

INDEPENDENT ENGINEER REPORT FOR Q2 2021

Prepared for: Natural Resources Canada and Nalcor Energy

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Quality Assurance Statement

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TABLE OF CONTENTS

LIMITATIONS AND SCOPE.....	1
GENERAL.....	1
1. CONSTRUCTION ACTIVITIES-MUSKRAT FALLS	1
2. CONSTRUCTION ACTIVITIES-LIL	3
3. OUTSTANDING ISSUES	4

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LIMITATIONS AND SCOPE

Due to Covid 19 pandemic travel restrictions the Independent Engineer (IE) team was unable to visit project sites since December 2019. Information for this Report is based on the Construction and other Reports, briefing documents, e-mails and teleconferences with Nalcor representatives.

This Report covers the Project deliverables as well as the technical challenges encountered during the period from March 2021 to June 2021 (inclusive). Due to implementation delays of the HVDC control and protection software and valve hall rehabilitation program, the schedules remained fluid throughout the reporting period.

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Source Material:

Construction Reports
LCP Transmission Progress Briefings
Power Development Progress Briefings
Webex meetings presentations
Valve Hall Site Activity Chart
Failure Investigation Reports L3501
Dam Safety Weekly Monitoring Reports for March 2021 (Reports for Q2 not yet received)
North Spur - Post Impoundment Report dated 11 March 2021

GENERAL

Operations at the Muskrat Falls Site have transitioned back to pre-outbreak conditions; and on March 27th, Newfoundland and Labrador moved into Alert Level 2, as previously noted. That status remains as of the date of this update. COVID-19 vaccinations are being offered to workers at the Muskrat Falls Site, which will further mitigate the risk of an outbreak at Site.

1. CONSTRUCTION ACTIVITIES-MUSKRAT FALLS

1.1 Powerhouse

IE submitted to Nalcor Project Delivery Team (PDT) their opinion on design of Emergency Shutdown and Emergency Intake Gate Close facilities. Nalcor is committed to ensuring the highest level of safety and reliability and are currently studying design modifications that meet the IE recommendations.

1.2 Dam Safety

Ongoing dam safety surveillance by Operations continued through Q2. As of 04 April 2021, there have been no anomalous responses or behaviour recorded, and no dam safety concerns have been identified. The North Spur - Post Impoundment Report was issued 11 March 2021. The report concludes that based on monitoring of dam safety instruments since the reservoir was impounded to full supply level in Sept 2019, there have been no unanticipated piezometric conditions, and no anomalous behaviour of the North Spur that would require a re-evaluation of design studies related to slope stability and progressive failure. The instrumentation indicates that piezometric levels have not yet fully stabilized throughout the North Spur and it is anticipated that at least two full years after impoundment may be required for levels to stabilize. The IE concurs with the conclusions of the report and has provided some suggestions for additional ways to summarize and present the instrumentation data, for example to compare the pre-and post-impoundment piezometric levels in various local areas of the North Spur.

1.3 Turbines and Generators

Unit 1

- Unit has been in operational status since Dec. 22, 2020.
- Monthly head cover / weld inspections are being made.
- Planned outage to replace the generator stator bar, implement head cover modifications and welding rework is tentatively scheduled for July/ August 2021.

Unit 2

- Head cover modifications and welding rework (including inner head cover, intermediate head cover and discharge ring) are complete.
- Overspeed testing was completed on April 20; post overspeed testing inspections are ongoing.
- Based on vibration data collection from Unit 2, Andritz has confirmed the design of the head cover modification.
- Unit was successfully synchronized to the grid by mid May 2021, commissioning tests and trial operations were completed by the end of May.
- Protection anomalies that resulted in unit forced outages were remedied.

Unit 3

- Dry commissioning activities ongoing; wet commissioning to commence by mid-May.
- Welding rework is complete; head cover modifications nearing completion.
- Wet commissioning started on June 7th.
- Release for service expected in late July 2021.

Unit 4

- Installation activities ongoing.
- Welding rework ongoing; head cover modifications planned for May.
- Release for service expected in September 2021.

1.4 Balance of Plant

Cahill-Ganotec is completing balance of plant systems; currently ~ 97% complete.

1.5 Hydro- Mechanical Status Update

- Commissioning for Intakes 2 through 4 is being completed in coordination with commissioning and startup activities for each Unit.
- Condition of intake gate secondary concrete is being assessed as the commissioning progresses.

2. CONSTRUCTION ACTIVITIES-LIL

2.1 Software Development Progress

- Amending Agreement Number 9 between LIL Ltd Partnership and GE Canada has been drafted.
- GE seeks approval for Deferral/descoping of software functions from the 'Full Function Bipole'.
- LIL Ltd Partnership can consider the removal of any software functionalities providing that GE confirms in writing that any form of a "Reduced" Full Function Bipole software release will not have any impact on the Performance Guarantees listed in Article 36 of the Agreement.
- GE has moved from the IST stage (integration system test) to the FST stage (factory system test) of Final Bipole Software testing on May 24, 2021. It is noted that unresolved bugs from IST and Interim Bipole commissioning have been pushed into the FST stage.
- Bug discovery and rate of resolution will impact software delivery timeline. Project schedule is dependent on GE resolving relatively high and increasing number of the bugs while proceeding with FST.
- GE has acknowledged that their schedule has slipped, and they will provide a revised schedule.

2.2 Software Development Risks

- Risk associated with Final Bipole completion is very high.
- LCP has not updated its forecast for Trial Operations start on September 15, 2021 (Trial Operations is complete after 30 consecutive days of power transfer without a system trip). In IE opinion, risk of schedule slippage beyond the September 2021 has increased and is in the range of 2-6 months.
- There is also a quality risk associated with releasing software before fixing the critical bugs. The ITP (independent third party) states that an additional 2-4 weeks added to the software testing and bug fixing schedule could result in higher quality software release and therefore fewer versions of software needed after FAT. This approach has the potential to shorten the dynamic commissioning and trial operations period and mitigate schedule slippage for the overall Final Bipole completions milestone.
- IE continue to emphasize the need to conduct full regression testing of the Final Bipole software.

2.3 Valve Hall Rehabilitation

- Manufacturing of replacement beams is ongoing at two European factories; quality issues with the first batch from each factory have slowed the production and numbers of beams were rejected.
- GE still intends to replace Pole 2 beams first, followed by Pole 1. The current plan is to operate LIL in monopole mode after completion of the Pole 2 work and in bipole mode after all beams are replaced.
- Originally all beam replacement work was scheduled to be complete in early August 2021. GE is expected to provide an updated beam replacement schedule.

2.3 SOP Synchronous Condensers

Scheduled completion timelines are May 2021 for SC3, July 2021 for SC2 and September 2021 for SC1. The SC's are not on Project critical path:

SC1

Elliptical bearings have arrived at site in May.

SC2

Elliptical bearings have been installed in May.

SC3

- Elliptical bearings have been installed and trial operations started on May 14, 2021.
- Following an incorrect Protection trip and subsequent setting corrections, trial operation restarted on May 17th.
- 200 hour trial operation was completed in June.

2.4 HVAc Transmission Lines (LTA)

Scope is completed and the asset has been turned over to Operations.

2.5 HVdc Transmission Lines LITL):

- Scope is completed and the asset has been turned over to operations. With respect to HVdc Specialties, the only remaining activity for the CD0501-001 contract is the calibration of the Electrode Line Fault Locator (ELFL) while online in bipole. GE requires resources from the UK to complete that work. It will be done later this year.
- Failure Investigation Report of L3501/ 2 Pole Assembly Turnbuckle Failure was released in May 2021. The turnbuckle apparently failed due to fatigue crack and propagation. Recommendations about installation procedures were provided.
- Failure Investigation Report of L3501/ 2 Tower and Conductor Damage was released in May 2021. Freezing rainstorm caused damage to a specific region of L3501/2, within the central southeastern portion of Labrador where the line runs from Muskrat Falls to Forteau, Labrador. There were three specific sections of the L3501/2 sustained damage; towers from structure 335 to 352, 361 to 369, as well as towers 505 to 527. The specific damage was contained solely to the electrode cross arms and conductors.
- Further study of possible remediation is recommended.

3. OUTSTANDING ISSUES

3.1 LIL- Operation in Monopole 'Overload' Mode

IE is of the opinion that full load tests should be conducted on each pole via their Lane 1 and Lane 2 control computers in order to; (a) verify the functionality of overload mode systems, (b) confirm basis of design and (c) comply with the GE Grid contractual requirements for Testing and Commissioning. Nalcor's position is that full load test poses significant risk to the grid, 900MW is not yet available and the contractual obligation with GE is established by the maximum power transfer available at the time of commissioning. Therefore, Nalcor suggests the acceptance of the LIL may occur without an actual test at the ambient temperature established overload transfer limit. In order to be confident GE has delivered the 900MW capability, tests up to available power supplemented with FAT and other testing will be relied on. Nalcor has further communicated that at some future point when system conditions are sufficiently robust to support the 900MW overload test, Nalcor intends to perform this test. Official resolution on the timing of the test is still pending.

3.2 Unit 1

By-passed generator stator bar in slot #517 needs to be replaced. A planned outage will be taken to replace the stator bar and to complete welding rework and head cover modifications. These have been tentatively scheduled for July/August 2021.

3.3 Emergency Shutdown Sequence

Circuit revisions are pending.

3.4 Control and Protection Software

- No agreement has been reached on the scope of software regressive testing. GE will provide more details on the extent of this testing.