

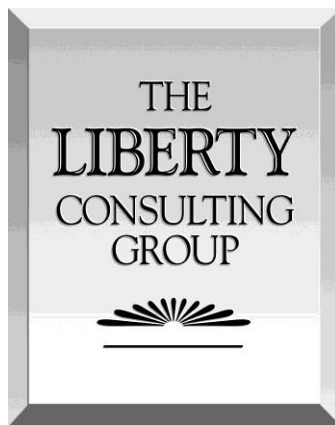
**Seventh Quarterly Monitoring Report on the  
Integration of Power Supply Facilities to the  
Island Interconnected System**

**Presented to:**

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

**Presented by:**

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*Table of Contents*

1. Introduction .....	1
a. The Purpose of this Report .....	1
b. LIL Readiness .....	2
2. Management’s Overall Perspective .....	2
3. Major Findings .....	3
a. LIL Schedule.....	3
b. Independent Monitoring of General Electric .....	4
c. Securing Needed Personnel .....	4
d. BTPO Training.....	5
e. Emergency Response/Restoration .....	6
f. Muskrat Falls Impoundment .....	6
g. Long-Term Agreement for the Optimization of Hydraulic Resources .....	6
4. Summary of Actual versus Scheduled Activity Completion.....	7
a. Overall Second Quarter Progress.....	7
b. New Schedule Baseline.....	7
c. Key Second Quarter Milestones .....	7
d. Second Quarter Activity Progress.....	9
e. Completion S-Curves.....	10
f. Summary of Progress by Teams .....	11
5. Follow-Up Action Items .....	11

## 1. Introduction

### a. The Purpose of this Report

This report sets forth the results of our review of scheduled and completed activities undertaken as part of the Transition to Operation (TTO) organization's activities to integrate the LCP into the province's electrical system. 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. Over the past twenty-one months, we have been monitoring TTO progress in preparation for turnover to operations. The scope of our monitoring excludes Muskrat Fall's construction activities, although we have examined 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 at Muskrat Falls.

TTO program management continues to plan and measure progress using the same four work streams we described in our prior quarterly reports. 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 services from outside sources, and the development of operations and maintenance plans, systems, strategies, and procedures for the integration of the Island Interconnected System(IIS) and the Lower Churchill Project (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
- RFCI (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 work in reviewing progress over the past quarter has continued to focus on the five substantive areas we have addressed over the past twenty-one months:

- Sufficiency of BTPO, RFI, and RFCI 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**

In addition to examining readiness for long-term operations, our prior quarterly reports also examined readiness to operate the LIL and the Maritime Link (ML) to permit import of power onto the Island prior to the availability of generation from Muskrat Falls. Operation of the LIL in monopole mode had been considered critical on a short-term basis, given the nature and status of supply resources available to serve the IIS under peak conditions. The ML has made available supply sources originating in or passing through Nova Scotia. 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.

It typically takes two months from First Power to complete commissioning of a pole. This duration proved insufficient for the first pole of the LIL. A series of problems extended commissioning of the first pole, with control and protection software required for operation the primary cause. We found surprising the large number of software problems exposed during the commissioning process. The LIL did transmit recall power to the IIS during the winter period, but was removed from service recently. The LIL is not expected to return to service until sometime in early 2020. It is scheduled to do so in bipole mode, making monopole operation no longer an option.

The current schedule for LIL operation calls for low power testing to begin in January 2020 - - well after the start of the coming winter period. Moreover, and with software problems still emerging, there is no longer any “float” in the schedule for getting the LIL into commercial operation. Therefore, any additional delays will extend the schedule further, creating a risk that the LIL will not provide a source of power flow until late in or after the coming winter season.

## **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 a list of topic areas and issues we provided to management. 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:

- LIL Monopole commissioning up to 140MW was completed in May, 2019.
- Installation of Pole 2 cabinets at Muskrat Falls and Soldiers Pond was completed.
- A static version of the bipole software was installed to facilitate commissioning of equipment.
- Independent Third Party (ITP) oversight of General Electric bipole software development commenced and is ongoing.

- Turnover of the Soldiers Pond, Muskrat Falls and Churchill Falls AC Switchyards to Power Supply Operations was completed.
- A detailed review of the TTO work plan produced additions to and refinement of detailed activities required to support operational transition and formed the basis for a revised baseline schedule as of May 01, 2019.
- Continued recruiting brought Transmission (58/60), Engineering (41/42), Support (14/14) personnel, and Generation (20/28) well towards completion.

### 3. Major Findings

#### a. LIL Schedule

The LIL will not operate in either monopole or bipole mode for much, and possibly most of the coming winter season. Hydro previously considered temporary monopole operation material to providing adequate assurances of system reliability during winter periods prior to completion of LCP commissioning. Nalcor has abandoned plans to employ monopole operation; the facility's next return to service will be in bipole mode. We therefore raised the option of reverting to monopole configuration using version 17c software for the coming winter. Nalcor advised that it continues the path to bipole commissioning. The work required to do so will imminently foreclose temporary monopole operation as an option, if that point of no return has not already passed.

If changed circumstances have substantially altered management's views of immediate-term system reliability, then Hydro needs to document them, establishing clearly any conclusion that elimination of monopole operation this coming winter does not add materially to the risk of material customer-service disruptions. We expect that ongoing Board proceedings on Hydro's Reliability and Resource Adequacy Report dated November 16, 2018 will carefully address reliability needs and examine closely the analytical and quantitative foundation for the near-term need for supply across the LIL. That examination's consideration of near-term reliability should be informed by clear and convincing analysis showing that circumstances warranting temporary monopole operation last year no longer exist.

As planned, the LIL was taken out of service on April 30 to install P&C monopole software version 17c and to test Auto Lane Change Over and Reduced dc Voltage operation. The LIL was re-energized on May 25 transferring up to 140MW during the testing period. The LIL was then taken out of service on June 5, and remains out of service, to prepare for installation of the bipole software.

At the time of our late July meeting, Nalcor advised that General Electric continued to maintain that it would complete bipole software development by the end of this month (August). At our late July meeting, Nalcor, described its concern about meeting that date, citing delays, a lack of float in the schedule, and risk to software quality should it seek to compress remaining work too much. Nalcor was recognizing at that time an expected seven-week delay in the expected delivery date of the software - - from late August to late October. A mid-August conference with Nalcor disclosed that agreement has been reached with General Electric on a two-month delay. Following receipt of bipole software, Nalcor will recommission Pole 1 using the bipole software, and then

commission the second pole. Pole 2 has not yet been energized. Bipole software delivery to the site in October, 2019 will result in low load testing not starting until January, 2020.

Nalcor has also extended the schedule for beginning trial bipole operations to February 20, 2020. A second/final version of the bipole software is now expected to be delivered to site in April 2020, following which further testing and final commissioning of the bipole would proceed. This software version will likely include a number of changes/corrections to the software, to reflect the experience gained during the initial commissioning tests.

After installation of the final bipole software, a roughly two-month period to complete commissioning would normally occur. This duration indicates commencement of final bipole testing around July 2020, with completion before the 2020/2021 winter season. Experience from LIL Pole 1 software/commissioning, however, indicates the potential for slippage potentially extending the commissioning process considerably. The agreement with General Electric to recognize a two-month bipole software delivery delay (to October 2019) reflects Nalcor's conclusion that an already-observed, unrecoverable, seven-week schedule delay had occurred. The two-month extension increases confidence that LIL bipole testing can commence in January 2020. Nevertheless, significant software "bug" identification and resolution risks to that date remain.

Long-continuing and extending LIL delays now threaten start-up activities at the Muskrat Falls generating units as well. 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 westerly over the LTA.

In the upcoming months, close and detailed monitoring of General Electric's progress will be required to better understand the impacts LIL availability will have on the winter 2019/20 operating period and Muskrat Falls commissioning. To assist in meeting this objective, we have requested, and management agreed to provide, additional schedule details of key activities, deliverables and expected durations for this critical work.

#### **b. Independent Monitoring of General Electric**

Our last quarterly report observed that General Electric had agreed to employ an independent third party (ITP) to confirm satisfaction of all system functionality requirements. Two firms have been monitoring General Electric's performance during the second quarter. Systematic was hired to assess software development progress and Amplitude was hired to assess conformance to HVdc functional requirements. We expressed some degree of optimism about their contribution in our last quarterly report - - more in terms of getting at the root causes of delays and establishing more realistic dates for completion. Their work appears to have contributed significantly to recognition of the magnitude and drivers of software problems and schedule delays and to agreement between Nalcor and General Electric on a two-month delay (to October) in software issuance.

#### **c. Securing Needed Personnel**

Substantial progress has been made in addressing the long-standing delays in securing personnel to operate LCP facilities. This quarter, an agreement to contract for Muskrat Falls operator positions has alleviated the concerns we have had, and has placed management in a sound position

with respect to the full range of personnel required to operate and support LCP assets after commissioning.

The following table shows second quarter progress in securing additional resources, most notably in Generation. The majority of remaining generation staffing will come under an agreement with Manitoba Hydro International (MHI), who will provide up to eight power system operators to support start-up operations, and will deliver a mentorship program for power system apprentices. Efforts to fill remaining generation positions are continuing, with one key position still remaining to be filled - - the Supervisor of Operations at Muskrat Falls. We found this development very positive for the short and intermediate terms, but there will remain a future need for managing the transition to internal resources carefully and expeditiously.

The third quarter is shaping up to be extremely active for the limited number of resources currently available to support critical commissioning and other LIL activities. As we note below, for example, training and emergency testing have experienced delays due to the press of needs related to the LIL. Effective communication, coordination and prioritization of resources will be essential to avoid future schedule impacts on activities such as these.

Overall Staffing Status as of June 30 ,2019							
	<u>***Total Planned</u>	<u>In Process</u>	<u>Hired-On-Board</u>	<u>Offers Accepted</u>	<u>*Total Secured</u>	<u>% Secured Second Quarter 2019</u>	<u>% Secured First Quarter 2019</u>
Transmission O&M Staff	60	0	57	1	58	97%	93%
Generation O&M Staff	28	7	20	0	20	71%	50%
Engineering Services Staff	42	1	41	0	41	98%	95%
Support Services Staff	14	0	14	0	14	100%	93%
BTPO Staff/Contractors	13	1	12	0	12	92%	85%
Total	157	9	144	1	145	92%	85%
<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>							

#### d. BTPO Training

Training remains an important concern, and another affected by the issues surrounding General Electric resource availability and performance. Unfortunately, very limited progress occurred in the second quarter.

Only 12 of the 21 identified General Electric Transmission Operator training courses in the TTO work plan have been completed. Limited progress occurred on General Electric training on the four Synchronous Condensers, with this training now scheduled for third and fourth quarter completion. As discussed in prior reports, delivery of the courses remains dependent on General Electric personnel currently involved on commissioning work 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.

**e. Emergency Response/Restoration**

Emergency response and restoration plans and exercises for the LIL's long overhead line that runs through Labrador and the Island remain incomplete and require significant attention, although a LIL delay that extends its reliable operation past this winter would mitigate this concern somewhat.

Completing Phase 1 Overhead Transmission Line (OHTL) emergency response and restoration plans was reported as a focus in 2018. However, we have observed and management has concurred, that 2019 has brought limited progress in developing the needed Phase II Long-term OHTL response Plan. Our review of the schedule shows a number of related activities slated for completion in the third quarter. It is essential this critical work remain on track and that necessary resources are deployed in support of completing these longer-term plans.

A second quarter Risk and Capability Assessment for emergency response requirements at the Muskrat Falls site took place. The assessment focused strictly on people and property protection in the event of natural, environmental or complex emergencies. The results of the Risk Assessment are being compiled into a draft report for use in determining the preferred operations based model for emergency response at the site.

**f. Muskrat Falls Impoundment**

Impoundment at Muskrat Falls has become imminent, but awaits government approval.

Start-up and first power activities slated for completion this fall will require impoundment of water to specified elevations at Muskrat Falls. A public notice of impoundment came on July 10th. The available window for impoundment (per Department of Natural Resources authorization) is July 15th to September 30th. Full impoundment, once approved to proceed by the government, requires a minimum of 30 days. Management expressed confidence of timely approval (in August), but observed that a window-threatening delay could substantially delay Muskrat Falls completion. (We subsequently were advised that impoundment has begun.)

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

The Board should expect imminently the filing of an amended Pilot Agreement to address rework to related agreements necessitated by deferring the filing of a long-term optimization agreement.

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. We previously reported management's observation that delaying Long-Term Agreement submittal required rework on a number of affiliate and external contracts related to Muskrat Falls Units 1&2. Management has now reported that Nalcor Energy Marketing (NEM) and Hydro management are drafting an amended and restated Pilot Agreement for presentation to the Board in August. 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.



## 4. Summary of Actual versus Scheduled Activity Completion

### a. Overall Second Quarter Progress

A new schedule re-baselines all TTO activities as of May 1, 2019. The schedule change makes activity completion monitoring more realistic. However, by definition, this re-baselining reduces the number of remaining activities lagging schedule.

Nevertheless, substantial work on construction and bulk TTO activities occurred in the second quarter, but much work remains as the window for completing them narrows. Many activities continue to lag, even after extension of their completion dates under the May baseline. We do believe that sufficient time remains to complete TTO work on time, should acceleration of progress rates continue, and provided that the problems driving LIL delays ease.

As nominally reported, second quarter progress shows improvement. However, much of the apparent 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, now show completion dates in the third and fourth quarters of 2019. Thus, we continue to have significant concern about the number of activities still awaiting completion. With the third quarter upon Nalcor, there is very little time left to accomplish the materially improved rate of work completion required to meet the schedule. We continue to emphasize the need, with ever less time remaining to complete activities, to turn the “corner” in completing critical work.

### b. New Schedule Baseline

We have previously reported the shortcomings in the schedule as we began our monitoring work in September 2017. These shortcomings limited their usefulness in monitoring performance and status effectively. We chose to use as our monitoring baseline an “official” baseline schedule established at that time. We have used management’s reports of progress against that schedule, incorporating some adjustments in early 2018. Through 2018, management made only limited changes to schedule. However, 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 base against which we measured schedule progress warranted a schedule re-baseline, which would make assessment of real progress more transparent.

Our last quarterly report recommended establishment of a new baseline schedule, given the implications of management’s detailed review of remaining work scope and the addition of a large number of new activities and schedule enhancements. Nalcor re-baselined the TTO schedule as of May 01, 2019. We hope that this new baseline will bring greater stability to schedule-assessment metrics going forward, and enable us to better assess future progress and identify potential exposure issues.

### c. Key Second 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,

Seventh Quarterly Transition-to-Operations Monitoring Report

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. In the past, Nalcor has categorized these TTO schedule milestone dates as “stretch targets.”

The chart below shows nominally reported milestone progress measured from the new May baseline. Unsurprisingly, re-baselining has served to produce forecasts that nearly all milestones are on or ahead of schedule. The one major exception, and it causes major concern, is the roughly two-month delay in LIL-Bi-pole Commissioning. Continuing problems with timing and quality of General Electric bipole control and protection software drive this delay. Work continues to proceed slowly, management has reported high rates of “bug” generation, expectations that that rate will increase, and no slack in the already delayed schedule.

The next 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	▲ 10/25/19	
LITL 1 <sup>st</sup> Power Transfer Labrador to Newfoundland (Pole 2/Bipole)	12/11/19	▲▲ 11/29/19	
LITL Bi-pole Commissioning (Initial Low Load)	01/07/20	▲▲ 02/17/20	
<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	▲ 10/04/19	▲
MFG First Power	12/09/19	▲ 11/29/19	▲
Power House Unit 3- Ready for Operation	05/06/20	▲ 12/23/19	▲
Power House Unit 4- Ready for Operation	07/20/20	▲ 03/06/20	▲
MFG Full Power	07/15/20		▲ 7/15/20
MFG Full Impoundment	08/14/19	▲ 08/14/19	

**d. Second Quarter Activity Progress**

Completion of planned activities for the second quarter continued to lag. The table below shows 19 activities scheduled for completion in the second-quarter of calendar 2019 - - management only completed 17. The transition team did complete an additional 8 activities which had been scheduled for completion in the third quarter of 2019.

**Second Quarter 2019-Performance Summary**

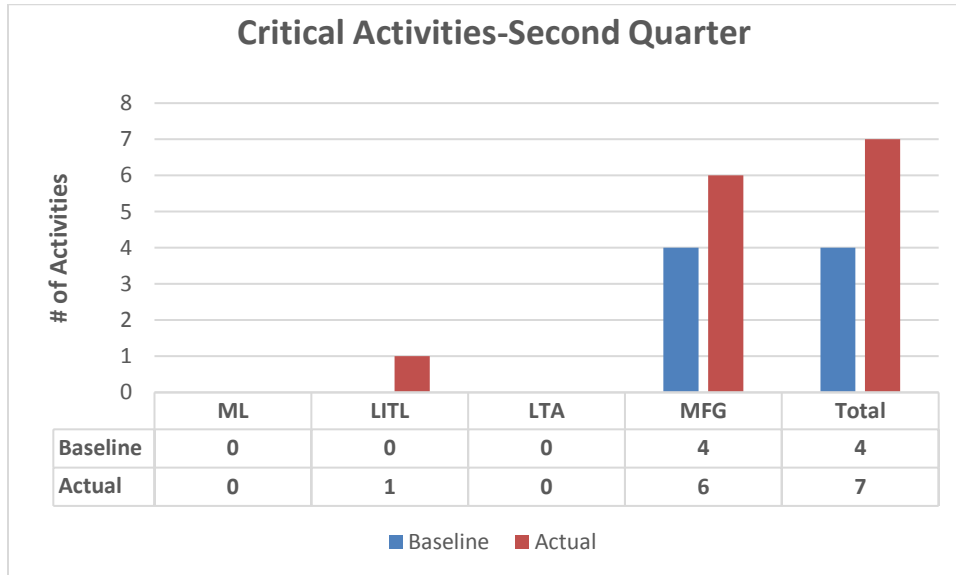
Baseline Activities		Unscheduled Activities	Total Completed
Scheduled	Completed	Completed	
19	17	8	25

Nominally, this rate of completion shows improvement, but has been much enhanced by the May re-baselining’s deferral of activities formerly scheduled for second quarter 2019 completion. A significant number of activities originally scheduled for completion in the second quarter 2019 or earlier have now moved to the third and fourth quarters of this year, after re-baselining.

The table’s activities slated for completion in the first 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 first-quarter progress on activities that schedules show as critical to completion.



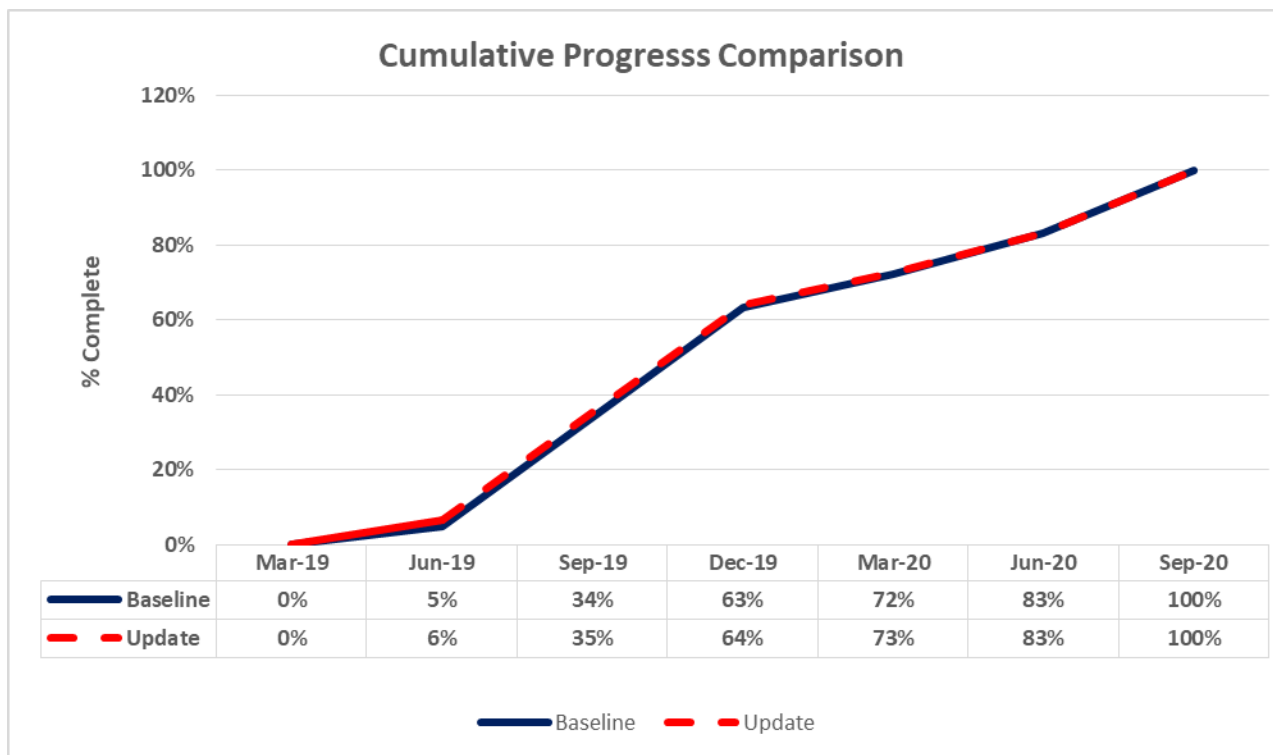
The May re-baseline called for the completion of four critical activities in the second quarter of 2019 - - all completed during the quarter. The second quarter also brought completion of three critical activities targeted for future quarters but were actually completed in the second quarter. A considerable number of outstanding activities originally targeted for completion in prior quarters remain 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.

**e. 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 second quarter completion of six percent of total outstanding activities, versus targeted completion of five percent. This quarterly performance, combined with the close alignment between the new baseline and future projections, suggest a solid path to completion. However, the effects of re-baselining call for caution in this regard. The chart shows a significant step-change from second quarter progress of 6 percent will be required to meet the 34 percent baseline target planned for the third quarter. Past performance suggests that attaining this level of achievement will be challenging. Third quarter performance should provide a more realistic assessment of true progress to-date.



Nevertheless, given the relationship between overall LCP schedule milestones and the dates driving TTO’s corresponding activities, we continue to believe that despite the delays, sufficient time still remains for TTO to complete its transition work, provided additional new scope is not identified and resources are not diverted to other areas.

#### **f. Summary of Progress by Teams**

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

- Stage IV (high power) advanced to 84 percent complete overall. Focus remained on completion of transitional studies expected to be concluded in August, with remaining high power studies completed by the end of the third quarter. Development and implementation of the strategy for the Nalcor reliability compliance program has been drafted. NLSO has received and accepted the LTA assets.
- BTPO continued to focus on securing staff for Muskrat Falls. Five apprentice hydro operators are onboard and all required journey person hydro operators have been secured through a vendor agreement with MHI (Hydro Operators RFP). A Risk & Capability Assessment for Emergency Response requirements at the Muskrat Falls site took place.
- However, BTPO's delivery of LIL operator training, slated for delivery by General Electric, continues to lag, as does development of low-frequency preventive maintenance items and checklists.
- The majority of the RFCI program has been completed. Key remaining items are tied to the completion of the Long-term Optimization Agreement, Muskrat Falls PPA scheduling protocol, Multi-Party Pooling Agreement (MPPA) and development of the bipole operating procedures.

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. Follow-Up Action Items**

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

- a. Pursue discussion with Nalcor of the details underlying the observations and recommendations of the most recent reports produced by the Independent Third Party consultants.
- b. Provide a more in-depth schedule of activities along with expected durations for the development and testing of the bipole software, and the subsequent commissioning of Pole 1, Pole 2, and the Bipole.