

PLANT VISIT AND MANUFACTURING INSPECTION ALSTOM GRID FABRICATION FACILITY IN STAFFORD, U.K. NOVEMBER 12, 2015

Prepared for: Natural Resources Canada and Nalcor

Project Lead: Nik Argirov

Date: January 1, 2016

Quality Assurance Statement

Office Address	740-1185 W Georgia Street, Vancouver BC, V6E 4E6
Prepared by	Vladimir Kahle and Nik Argirov
Reviewed by	Nik Argirov and Howard Lee
Approved for Issue by	Howard Lee

Disclaimer

This document contains information from MWH which may be confidential or proprietary. Any unauthorized use of the information contained herein is strictly prohibited and MWH shall not be liable for any use outside the intended and approved purpose.

This page left intentionally blank

TABLE OF CONTENTS

1. General	1
2. Orientation Meeting at the HVDC Center of Excellence (COE)	1
3. Factory Tour	2
4. Comments and Conclusions	2

This page left intentionally blank

1. General

On November 12, 2015, the Independent Engineer (IE) MWH, represented by Nik Argirov and Vladimir Kahle, together with two senior management representatives from Nalcor met with the Alstom plant management and conducted tours of select production facilities in Stafford, U.K.

Alstom Grid has been contracted to carry out the HVDC converter facilities turnkey project for the Lower Churchill Project and will supply, install and commission the power transformers, control cubicles and thyristor valves.

The purpose of the plant visit / inspection was to verify the status of Alstom's work and to review their QA/QC process relative to the manufacturing of the equipment supplied under this Contract.

2. Orientation Meeting at the HVDC Center of Excellence (COE)

Meeting started with a thorough safety briefing followed by a presentation, which overviewed Alstom Grid history, organization and the latest integration within GE, scope of COE services, quality management, and technical aspects of the equipment produced for Lower Churchill Project and details on the project progress.

Notes taken by the IE at the presentation include the following;

Emphasis on the safety procedures indicates sound management of the facility and care for its staff. It was reported that there were no lost time accidents in the past two years.

The scope of the COE services include Operations, Technology (engineering/ design, type testing, R&D), Production and Business Development, Installation, Commissioning and Integration into the utilities grids. To date, Alstom has completed or is currently working on 40 projects with total installed capacity of 35 000MW.

In addition, the presentation covered:

- a) Alstom's Quality Management Program - the operation is certified under ISO9001, ISO14001 and ISO18001. A comprehensive quality auditing program is in place for the COE products:
 - Off-the-shelf low risk components are used.
 - High-risk components are sampled and audited.
 - Supplier processes are audited.
 - Equipment is pretested and pre- shipment inspection reports are issued.
- b) Project Progress
 - Approval sessions are taking place.
 - Discussions on harmonic filter modifications specifics are ongoing. Reduction of cable length (and consequently its capacitance) resulted in resonance effect. Item is in progress.
 - Current priorities are preparation of the HVAC and DC single line diagrams (SLD's), calculations and SLD's for the auxiliaries and development of control and protections' (C&P) principles and tripping matrices.
 - Manufacturing of the bi-pole control cubicles is taking place.
 - Valve modules are manufactured for type tests.
- c) Lower Churchill Project (LCP) Controls Test Strategy

- Project control consists of two different systems – DS Agile (Lyon, France & Canada), managing the AC and Station Management and Control System (SMCS), and Series V (Stafford, UK), managing the HVDC.
- To ensure correct integration and coordination of all controls and protections, system design is being carried out in the Stafford facility.
- In order to ensure proper overall functionality, integrated testing is being planned.

3. Factory Tour

Visit to HVDC COE Testing Lab

- The test lab is equipped with real time digital simulator (RTDS) that permits input of the grid parameters, i.e. an accurate representation of the Customer's system. Control cubicles testing using the digital model of the Customer's electric system will take place prior to the delivery to site.
- Test records will be in hard copy format with entries by hand to ensure only true, as observed, results will be recorded.
- Test lab lead appears to be very knowledgeable of the testing process and its details.
- Document control for both the hardware and software is in place. It was discussed at length and it appears to be well developed and suitable for the tasks at hand.
- We viewed the actual control cubicles and discussed the static voltage and RFI controls. Alstom has addressed both concerns.
- Thyristor valve test assembly was observed and detailed explanation of the type testing methodology was given by the test lead. This facility permits application of both the high current and high voltage to the tested module.

Visit to Grid Power Transformer Plant

- Head of Projects and Industrial & Quality Manager conducted the briefing and plant tour.
- Personal Protection Equipment (PPE) is available and is worn by the employees.
- Housekeeping appears very good; we observed clean floors, no loose material or tools, equipment in apparently good order.
- Alstom reported they have weekly meetings of the management team to assess the work results, identify risks and propose solutions. Alstom communicates with NALCOR on regular basis.
- We observed transformer coil and core manufacturing process and visited several workstations.
- QC starts at each workstation by working to detailed design instructions. The continuity for multiple shift workers at each workstation is provided by keeping detailed logs of the completed steps.

Due to the propriety nature of the manufacturing process, photos were not allowed to be taken in the facilities.

4. Comments and Conclusions

The orientation meeting and the following tour/visits to the manufacturing and test facilities indicated that Alstom's staff key competencies, organization and processes are appropriate for carrying out the manufacturing and testing portion of the Lower Churchill Project contracts. The test labs appear properly equipped and staffed to perform the required type and pre-delivery testing.