

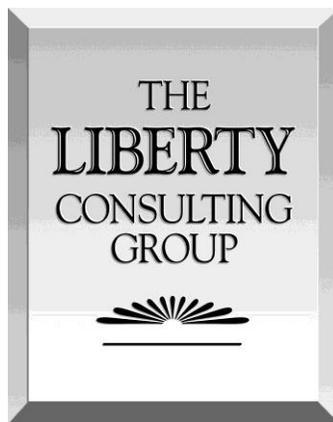
**Fifth Quarterly Monitoring Report on the
Integration of Power Supply Facilities to the
Island Interconnected System**

Presented to:

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

Presented by:

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1. Introduction

a. Interim and Longer-Term Transmission System Readiness

The Transition to Operations (TTO) organization has been tasked with integrating Muskrat Falls and the Labrador-Island Link (LIL) into the province's electrical system. Over the past year, we have been monitoring TTO progress in preparation for the turnover to operations of the LIL. We have not addressed construction of Muskrat Falls, where we have limited our review to efforts planned and executed to become fully prepared to operate the facilities that connect the new generating station to the Island grid, after supply resources become available.

We have also examined readiness to operate the network facilities that will, in the interim before Muskrat Falls completion, permit the import of power from the LIL and the Maritime Link (ML). A long-standing concern with and focus on the sufficiency of supply resources to serve the Island Interconnected System (IIS) led to a decision to place a special focus on readiness of those links, to provide import sources of supply prior to the availability of electricity production from Muskrat Falls. The LIL will make recall power available from the LIL connection to Labrador and the ML will make available supply sources originating in or passing through Nova Scotia.

We therefore address readiness in both the interim (pre-Muskat Falls) and longer-term (post Muskrat Falls) periods. Hydro has in the past addressed the need for support provided from LIL connections to an operating IIS and an operating ML. The focus placed on completing and getting the LIL into operation led to the establishment of a 1st power date for the link of July 1, 2018, with first power transfer achieved on June 11, 2018. Achieving 1st power defines the beginning of a list of tests of power transmission from Muskrat Falls to Soldiers Pond, during which the specified performance is demonstrated prior to commercial operation.

Typically, the duration from first power to the completion of commissioning of a pole takes no more than two months. Satisfactory completion of the required tests begins a two-month trial operation period, during which the scheme must continuously transmit power. Any trips during that time restarts the trial-period duration. Management therefore expected an end of second quarter 1st power date to make the LIL available to support supply needs on the IIS this winter. Supply adequacy has proved very troublesome in past winter seasons, and remains a matter of significant attention now.

The commissioning process has not gone as planned, due to a number of problems. The first pole remained uncommissioned in late February. Control and protection software required for operation, still available in a non-final form, has proven the primary source of commissioning delay. We have found surprising the large number of software problems found during the commissioning process. Such software should undergo rigorous factory testing prior to dispatch to site. At this stage, one cannot estimate when the trial operation period can commence. Nevertheless, the LIL has been used to transmit some recall power to the IIS. It has tripped on several occasions in recent months. Fortunately, operation of the Maritime Link averted Under Frequency Load shedding on several of those LIL trip occasions.

As our preceding quarterly report observed, TTO program management continues to plan and measure progress using the same four work streams we described in our last quarterly report. 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. For example, in many cases, TTO activity commencement depends on construction (and other) work being performed by General Electric. Our interest in construction milestones in this report focuses solely on addressing how they may influence TTO activities.

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 outside resources, and the development of operations and maintenance plans, systems, strategies, and procedures for the integration of 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) required reports, contractor deliverables, and turnovers to operations.

b. The Purpose of this Report

This report sets forth the results of our fifth quarterly review of efforts under the BTPO, RFI, and RCFI work streams. We address how well TTO work has proceeded in support of the integration of and reliable operation of the assets at the planned in-service dates.

Our work in reviewing progress over the past quarter has continued to focus on the five substantive areas we have addressed over the past year:

- Sufficiency of BTPO, RFI, and RCFI work stream plans and schedules in providing a sufficiently comprehensive, well-defined, logically sequenced and tied 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.

2. Management's Overall Perspective

As it has done regularly in connection with our quarterly reviews, management prepared a detailed presentation describing TTO progress. This presentation also addressed specifically an extensive list of topic areas and issues we provided following our review of a report on TTO schedule activities. We found the report generally responsive to the topics and issues about which we sought information. Within the limits of what one can glean from a review of the TTO work stream scheduling and reporting (we discuss those limits below), we found the presentation and

management’s responses to our detailed questions useful in our assessment of schedule status and jeopardy to key milestone dates. We continue to acknowledge management’s support for our efforts. An overview of key accomplishments provided by management follows:

- All identified critical path items to support winter readiness of LIL monopole operation were completed.
- The LIL was re-energized on November 1. It transferred power from Churchill Falls to the Island, at levels up to 140MW at Soldiers Pond). However, as the next table shows, the LIL has experienced a number of trips and outages.
- The 735kV and 315kV breaker upgrades were completed at CFTS2.
- VT replacements at CFTS and MFTS were completed in support for winter power transfer.
- Close-out of last remaining punches, quality items and document deliverables for HVac and HVdc OTLs were completed.
- Software version 15 has been installed at site. Version 16 has been tested, but it has been decided not to install this version. Factory Acceptance Tests on Software Release 17 have been completed, but it is unlikely that this version will be installed until after the winter period, because installation requires a two week outage of the LIL.
- Pilot Agreement for Optimization of Hydraulic Resources was approved by PUB.
- Recruiting progressed with 55/59 Transmission, 9/27 Generation, 38/43 engineering, and 11/15 Support Services roles secured as of the end of December.

Date of Trip	Power Transmitted	Reason for Trip
Nov 7 th , 2018	60MW	Glycol Leak (valve cooling)
Jan 13 th , 2019	120MW	Incorrect control cabling installation
Jan 16 th , 2019	150MW	Incorrect protection setting
Jan 17 th , 2019	100MW	Connection issue in MF control panel
Jan 26 th , 2019	unknown	Loose connection in control cubicle
Feb 5 th , 2019	110MW	Incorrect protection setting

One should expect multiple trips during commissioning of a configuration such as the LIL. The number of trips typically decreases as testing progresses to higher power levels, but this has not proven the case for the LIL, as the preceding table indicates. Operation at higher power (above 130MW) has revealed a number of control and protection issues. Note that expected power levels before completion of commissioning are higher (225MW).

3. Summary of Liberty’s Conclusions

a. Monopole LIL Operation

A problem-plagued process: Management has, at best, achieved mixed success in seeking to make the LIL a reliable performer at high capacity levels in meeting Island loads this winter.

Some time ago, Nalcor changed its plans for completing work on the LIL to enable first operation of a single pole. The goal of this change was to permit the use this coming winter season of what

will eventually become a bi-pole power transmission path. Successful completion of this plan would provide access to recall power from Labrador, through initial, monopole operation.

With the achievement of 1st power in June, management's third and fourth quarter focus became the completion of activities necessary to support higher power and commissioning of the LIL monopole in preparation for trial operations and commercial operation, which was targeted for December 31, 2018. Significant progress was made in the fourth quarter and the system was at times operational transferring power to the IIS. However, there were numerous issues encountered along the way and the monopole has still not been able to achieve maximum transfer limits (225MW) and is not fully commissioned, as of our latest monitoring meeting held on February 13, 2019. At this stage it is not possible to predict when the first pole will have completed the commissioning process.

b. Other TTO Work

Constructing delays giving TTO work a schedule "breather": Substantial work on construction and other bulk TTO activities remains. We observed in our report for the last quarter that the pace of progress would have to pick up substantially in 2018 for a return to conformity with the expectations of the baseline program. Progress has still not recaptured all time lost in the previous quarters, even as measured by management. Management nevertheless observed that remaining deliverables to enable asset turnover for commercial operations remained on track. We continue to have significant reservations but despite the delays, it appears that sufficient time still remains for TTO to complete its transition work, provided additional work scope does not emerge, and provided that management does not divert resources to other work.

The pace of transition work has clearly accelerated, but significant numbers of activities remain to be completed. 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 handed additional time due to construction delays, as construction/turnover activities near completion, TTO must become more effective and consistent in meeting its schedule completion dates, in order to avoid impacts to the reliable operation of the assets.

Management should make a detailed review of remaining work scope a high priority, in order to avoid potential schedule issues as the project moves into its final stages.

Remains an area of very strong concern: General Electric continued to miss deadlines affecting the work of the transition team. At this point, based on their performance to-date, we continue to remain skeptical about GE's ability to deliver on their commitments. We are very concerned there is a high probability that bi-pole commissioning will slip and run well into the winter 2019/2020 operating period, which would clearly present some significant challenges. Securing greater focus and more timely performance from General Electric will continue to be the greatest challenge facing management in coming months.

GE controls software issues and equipment failures adversely affected dynamic commissioning efforts on the monopole. Management has entered into an agreement with GE for milestone deliverables supporting a bi-pole completion in 2019. GE continues to support daily winter power

transfers over the monopole, investigating and resolving various system issues. GE will shift efforts in 2019 to focus on software development for the bi-pole, which is slated for release in August, 2019. The two poles will have identical software, suggesting a much quicker 2nd pole commissioning, compared to the first, provided that the software and hardware will have been tested properly at the factory before the commissioning of Pole 2 commences. The bipole controller basically co-ordinates the operation of the two poles. GE's past experience should make the process straightforward, but the problems experienced to date moderate any resulting optimism.

It appears that an agreement has been reached with GE on responsibility between the parties on issues relating to performance to date. That resolution includes establishment of an Independent Third Party to confirm that all system functionality requirements are met. At this point, we do not fully understand the scope of this agreement and Management was not prepared to discuss the details at our most recent meeting. We requested more specific information regarding the agreement. Management has agreed to provide further details in the near future.

Difficulties in staffing remain; approach changing: Management has made little progress in the fourth quarter securing additional resources. We found particularly concerning the slow progress in hiring staff for Muskrat Falls Generation. Management cited this quarter a different driver of hiring pace. At our work session last quarter, management responded to our questions about open positions by stating that it had made a conscious decision to defer significant hiring until late 2018, to better match employment starts with operations needs (more precisely the schedules driving those needs). Management reported at that time the existence of a strong pool of apprentice training program candidates to fill these positions as the need to do so arose. Management now reports major difficulties in finding and securing experienced operating personnel willing to relocate to the site (for example, citing high costs of living). The problem has become sufficiently severe to lead management to place reliance on contractor support (perhaps using retirees brought back through a third party), perhaps for an extended period, as apprentices gain necessary experience.

4. Program Schedule Structure and Third Quarter Performance

a. Summary

Shortcomings in TTO activity schedules and in the ability to use them to monitor performance and status effectively led us to begin our monitoring work under a “work around” approach to support our monitoring work back in September 2017. That approach involved use of an “official” baseline schedule established at that time. Our work has included reports from Management on progress against that schedule, continuing through the present. Management made a surprisingly large number of changes to this schedule in the last quarter of 2017. Those changes included activity additions that we viewed as sound enhancements in schedule detail which prompted us to make some additional adjustments to the baseline in early 2018. These changes did not produce schedule extensions for any activities.

The schedule stabilized, but we have continued to find it limited in certain respects:

- Sufficiency of linkages among schedule activities
- Continuing use of long duration activities

- Reliance on subjective, percent complete information to assess progress.

b. September-December 2018 Milestone Changes

The foundation for the baseline integration schedule used by TTO comes from several key milestones extracted from the LCP construction schedule. These milestones provide a framework for the planning, scheduling, and tracking of TTO activities designed 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. In the past, Nalcor has categorized these TTO schedule milestone dates as “stretch targets.”

The chart below shows that nominally reported milestone progress since the September 2017 baseline has continually fallen short of planned levels. Since the last quarterly report, progress on LITL Monopole Commissioning continued to slip. As of our February 13, 2019 monitoring meeting, the monopole was still not fully commissioned.

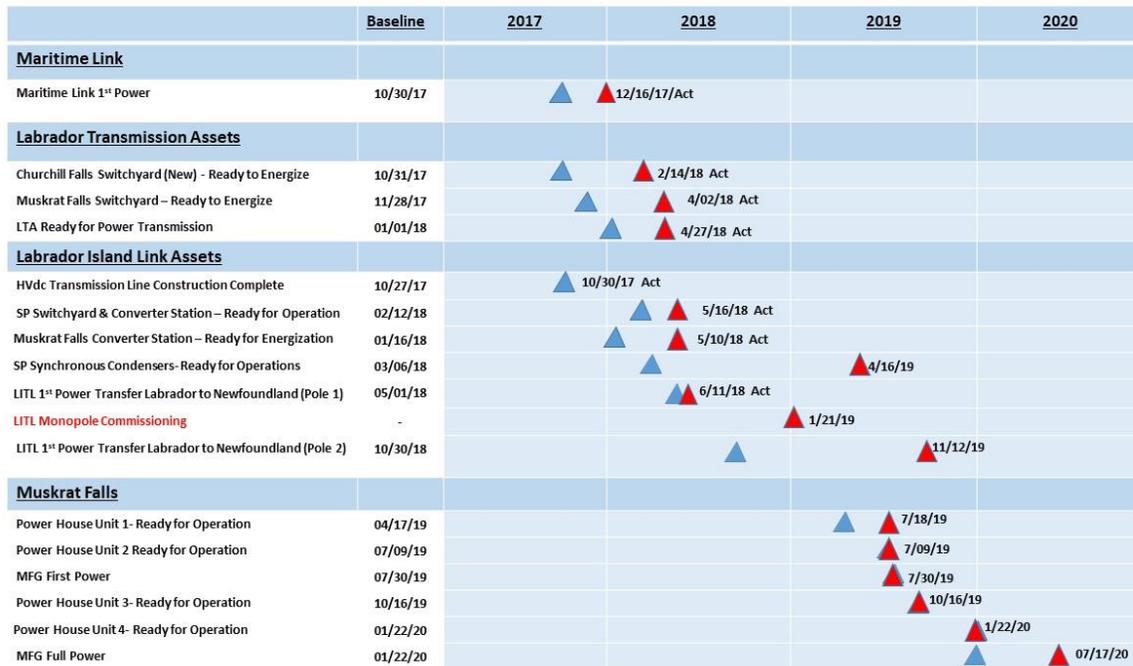
In the past, management listed two main contributors to delays in achieving milestones: (a) General Electric’s late completion of construction/turnover activities and (b) internal resource shortages. General Electric’s performance continues to pose major schedule threats. However, we did see some positive signs related to GE, as Management reports the following advancements:

- An agreement has been established with GE for milestone deliverables supporting bi-pole completion in 2019.
- Commercial issues to the end of 2018 have been resolved.

The agreements with GE comprise a step in the right direction, but, by themselves, and in light of now longstanding delays associated with GE’s work, caution dictates a reluctance to assume that GE’s past performance will likely improve dramatically going forward.

The next chart provides a high-level overview, showing activities related to power delivery to the IIS. Original baseline dates show in blue and actual/forecast dates in red. Note that the date of completion of commissioning of the first pole had not been achieved by the date stated on this chart (21st January 2019).

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c. September– December Activity Slippage

Completion of planned activities for the fourth quarter continued to lag. The table below shows 17 activities scheduled for completion in the fourth-quarter of calendar 2018, but management completed only 5. The transition team did complete an additional 75 activities delayed from prior quarters, but a considerable number of outstanding activities from prior quarters still remain to be completed. This phenomenon frequently occurs on large, complex projects, but raises cause for concern when it continues, as here, to be the case as they approach completion. Continuing inability to complete such a large number of scheduled activities raises significant concern. With ever less time to complete such activities, a “corner” needs to be turned in meeting planned dates.

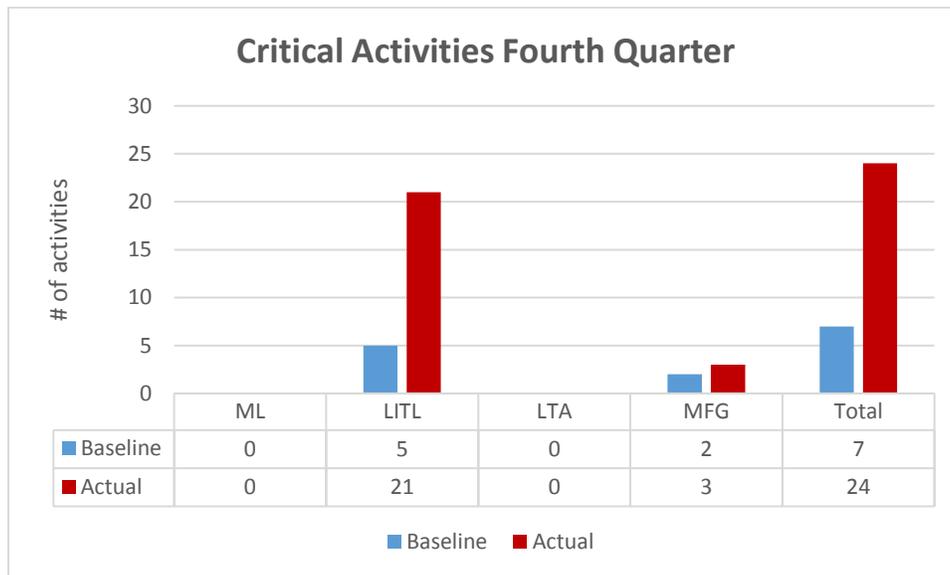
Fourth Quarter 2018-Performance Summary

Baseline Activities Scheduled	Baseline Activities Scheduled and Completed	Unscheduled Activities Completed	Total Activities Completed
17	5	75	80

The preceding table’s activities slated for completion in the fourth 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.

At this phase of the project, a focus on critical activities best illuminates schedule status. The chart below summarizes fourth-quarter progress on activities that schedules show as critical to completion.



The baseline schedule called for the completion of 7 critical activities in the third quarter of 2018. None of these activities were actually completed in the fourth-quarter. Management did complete a total of 24 critical activities in the quarter - - all of these were scheduled for completion by the end of the preceding quarter (September 30, 2018) or newly identified items.

d. The Completion “S-Curve”

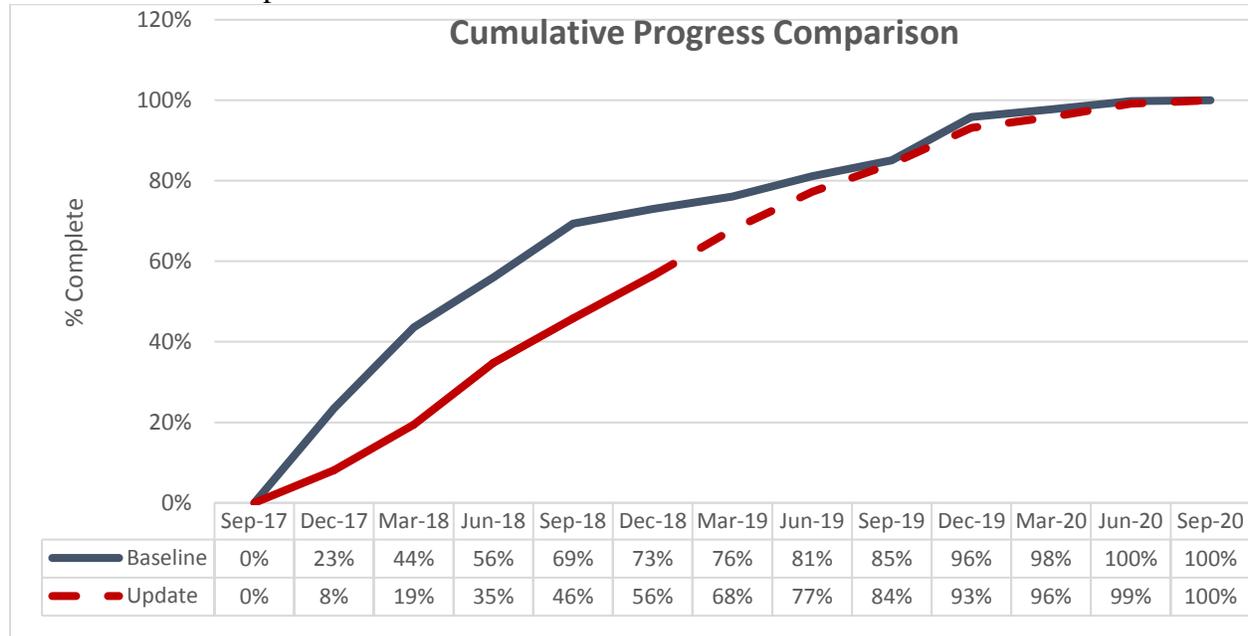
We reported last quarter on progress against a cumulative percent-complete “S-curve” as a metric for assessing delay. We found this approach useful, given the gaps in schedule construction and reporting described earlier. Percent complete as we measured it equals cumulative number of activities scheduled for completion divided by total outstanding activities. Our curve through the fourth quarter, incorporating all planned activities, confirmed a lack of progress at rates commensurate with the activities called for by the September 2017 baseline. The curve showed completion of only 56 percent of total outstanding activities, versus targeted completion of 73 percent.

We observed in our report for the previous quarter that the pace of progress would have to pick up substantially in 2018 for a return to conformity with the expectations of the baseline. The next chart shows that progress continued to lag by the S-Curve measure through December, 2018. In the fourth quarter, progress advanced by 10 percent, as compared to 11 percent in the third quarter. Overall progress improved to 56 percent, but still fell significantly short of the baseline target of 73 percent. We were encouraged by the improvement we saw in the second quarter (16 percent) but it appears like progress regressed somewhat in the third and fourth quarters.

In the past, Management has cited two primary constraints driving low completion rates: (a) setbacks in completing baseline activities resulting from late staffing additions, and (b) delays in completing General Electric work activities. As previously discussed, progress has been made in addressing staffing issues but the elongated duration of transmission support/activities have stretched existing resources and had an impact on completion of items in the generation transition

plan. As for GE, challenges still exist and significant improvement in their schedule performance associated with bi-pole commissioning will be essential to avoid further resource impacts on the completion of generation related activities.

Despite the delays, sufficient time still remains for TTO to complete their transition work, provided additional new scope is not identified and resources are not diverted to other areas. A detailed review of remaining work scope should be a high priority to avoid potential issues as the project moves into its final phase.



e. Summary of Progress by Teams

The three teams whose work streams we examined made the following overall progress in the quarter just ended.

- The RFI team made progress in a number of areas. Stage IV (high power) Studies progressed to 80% complete overall. However, several key studies remain to be completed with this work now forecast for completion in the third quarter. Significant progress was made in the development of NERC Reliability Standards, with 32 documents delivered, and 16 of the next batch of documents at ~50% complete. The JD1 (JD Edwards) system utilized for financial and asset management functions was readied and configured for operation by power supply companies.
- THE BTPO team completed development of high frequency PM’s and check sheets for the converters and synchronous condenser plant. High frequency PM’s & check sheets are now in place for all LTA and LITL assets. BTPO continued its progress in securing Transmission OM&A contracts completing 42 of 58, including all 2018 winter readiness requirements. BTPO continued to focus on hiring staff for Muskrat Falls, but attracting qualified candidates has proven to be a challenge due to the high cost of living in the area. BTPO’s development of asset management plans, delivery of

employee training, in particular operator training, slated for delivery by General Electric continue to lag.

- The RFCI Team filed with the PUB on August 23, 2018 a pilot agreement for the Optimization of Hydraulic Resources. The pilot agreement was approved by the PUB on December 18, 2018.

f. Management's Conversance with Schedule Drivers

The schedule and the supplemental information continued to support a very high-level evaluation of overall performance during the past quarter. Team leads and support personnel for each of the TTO work streams pertinent to our review continued to show knowledge of and confidence about their areas of responsibility. Management generally provided significant information in its presentation to us, and generally offered clear responses to our questions.

5. Specific Issues

Our work in the quarter addressed by this report found a number of specific issues bearing attention.

- LIL Pole 1 In-service Date
- LIL Bi-Pole In service Date
- General Electric (GE)
- Commercial Generation Production Optimization Arrangements
- Stage IV Studies
- BTPO Training
- Staffing

a. LIL Pole 1 In-service Date-

Significant effort in the fourth quarter was devoted to commissioning the LIL Pole 1. The LIL was re-energized on November 1, 2018 at 45 MW, using the existing version (version15) of GE software. Another version (16) was delivered to the site and factory acceptance testing ("FAT") of the next release (17) was completed in Stafford. A decision was made to remain operating on version (15) for the remainder of the winter season due to the ongoing satisfactory performance of this version and to avoid the impact of a winter period outage, which would be required to install the new software. The LIL transferred power from Churchill Falls to the Island on a 24/7 continuous operation in December, 2018. Power transfers over LIL Pole 1 reached 150 MW but never reached the anticipated 225 MW transfer limits. However, there have been several trips of the LIL during January 2019 and February 2019.

As of our latest meeting in February, LIL Pole 1 was limited to transferring 45 MW due to an external fault on the AC system having caused a trip of the LIL. Management is investigating this problem and once this issue is resolved, Hydro and Nalcor will resume increasing transfer levels and assessing LIL performance to determine when higher power transfer commissioning is concluded. Hydro will inform the Board once this determination is made.

b. LIL Bi-Pole In-service Date

The current plan is to have the LIL Bi-Pole in service by the end of 2019. Management has indicated GE has committed to deliver the bi-pole operating software in August. Therefore, the commissioning of Pole 2 should commence as soon as possible, such that both poles are available for bi-pole commissioning.

Ideally, Pole 2 should be commissioned using the latest version of the control and protection software, i.e. not the version presently used on Pole 1. Pole 1 should remain with the present software, until the new software has been proven to operate satisfactorily during commissioning. Whilst Pole 2 is being commissioned, only one of the two poles shall be in service. When Pole 2 has been commissioned, Pole 1 should be updated to the same software and hardware as Pole 2.

Low load bi-pole commissioning is slated to start in October. Based on GE's recent history on the LIL Pole 1 software/commissioning effort, we are very concerned that bi-pole commissioning will slip and run well into the winter operating period, increasing the probability of system outages. However, provided that both poles have been completely commissioned, the probability of a prolonged outage should be small, because it should be possible for each pole to be operated independently, if the bi-pole controller does not perform as required.

c. Stage IV Studies

Based on the schedule furnished in the third quarter update, Stage IV (High Power) Studies were scheduled for completion by December 31, 2018. Completion of some components of the high power operational studies have now moved to the third quarter of 2019. In addition, consideration is being given to additional analysis to support the transitional period between low power and high power. Results from these studies may have broader implications that could impact decisions related to future generation needs. Management will provide additional details as the studies are finalized.

d. General Electric (GE)

GE continues to support daily winter power transfers over the monopole, investigating and resolving various system issues. Management reports that all outstanding commercial issues with GE through 2018 have been resolved. GE is now shifting its efforts to focus on software development for the bi-pole, which is slated for release in August, 2019. Management has entered into an agreement with GE for milestone deliverables supporting a bi-pole completion in 2019. In addition, GE and Management have agreed to appoint an Independent Third Party to confirm that all system functionality requirements are met. At this point, we do not fully understand the scope of this agreement and Management was not prepared to discuss the details at our most recent meeting. Liberty requested more specific information regarding the agreement and Management has agreed to provide further details in the near future.

Management has expressed slightly more optimism regarding GE's ability to meet future commitments, however, considering past performance, along with the considerable workload remaining, we continue to remain skeptical. Close monitoring and continued pressure on GE will be essential to ensure timely completion of this critical work.

e. Long-Term Agreement for the Optimization of Hydraulic Resources

A Pilot Agreement was proposed by Hydro in an application to the PUB in August, to accumulate the proceeds from such activities in a deferral account, pending a future application on its disposition and how the accumulated value is shared between the participating Nalcor entities. The Pilot Agreement was approved by the PUB on December 18, 2018. The PUB order required that the Long-Term Agreement not be filed for a period of one year, in order to allow time for assessing the effectiveness of the Pilot Agreement. At our recent meeting, Management indicated delaying the submittal of the Long-Term Agreement by one year, will now require rework on a number of affiliate and external contracts related to Muskrat Falls Units 1&2. Management is still assessing the impacts of this matter and expects to have a broad approach to addressing this in the first quarter of 2019.

f. BTPO Training

As of December 31, no progress was made in the fourth quarter, with only ten of the twenty identified General Electric Transmission Operator training courses in the TTO work plan completed. No GE training was completed on the Synchronous Condensers with four courses identified and none being completed. Remaining courses are being rescheduled, but the latest information from management show it unlikely that this training will be completed prior to the LIL Pole 1 being placed in-service. It would have been highly desirable to have had this training completed prior to the LIL being in service. Delivery of the courses remains dependent on General Electric personnel currently involved on higher priority commissioning work. 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.

g. Staffing

As indicated in the table below, little progress was made in the fourth quarter securing additional resources. Of particular concern is the slow progress in hiring staff for Muskrat Falls Generation. In our third quarter meeting, Liberty questioned Management about the apparent delays in securing staff for MF. Management reported they made a decision to defer most of this hiring into the third and fourth quarter of 2018, to conform to when these resources will actually be required. They further stated that they had a strong pool of apprentice training program candidates to fill these positions, as the need arises. In our most recent meeting, Management has now indicated they are having a difficult time securing experienced operating positions due to the high cost of living in the area, and will need to rely on contractor support and retirees to supplement existing staff, until such time that suitable candidates are secured or entry level apprentices gain necessary experience.

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Overall Staffing Status as of December 31,2018							
	<u>Total Planned</u>	<u>In Process</u>	<u>Hired-On-Board</u>	<u>Offers Accepted</u>	<u>*Total Secured</u>	<u>% Secured Fourth Quarter</u>	<u>% SecuredThird Quarter</u>
Transmission O&M Staff	59	0	55	0	55	93%	92%
Generation O&M Staff	27	10	8	1	9	33%	30%
Engineering Services Staff	43	4	34	4	38	88%	88%
Support Services Staff	15	0	11	0	11	73%	73%
BTPO Staff/Contractors	15	2	11	0	11	73%	73%
Total	159	16	119	5	124	78%	77%
* Secured = On-Board + Offer Accepted							
**In Process includes posted, screening, interview or offer stage							