

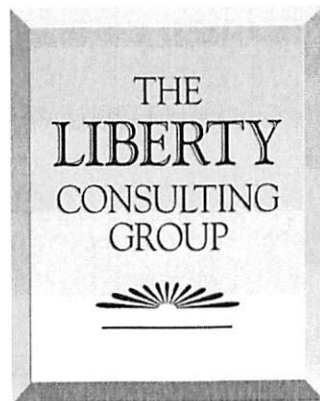
**First Quarterly Monitoring Report on the
Integration of Power Supply Facilities to the
Island Interconnected System**

Presented to:

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

Presented by:

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1. Introduction

a. The LCP's Transition from Construction to Operations

Hydro says that the Lower Churchill Project (LCP) will produce a “step change to NL’s electricity system,” acknowledging that integration of the facilities under construction will require a programmatic approach to ensuring technical and operations readiness as construction approaches completion. Management has sought to enable a “smooth and successful transition to the asset owners and operational organization”¹ by creating a structured program, supported by a large team of internal and external personnel possessing a wide range of experiences and backgrounds, for ensuring technical and operations readiness.

This program, termed by management the Transition to Operations (TTO) forms the focus of our review of progress over the last quarter of 2017. The TTO’s approach to ensuring a “smooth transition from LCP construction to operations” involves the planning, scheduling, resourcing and execution of four work streams. None of them directly involved LCP construction work, which operates under its own plans and schedules. However, progress against those construction milestones has a bearing on and some material linkages to the TTO work streams and the schedules for completing them. We have made some references to those construction milestones in this report, for the purpose of discussing how they may influence TTO activities.

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

- BTPO (Building the Production Organization), which focuses 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 Island Integrated System (“IIS”) and the LCP
- RFI (Ready for Integration), which focuses 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), which focuses on commercial, legislative, control over hydro-electric resources, and regulatory matters
- RFO (Ready for Operations), which has 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

The Board of Commissioners of Public Utilities (the “Board”) asked The Liberty Consulting Group (Liberty) to examine and assess progress in accomplishing a smooth and successful transition to operations. This work supports the interests of the Board and stakeholders in assessing the impacts from the integration of the LCP on reliability and adequacy of the IIS. We are doing so by examining plans, schedules, and status of activities in the first three of the four TTO work streams. Our work does not include an examination of LCP construction status or progress. Nalcor

¹ TTO Work Plan Review, Reporting Discussion & Other Items (September 26, 2017)

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has embedded the team responsible for the RFO work stream into the LCP organization responsible for construction. We therefore have excluded its work as well from our review.

We worked with Hydro and Nalcor last fall to establish a monitoring framework that would provide visibility on and an understanding sufficient to monitor TTO status. We planned for a series of quarterly meetings with management followed by reports addressing that status. This report sets forth the results of our first quarterly review of the efforts through the BTPO, RFI, and RFCI work streams to prepare for the operation of the LCP assets that will bring power from the Muskrat Falls generating facilities. These reports will address whether this TTO work is proceeding in a manner that will support the integration of and reliable operation of the assets at the planned in-service dates.

Our work in reviewing progress over the past quarter sought answers to a series of basic questions:

- Do the BTPO, RFI, and RFCI work stream plans and schedules present a sufficiently comprehensive, well-defined, logically sequenced and tied set of activities to support the TTO?
- What progress was made in the last quarter relative to the schedules for these three work streams?
- Can management provide meaningful answers to questions about the status of scheduled activities?
- Has management identified actions that, if executed, can succeed in meeting the schedule established last fall for these three work streams?
- What specific measures, actions, and results should form the focus of our next quarter's monitoring efforts?
- What lessons learned from our past quarter's monitoring efforts will enhance future ones?

In September 2017, Liberty and Board Staff met with Nalcor/Hydro management to: (a) develop an understanding of the plans for and status of activities necessary for integration of the new facilities into the IIS and (b) to establish a monitoring process by which the Board can secure information from an independent source about the effectiveness and timeliness of the integration program and processes.

At the time of our September 2017 meeting, Nalcor/Hydro had been relying on a schedule including varying and inconsistent levels of detail and limited logic ties. Factors like these constrained the ability to identify and analyze progress on critical-path activities. Management was basing progress updates in significant part on subjective assignments of activity percentages completed and numerous long-duration tasks compromised the ability to make early identification of completion problems emerging on those tasks. Management advised at the September meeting that it had recently retained a project management professional, who had made and would continue to make plan improvements. This professional also migrated plans and schedules to a significantly improved tool (Primavera), which would enhance progress tracking and progress measurement.

Shortcomings in management's plans and the resulting ability to monitor performance and status effectively led us to adopt a monitoring approach designed to "work around" the resulting gaps in data important for measuring TTO progress. We settled on an "official" baseline schedule established on September 27, 2017. It was agreed that Hydro/Nalcor would then, as it did for this first monitoring period, provide quarterly schedule updates for our analysis, comparing progress to that September baseline's milestones. We would then identify issues in advance of a regular quarterly meeting for discussion. Hydro/Nalcor was also to provide a "big-picture" assessment of status and progress, accompanied by an explanation of progress on activities critical to schedule (or "critical path") and risks to their successful, timely completion.

2. Summary of Liberty's Conclusions

Hydro/Nalcor has since last September materially improved the detail in its schedule, which shows a maturing understanding of work requirements. The improvements also appear to reflect the benefits of making resource additions (albeit late), on which it made substantial progress (but did not complete) in the past quarter. Moreover, the last quarter did produce significant work accomplishment. Meaningful progress in all areas was evident. Management displayed a sufficiently high priority on and attention to the work needed for readiness.

However, continuing fluidity in activity definition, a low level of logic ties among activities, a large number of long-duration activities, and the use of subjectively determined weightings (percentages complete for activities still in progress) continue to diminish confidence in management's tools for evaluating status and progress.

While management demonstrated engagement and was knowledgeable about what it needs to do, we did not get reassuring answers about why so few activities planned to be completed were actually completed last quarter. These slow completion rates and later than planned filling of jobs compound uncertainty about the ability to make progress as required by the schedule. Significantly increasing completion rates will be necessary to validate management's confidence about meeting schedule.

Management, despite its sense of accomplishment and optimism about what last quarter's progress augers for the future, has nevertheless recognized that accelerated completion of work activities will be required to meet schedule. Bringing in outside resources has emerged as a significant means for filling positions - - a process that has not proceeded as fast as scheduled. It has expressed full confidence in the ability of its internally/externally structured team to accomplish that acceleration. Liberty, however, continues to believe that the metric of activities completed versus planned to be completed is the best reflector of the sufficiency of the rate of work completion.

The fourth quarter brought many changes and material impacts on work completion. The performance to-date certainly raises concern as to whether management is proceeding in a manner that will assure reliable operation of the assets at the planned in-service dates. However, we believe that sufficient time remains to "get things back on track," particularly should management aggressively pursue the securing of an appropriate level of skilled resources. The performance in the first quarter of 2018, and its large number of key activities slated for completion, should prove very telling as to the likelihood of future success.

We propose to continue examining the rate of staffing additions, the degree to which those additions are in fact accelerating completion of work activities, and efforts to assess progress on critical paths.

At our meeting in September, management outlined a change in structure that removed all LCP-related work from Hydro and into the Nalcor organization. In the near term, this change in strategy appears to have had an impact on fourth quarter performance, given delays in hiring and the arrival of new personnel. As new resources have been brought on board, they have identified new scope, forecast dates and schedule enhancements.

We have reported previously that we consider the availability of recall power from Churchill Falls to Soldiers Pond (contingent on energization of Pole 1 of the HVdc link) next winter as important to maintaining reliability on the IIS. Delay in that energization disclosed this past quarter does not yet threaten its availability next winter, but it will be necessary to advance progress in the next quarter to make Pole 1 available in time. The last quarter's slower than expected pace of completing activities in support of overall testing/readiness completion will also need to increase to ensure reliability on the IIS in the longer term. Management has taken steps to accelerate that pace, but it remains too early to judge their likely effectiveness. The next quarter, however, will need to exhibit improved progress.

3. Program Schedule Structure and Fourth Quarter Performance

a. Findings

Summary

A positive development has come with the addition of more detailed activities to the baseline schedule, which reflects a deepening understanding of work required and its status. Countering this development somewhat, we made three observations about the quality of the schedule:

- The growth in activities at this stage raises concern about whether stability in activity identification has now come to what should by now be a reasonably mature organization, plans, and schedules
- The limited degree of evident linkage among activities makes assessment of progress and schedule jeopardy difficult
- The continuing overuse of long-duration activities obscures management's ability to gauge where attention is needed to maintain satisfactory schedule progress.

We also found, based on rates of activity completion, that the fourth quarter rate of completion was far less than planned.

Schedule Structure and Detail

Management had expressed a high degree of confidence in the September 2017 schedule we adopted as our progress measurement baseline for our future quarterly reporting. Management then considered it comprehensive in laying out the detailed work activities going forward, with the transition team fully "bought-in" to its activity definitions and durations. We had anticipated that

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the passage of time and progress in planned activities would occasion plan changes and enhancements required. Over 200 new activities have been added to the baseline schedule since that time. This large increase represents a fifty percent growth in activities over the September schedule's 400.

Expecting a more evolutionary set of changes, we found the magnitude of fourth quarter plan changes surprising. The more than 200 new activities reflected both added work scope and various schedule modifications. The changes have made it challenging to evaluate fourth quarter progress, but Liberty has been able to work through the details and formulate some insights.

The activity additions made sound enhancements in the level of detail provided by the schedule. However, the large number of changes at this stage of the readiness program raises question about the sufficiency of management's grasp on the full scope of the work remaining to completion. The challenges in securing planned resources and the substantial degree of fluidity remaining in work definition make it appropriate to examine carefully whether additional activities will continue to be identified, now that increasing numbers of personnel have come on board. It will be critical to look for stability in work definition and planning as a sign of management's ability to meet its current schedule. On the other hand, the addition of resources and the addition of work activities do show both a maturing organization and understanding of required work.

Management has structured the baseline integration schedule around several key milestones extracted from the LCP construction schedule. While we are not examining the construction schedule or progress against it, some of its milestones affect the testing/readiness activities that we are examining. Certain construction milestones form a framework that the transition team utilizes to prioritize and track work activities. The milestones provide the link between the overall project construction plan and the various integration activities. The schedule characterizes the milestone dates as "stretch targets." The milestones reflected in the plan may differ with dates released to the public.

Activity Ties and Durations

Despite the added activities, the schedule continues, as we observed earlier, to display limited logic ties among the activities. Detailed linking of activities in a large program such as exists here, is critical to a sufficient understanding of schedule status and the sources of jeopardy in overall work completion. The schedule also contains too great a number of long-duration tasks - - an observation we also made earlier. Overuse of long-duration activities obscures the ability to focus attention on activities (and the sub-activities comprising them) that may not be proceeding promptly to completion.

Fourth Quarter Milestone Changes

Nominally reported milestone progress since the baseline was established in September 2017 has fallen short of planned levels in terms of activity completion. The recent achievement of two key milestones was reported: (a) first power on the Maritime Link, and (b) construction completion on the HVdc overhead line. Most milestones, however, have slipped - - some by as much as six

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months. We took particular note of the two-month slippage in activities related to low power energization of the LIL. The chart below illustrates the significant changes in the milestone schedule during the fourth quarter. Management attributed the milestone changes to delays in GE grid readiness/construction activities - - not to delays in the transition/readiness activities that form the focus of our review. The fourth quarter witnessed considerable slippage in these transition/readiness activities, but management appears correct in concluding that TTO work has not been directly responsible for slippages in overall milestone dates. Delays in construction activities have kept transition/readiness work from becoming critical to schedule. Nevertheless, continuing delays in transition/readiness work are far less likely to continue to be so benign. As we have reported in the past, we view the availability of recall power this next winter (following energization of Pole 1 of the HVdc link) as important in ensuring reliability on the IIS.

It appears that the main reason for slippage of commissioning and energization of the LIL has resulted from delays in performance by GE Grid, in particular the finalization of control and protection systems. Progress in that area has led to delay in starting factory testing of the controls and protection, which must be completed before converter station energizing and testing.

0	Baseline	2017	2018	2019	2020
Maritime Link					
Granite Canal Switchyard - Substantial Completion	09/07/2017	08/04/17 Actual			
Bottom Brook Switchyard-Substantial Completion	09/18/2017	07/13/17 Actual			
Maritime Link 1 st Power	10/30/2017	12/16/17 Actual			
Labrador Transmission Assets					
Churchill Falls Switchyard (New) - Ready to Energize	10/31/2017	01/24/18			
Muskrat Falls Switchyard - Ready to Energize	11/28/2017	02/28/18			
LTA Ready for Power Transmission	01/01/2018	03/12/18			
Labrador Island Link Assets					
HVdc Transmission Line Construction Complete	10/27/2017	10/30/17 Actual			
SP Switchyard & Converter Station - Ready for Operation	02/12/2018	03/15/18			
Muskrat Falls Converter Station - Ready for Energization	01/16/2018	03/26/18			
SP Synchronous Condensers- Ready for Operations	03/06/2018	09/10/18			
LITL 1 st Power Transfer Labrador to Newfoundland (Pole 1)	05/01/2018	07/01/18			
LITL 1 st Power Transfer Labrador to Newfoundland (Pole 2)	10/30/2018	02/11/19			
Muskrat Falls					
Power House Unit 1- Ready for Operation	04/17/2019		12/09/19		
Power House Unit 2 ready for Operation	07/09/2019		02/21/20		
MFG First Power	07/30/2019		12/09/19		
Power House Unit 3- Ready for Operation	10/16/2019		05/06/20		
Power House Unit 4- Ready for Operation	01/22/2020		07/20/20		
MFG Full Power	01/22/2020		07/20/20		

Fourth-Quarter Activity Slippage

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Fourth quarter progress on integration activities lagged when compared to the baseline plan established in September 2017. As shown in the table below, 104 activities were scheduled for fourth-quarter (calendar 2017) completion in the baseline, but only 23 were completed. Management also completed an additional 35 activities either scheduled for completion prior to or after the fourth quarter.

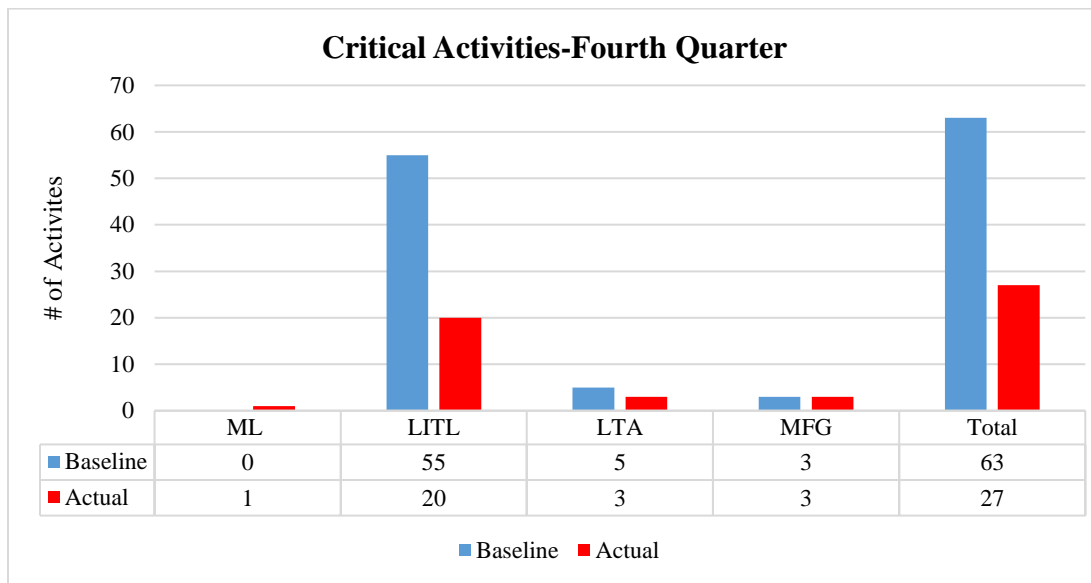
Fourth Quarter 2017 – Performance Summary

Baseline Activities Scheduled	Baseline Activities Scheduled and Completed	Unscheduled Activities Completed	Total Activities Completed
104	23	35	58

Activities slated for completion in the fourth quarter fall into two categories:

- Critical activities - - those that have an impact on critical path milestones
- Bulk activities - - those that just require completion by the end of the project.

One needs to differentiate between the two when assessing quarterly performance. At this phase of the project, a focus on critical activities best illuminates schedule status. The chart below summarizes fourth-quarter progress on activities shown as critical to completion per schedules.



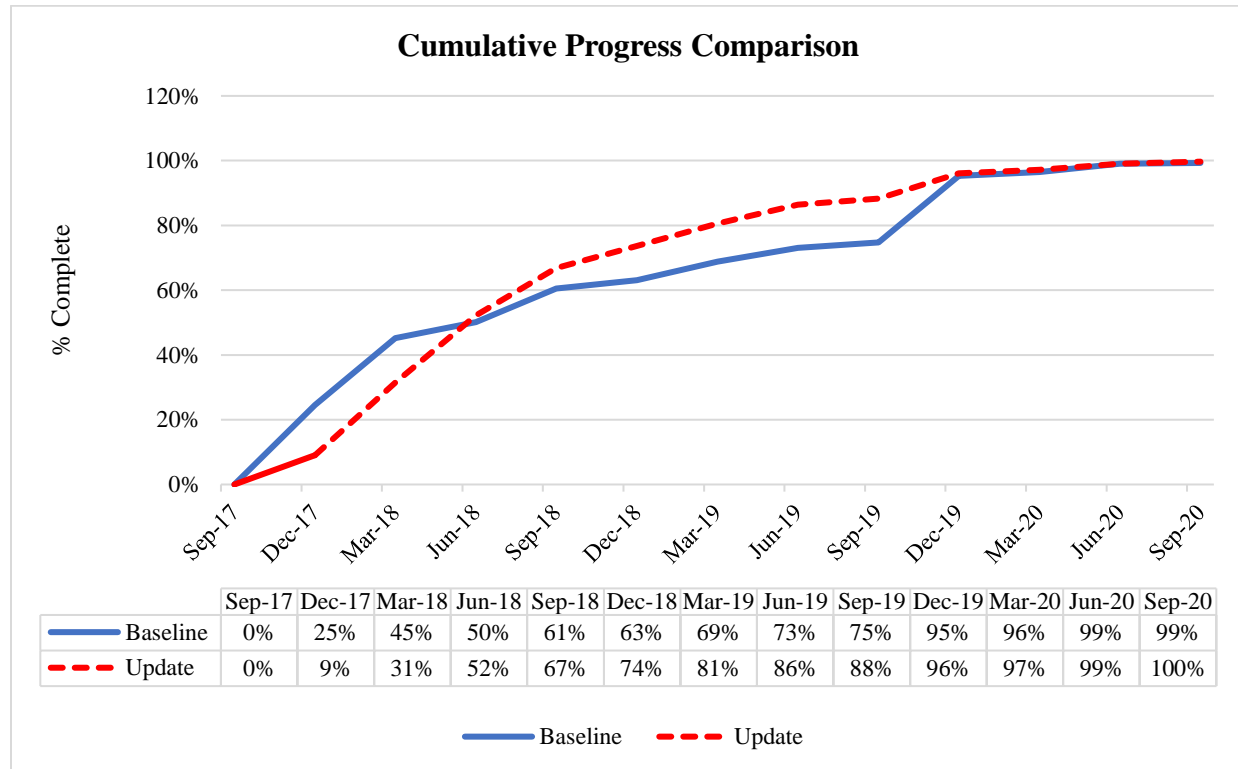
Only 13 of 63 critical activities targeted for completion in the fourth quarter were completed. Completing an additional 14 unscheduled activities brought the total to 27. Even including the unscheduled activities produces a completion rate of about 40 percent. While not, as previously discussed, responsible so far for milestone delays, a failure to accelerate completion of these activities will begin to produce material impacts.

The Completion “S-Curve”

With fourth-quarter performance significantly lagging expectations as compared to the baseline, Nalcor/Hydro has reworked its plan to reflect delays and to incorporate new activities resulting

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from scope changes. In order to gauge the implications of these substantial changes, we developed a cumulative percent-complete S-curve comparison, which the next chart illustrates. We incorporated all planned activities into this curve. Percent complete as we measured it equals cumulative number of activities scheduled for completion divided by total outstanding activities.



The chart depicts the lack of fourth quarter progress relative to the baseline plan. As of December 31, 2017, only 9 percent of the total outstanding activities had been completed, as compared to the target of 25 percent from the baseline. The primary drivers of the low completion rate were delays in completing baseline activities and the addition of new activities. The chart also suggests management’s current recovery plan will not bring it back in line with the baseline target until about the second quarter of 2018. Clearly, the pace of progress will have to pick up substantially in 2018 for a return to conformity with the expectations of the baseline.

At our recent update discussion, Nalcor/Hydro requested that Liberty re-baseline the plan as a result of the numerous changes made in the fourth quarter. Currently, Liberty sees no value in changing the baseline, we continue to believe that retaining the current baseline enables us to better understand plan changes and to provide a more meaningful analysis of progress.

At a high level, fourth quarter work in the major categories of work relevant to our examination was as follows:

- The RFI team made significant progress in a number of areas, but progress lagged in controls and protection systems development and in support for testing, commissioning and witnessing functions. The RFI team is also slightly behind in the implementation of Phase 1 reliability standards.

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- The BTPO group made progress in hiring staff, but requires a more concerted focus in 2018's first quarter. The BTPO team is also behind in coordinating and delivering employee training and in developing asset management plans.
- The RFCI team appears generally on-schedule.
- The RFO team has no activities in the transition schedule; its activities are embedded in the LCP.

b. Hydro/Nalcor Position

Management expressed comfort with the quality of the schedule, as well as progress against it. As we discuss below, management considers its weighting of activities and its measurement of weighting against them sufficient to give it a suitable handle on progress. Management bases progress updates largely on the basis of percent-complete estimates for schedule activities. These estimates do not have an objective basis, instead relying generally on the judgments of supervisors, often those who would be called to task were they to value progress at less than required rates.

Despite the fourth quarter setbacks, management appears aware of and working on the priority items needing additional attention. As previously stated, delays in construction activities have served to mitigate the lack of performance, and afforded management additional time to get on track with respect to transition/readiness activities. Management's development of a recovery plan including a more complete scope, along with some corresponding schedule enhancements are examples.

c. Liberty's Conclusions

At this point, a rework of the schedule does not appear to present a realistic option. However, it is important to examine over the next quarter whether stability in activity definition has emerged, and whether resource additions: (a) will be completed as planned, and (b) will lead to production of the work products for which they are responsible. Hydro/Nalcor has expressed a continuing desire effectively to re-baseline schedule dates, which they previously agreed to hold fixed for progress monitoring purposes. We continue unpersuaded on that change, lest a continuing set of "moving targets" further obscure the ability to provide meaningful assessments of progress.

Given the lack of logic ties and the number of long-duration activities, we had determined to measure progress using curves showing cumulative progress in completing what appeared to us to be logically related groupings of activities. We continue to consider that the correct approach, and propose to continue supplementing it with detailed questions developed from a review of activity sets with apparently low completion rates.

In summary, we continue to have concerns about reliance on the tools management uses as a valid indicator of status and progress. Judging true status and progress will continue to require more subjectivity, than would be the case for a schedule developed more closely in accord with the complexity and magnitude of the challenges that exist here.

A preliminary review of the updated recovery plan indicated that it may prove feasible, absent significant increases in scope, additional construction delays and further issues in securing critical

resources (internal and contractor). However, we are not confident that management will execute this plan effectively. In particular, the resource issue may continue as a major challenge, impairing future performance. This issue warrants close attention during the early part of 2018.

4. Management's Ability to Answer Questions

a. Summary

The schedule and the supplemental information supplied supported a high-level evaluation of overall performance during the past quarter. It appeared clear that performance had lagged. Our review of detailed data identified apparently lagging areas. We used that data to develop items for discussion at our recent update meeting. Management provided significant information in a presentation, and offered clear responses to our questions. Team leads and support personnel for each of the TTO work streams pertinent to our review attended the meeting. Each appeared knowledgeable and confident about their areas of responsibility. Management clearly has dedicated a very high level of priority to its preparation for operations, both transitional and long term.

As noted above, however, measurement of progress at the detailed level remains restricted by schedule quality, detail, and progress measurement methods. We presented information about the numbers of activities completed versus required for sets of related activities that we established. Acknowledging that many activity sets stand at low rates of activity completion, the scheduling lead expressed confidence that the low rates Liberty observed were not problematic. He relied on the percentages assigned to activities in progress as sufficient to support schedule. Supervisors assign to in-progress activities a weighting representing their views of what portion of such activities has been completed. Thus, for example, if 80 percent of a set of activities remain in progress, if they are all 90 percent complete, then the measure of completeness is not 20 percent, but actually the sum of the 20 percent completed plus 90 percent of the remaining 80 percent.

b. Hydro/Nalcor Position

Leadership and management expressed a high degree of optimism based on last quarter's work and a strong confidence in ability to meet all schedule deadlines. Management remained confident that no material areas face schedule jeopardy, that all work is covered by sound plans, and that it will be successful in executing those plans.

c. Liberty's Conclusions

From an overall perspective, management is engaged and knowledgeable about what it needs to do. However, our assessment of the volume of activities accomplished versus required to be done at work completion does not align with management's expression of confidence. Note also that management acknowledges that improved performance in the future is required. Slow rates of activity completion (measured against total required to be completed), the subjectivity in measuring percent complete, and the introduction of large numbers of personnel later than planned underscore the validity of questioning management's view at the summary level that "all is well."

We will continue to monitor closely activities complete versus required in the next quarter. Significantly increasing rates of completion may well validate management's use of percentages complete; the lack of such increases will, however, expose a material flaw in assessing schedule.

5. Planned Changes

a. Summary

In particular, the areas where we observed material indicators of significant completion lags last quarter included:

1. Completion of system testing/commissioning/witnessing activities
2. Implementation of Phase 1 reliability standards
3. Development of an asset management program
4. Delivery of final points lists related to ECC control and monitoring.

Management has identified plans to mitigate further slippage, and to get these items back on schedule. These plans include the deployment of additional resources, both internal and contracted, to accelerate the completion of activities in areas like these. Success will in major part depend on the ability of GE Grid to complete first the design of the control and protection system, and then Factory System Testing.

b. Hydro/Nalcor Position

While expressing a high degree of satisfaction with work last quarter and full confidence in meeting schedule, management acknowledged that improvement in activity completion must occur. With delayed resources now being added, management believes that it has the resources needed to accelerate work production and activity completion to levels that will avoid schedule delay.

c. Liberty's Conclusions

One cannot rule out significant acceleration in activity completion, given the increase in resources. However, as the low rate of completion last quarter demonstrates, acceleration is more anticipatory than it is existing. Management has noted that many of the resources added are contracted, rather than employed. It remains to be seen whether the numbers and capabilities are up to the task of accelerating work efforts required for readiness. As noted, we continue to consider work activities completed, not resources added or percentages credited, as critical. Close examination of those activities to identify whether or not pace of completion is improving and to determine whether management has identified their criticality to schedule with sufficient specificity will be a priority.

6. Next Quarter's Key Monitoring Activities

Next quarter efforts should focus on:

- Continuing to evaluate overall performance utilizing the metrics we have established, focusing on work activities completed versus planned to be completed by activity groups
- Detailed examination of the four numbered areas of particular exposure from the section preceding this one

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- Evaluating new activity additions to assess, (a) comprehensiveness and finality of required work scope, any growth in scope, and (c) potential impact on plan effectiveness and schedule
- Continuing to focus on efforts to fill key positions, secure the total numbers required, and demonstrate staffing effectiveness through successfully completed activities depending on additions.

7. Level of Support for Monitoring Efforts

Hydro/Nalcor provided the detailed excel schedule data at the time promised. We experienced a delay in securing supporting information, however. We asked for: (a) a brief overview of quarterly performance including major accomplishments, (b) a discussion on areas behind schedule and corrective actions underway to address them, and (c) critical path analysis with respect to the project milestones. We anticipated receipt of this information prior to the update meeting but did not receive it until an hour before the meeting. Management reported a misunderstanding as the source of this delay. During our interaction with management, we found that they ultimately provided the information we requested and answered our questions, but appear guarded and selective in what they provide.

We will be working in the next several few weeks to ensure clarity in what information is needed and when in advance of the quarterly meeting. We will also monitor progress in GE Grid control and protection activities for potential impact on the readiness activities that form the focus of our monitoring.