unit 1- Ready for Operation	11/29/19	▲	▲ 11/29/19
Power House Unit 2 Ready for Operation	02/21/20		▲ 3/03/20
MFG First Power	12/09/19		▲ 12/16/19
Power House Unit 3- Ready for Operation	05/06/20		▲▲ 6/01/20
Power House Unit 4- Ready for Operation	07/20/20		▲ 7/30/20
MFG Full Power	07/15/20		▲▲ 8/13/20
MFG Full Impoundment	08/14/19	▲▲	▲ 09/4/19 Actual

*Note: As previously discussed, the LCP Project Milestone for bipole 1st Power is 2/03/20. This is driven by non-TTO activities. The TTO Milestone date above indicates all TTO activities in support of this milestone will be completed by 12/31/19.*

**c. Third Quarter Activity Progress**

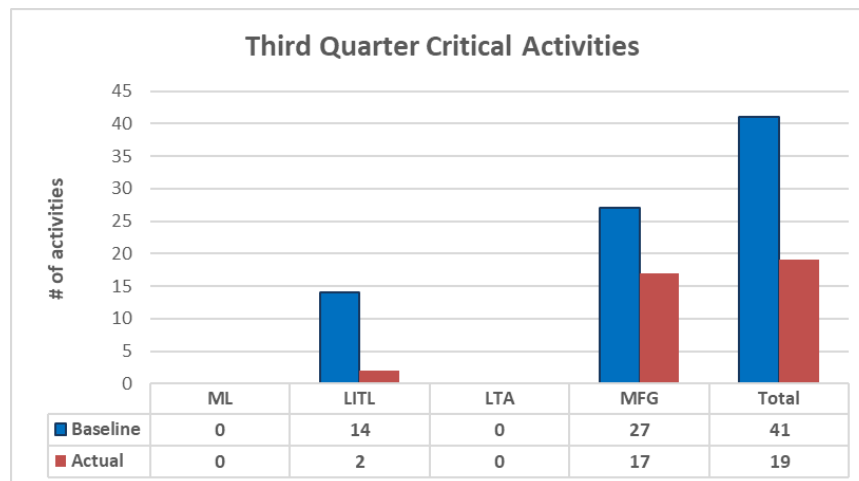
Completion of planned activities for the third quarter continued to lag. The table below shows 112 activities scheduled for completion in the third quarter of calendar 2019. Management completed less than half of them (50 in total). The transition team did complete an additional six activities scheduled for completion in later in 2019.

<b>Third Quarter 2019-Performance Summary</b>			
<b>Baseline Activities Scheduled</b>	<b>Baseline Activities Scheduled and Completed</b>	<b>Unscheduled Activities Completed</b>	<b>Total Activities Completed</b>
<b>112</b>	<b>50</b>	<b>6</b>	<b>56</b>

A significant number of activities originally scheduled for completion in the third quarter 2019 or earlier have now moved to the fourth quarter of this year. The table’s activities slated for completion in the third quarter fell into two categories:

- Critical activities - - those having an impact on critical path milestones
- Bulk activities - - those just requiring completion by the end of the project.

The chart below summarizes third-quarter progress on activities that schedules show as critical to completion.



The May re-baseline called for the completion of 41 critical activities in the third quarter of 2019. Again, management’s completion of only 19 reflects less than half the planned number. The third quarter also brought completion of one critical activity targeted for later completion. A considerable number of outstanding activities originally targeted for completion in prior quarters remains to be completed. As we have reported for some time, continuation of a large number of

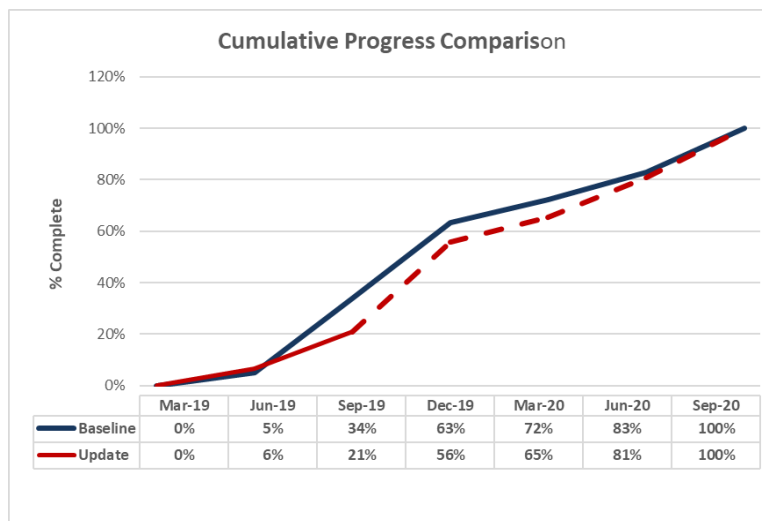


outstanding activities increases in importance the schedule threat as overall project completion approaches.

**d. Completion S-Curves**

We have been measuring progress against a cumulative percent-complete “S-curve,” initiated at the outset of our monitoring activities due to gaps in management’s schedule construction and reporting. Percent complete as we have measured it equals cumulative number of activities scheduled for completion divided by total outstanding activities.

The May re-baseline caused us to re-initialize our curve to begin measurement of progress starting with the second quarter of 2019. The re-initialized curve shows 15 percent of total outstanding activities completed in the third quarter, versus a targeted completion of 29 percent. In essence, only about half as many items were completed as compared to the plan for the quarter. We found particularly concerning the significant step change forecast for the fourth quarter. The chart shows fourth quarter progress forecasted to achieve 35 percent, which would result in a 56 percent cumulative percent complete at year end. Even with the accomplishment of this very unlikely level of achievement, it would still fall short of the baseline year-end target of 63 percent, established in May. Past performance suggests that attaining this level of achievement will be extremely challenging and very unlikely.



Nevertheless, given the breathing room given to TTO by sources of delay outside its responsibilities, theoretically leaves enough time for TTO to complete its work in line with overall LCP schedules, absent: (a) new scope, (b) continued failure to meet targets, (c) persistent identification of new and substantial problems, and (d) the ability to command the resources to complete all required work tasks.

**6. Follow-Up Action Items**

The following is a list of action items resulting from the recent discussions at the monitoring meeting.

- Nalcor to provide the General Electric Common - PSCAD™ Dynamic Performance Study.

- Nalcor to provide an overview of the Phase II Overhead Transmission Lines Emergency Response Plans by end of November 2019.

We also consider direct access to the reporting of the independent monitors important in: (a) ensuring that sufficient transparency exists with respect to issues that have lingered for a long time, and continue to cause schedule delay, and (b) providing a sound basis for optimism about future schedule performance. As we did throughout the current quarter's monitoring efforts, we will continue to press for such access.