

MEETINGS IN ST. JOHN'S AND VISITS TO LOWER CHURCHILL PROJECT SITES, OCTOBER 4 TO 8, 2021

Prepared for: Natural Resources Canada and Nalcor Energy

IE Point of Contact: Nik Argirov

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Quality Assurance Statement

Office Address	803-633 Kinghorne Mews, Vancouver BC, V6Z 3H3
Prepared by	Nik Argirov, Vlad Kahle, Hamdy Khalil, Tim Little
Reviewed by	Nik Argirov
Approved for Issue by	Nik Argirov

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1. GENERAL

The Independent Engineer (IE) team visited Muskrat Falls Generating Station as well as the Soldiers Pond Station and attended project meetings in person or by Webex in St. John's between October 5 to 8, 2021. NALCOR senior management and technical specialists as well as NRC and NL government representatives participated both in person and by Webex. The purpose of the meeting was Lower Churchill Project update for the IE and Government representatives.

IE team: Nik Argirov (IE Team Lead)
Vlad Kahle (IE Electrical SME)
Hamdy Khalil (IE Transmission SME)
Tim Little (IE Geotechnical SME)

NALCOR Meetings and Site Visit Coordinator: Ms. Rosanne Williams

Trip itinerary:

October 4:

- Arrive and overnight in St John's

October 5:

- SOP Converter Station and Synchronous Condenser building visit
- C1 & C3 Project Update
- TL Operations Update
- LIL Bipole software technical discussion

October 6:

- Commissioning process
- Commissioning / Completion Certificates
- E-stop Update
- LCP LTAMP

October 6:

- Travel to HVGB
- Muskrat Falls powerhouse tour
- Dam Safety Program Review
- Return to St John's, NL

October 7:

- Wrap- up by Webex
- Depart from St John's to home bases

2. SOP SITE VISIT AND TECHNICAL UPDATE– OCTOBER 7, 2021

2.1 SOP Converter and SC Buildings Visit

- The site construction, commissioning and clean-up are virtually complete.
- Converters are off- line to permit GE to perform static tests.
- Fiberglass beam replacement program has been completed.
- All three synchronous condensers are running.
- SC1 is in Trial Operation, it experienced no issues to date.
- The SCs were tested between +75% to -75% of reactive power output. Testing through their full +/- 100% range will be completed when system conditions permit, tentatively planned for mid-December 2021.

2.2 C1 & C3 Project Update

- U1 is down for oil clean up. No spill occurred to the environment; the unit will be down till mid-Oct to complete the work and address minor punches. Stator bar replacement is complete.
- U2 tripped twice due to vibration. Remediation will require guide bearing hardware replacement.
- U3 is operating. Andritz and operations are planning completion of remaining punch list items.
- U4 commissioning is in progress. Release for Service is expected by end of October 2021.
- Completion Certificates for U1, U2 and U3 were issued to IE for acceptance. It is imperative that Completion Certificates are accepted for all four units by November 1st.
- It is important to differentiate between deficiencies and punch list items and communicate any issues that may delay commissioning a.s.a.p. such that LCP achieves closure before the November 1st.
- It was agreed that Line Charging test will be completed once Unit 4 has been commissioned.
- Intake concrete issues and E- stop have been moved to the Punch List.
- Essential Station Service loads and Emergency Diesel auto transfer will be tested for each unit, Black Start operating manual preparation and system tests have been deferred.

2.3 TL Maintenance and Operations Update:

- Planned Maintenance Activities are:
 - Helicopter patrols include monthly routine aerial inspection.
 - Extreme weather helicopter inspections.
 - Climbing inspections: 100% of the structures had initial climbing inspection. Future climbing inspections every 10 years. i.e., 10% of the inspections will be completed each year.
 - Planned ongoing annual ground inspection.
 - Drone inspections were done on the Labrador portion of LIL line.
 - HVDC construction drawings and files have been updated.
 - As-built LiDAR survey was completed in 2021.

- Detailed inspection completed for Bridges and Culverts.
- Maintenance of roads within ROW “Right-Of-Way”.
- Corrective maintenance was completed on OPGW armor, corona rings, insulator replacement, damper replacement, electrode line splices.
- LIL Fault Locator (LFL) testing complete.
- Electrode Line Fault Locator (ELFL) testing complete for NL electrode line. Labrador electrode line tests are scheduled for October 2021.

2.4 LIL Bipole Software Technical Discussion

- Deferred functions request by GE has not been accepted in its entirety.
- FAT is expected by mid-November.
- Frequency control and overload operation are not on the deferred items list.
- Resolution of issues associated with equipment interlocks has been submitted for arbitration.
- External current and power modulation will be implemented in the final version of the software.
- Status of Auto Sequencing has not yet been communicated to IE. Nalcor does not consider this to be a major issue. IE is to be updated on the status.
- As a result of some non-critical deferrals, operating restrictions will be in place until they are resolved by GE, which may be in January / February 2022.
- IE were advised there will be regression testing of the completed Protection and Control software prior to the final sign-off.
- Nalcor acceptance criteria will be based on satisfactory outcome of Regression Testing and Trial Operations, submission of P&C software documentation and completed technical training.
- The new maximum transfer limit for LIL is now 312 MW.

3. COMMISSIONING AND TECHNICAL MEETING – OCTOBER 6, 2021

3.1 Commissioning Requirements

- The balance of operating and maintenance manuals need to be submitted to IE, however, not necessary before coalition of commission. IE will advise on the missing manuals.
- Updated Punch Lists was provided to IE on 04 October 2021.

3.2 E- stop

- Estimating the cost of E- stop circuits changes will be done in Q1 2022.
- Nalcor will be coordinating the review with SNC Lavalin. As yet, Nalcor has not completed the scope of the revisions.

- Once the design is completed it will be submitted to Andritz so they can assess potential impact of those changes on equipment warranty. As yet, Andritz has not been involved.
- It is anticipated that those revisions will be staged on per machine basis and they would take advantage of generation units' maintenance outages.
- Nalcor agreed to revise the E- stop scheme in commercially reasonable time period and within the one-year Punch List completion period.
- In the interim period the current design will remain in service as is. Responsibility for the E- stop scheme performance rests with the engineer of record who initially approved it.

3.3 LCP LTAMP

- LTAMP is a framework for long term management of asset performance. It defines accountability, equipment condition assessment and resourcing.
- Annual Maintenance Plan preparation is in progress. Once completed it will be submitted to IE.

4. MUSKRAT FALLS PROJECT SITE – OCTOBER 7, 2021

4.2 Powerhouse Visit

- Unit 1 and Unit 2 are down for remedial work, Unit 3 is operating. Unit 4 was readied for 130% overspeed test that was done later that day.
- Control Room is functional and attended by the operators.
- IE were advised there will be additional operational testing of all station services and emergency diesel generator automatic transfer schemes.
- The team conducted tours of the Generator & Turbine floors as well as of the intake gates and intake house.
- Rehabilitation and reclamation of the site is nearly completed.

4.3 Converter Station and GIS:

- Stations were not visited this time since the Pole 2 fiberglass beam replacement program has been completed and GIS station is also complete.

4.4 Dam Safety

- Ongoing dam safety surveillance by Operations continues with regular visual inspections and monitoring of instruments that measure piezometric pressures, seepage flows, displacements, and seismic shaking. Dam safety monitoring observations and recorded instrumentation data continue to be reported in Dam Safety Weekly Monitoring Reports.
- The reservoir has been maintained at a steady level since being filled to full pool in September 2019. During that period, the downstream tailwater level has varied within a total range of about 3 m, depending on seasonal conditions and the flow volume being passed through the spillway and powerplant. After the initial response to reservoir filling, most dam

safety instruments in the dams and their foundations have continued to show stable conditions with some small cyclic trends that appear to be related to seasonal temperature variations. Seepage flows in the dam drainage galleries remain very low.

- The IE team visited the North Spur and accompanied an Operations Dam Safety team member on a typical routine inspection of all the dams, including exterior areas and drainage galleries. Conditions were observed to be consistent with those reported in the weekly monitoring reports and no anomalous or unusual conditions were noted.
- Based on visual observation, there have been no significant changes to the slopes on the upstream and downstream sides of the North Spur. Areas of bare sand on portions of the slopes continue to experience some surficial erosion by wind and surface runoff; some small vegetation is beginning to take hold in some such areas, although that will likely be a slow process on the steeper exposed slopes. The riprap along the upstream face of the North Spur is stable and there is very little accumulated woody debris from the reservoir. Instrumentation in the North Spur indicates generally stable conditions, with a few piezometers in the intermediate aquifer still showing slowly increasing levels that are interpreted to reflect continued response of groundwater levels to both the effect of the new reservoir and the shutdown of pump wells in February 2019.

5. WEBEX RECAP AND ACTION ITEMS – OCTOBER 8, 2021

- SOP, there are no follow-up items at this time.
- New schedule for software deliveries and testing will be available in week of October 12th.
- Transmission Operation: Special inspections such as IR “Infra-Red” and as-built design “updated PLSCADD design based on as-built LiDAR survey.
- U2 vibration issues have been resolved by replacement of the hardware support. Similar hardware for U1, U3 and U4 will not be replaced at this time but, the units will be monitored during operation.
- IE requested an update on U4 130% overspeed test.
- Commissioning Manuals will be provided to IE as a part of the commissioning deliverables.
- IE requested copy of attestation from Andritz that largest forces occur at 140% and then diminish at 150% of the turbine generator speeds. IE were advised the design safety factor for the TG is 2.0.
- IE will enter the remaining Station Service tests and black start into the Tracker.
- Nalcor will consult with the NLSO regarding operating restrictions, if any, associated with implementation of the Overload feature.
- 2022 Annual Maintenance Plan and budget will be submitted to IE by December 1, 2021. It has not yet been approved by the Board.

APPENDIX - SITE PHOTOGRAPHS



Photo 1: Synchronous condenser, Soldiers Pond.



Photo 2: Muskrat Falls spillway and north dam.



Photo 3: Muskrat Falls powerhouse interior.



Photo 4: Upstream side of North Spur.



Photo 5: Downstream side of North Spur.



Photo 6: North Dam drainage gallery.



Left - Photo 7: Typical V-notch weir for measuring flow in drainage gallery ditch.

Right - Photo 8: Typical dam safety instrumentation cabinet.