PLANT VISIT AND MANUFACTURING INSPECTION
SINOHYDRO FABRICATION FACILITY IN
JIAJIANG, CHINA

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Quality Assurance Statement

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Appendix 1: Photographs
1. General

On November 08, 2016, the Independent Engineer (IE), MWH, represented by Nik Argirov, together with a senior management representative from Nalcor, the Lower Churchill Project (LCP) site representatives met with Sinohydro’s company management and performed project equipment (Gates, Stoplogs and Trash Racks) inspection at the production facility in Jiajiang, China. Representatives from Andritz Hydro (AH) were also present during the visit.

Andritz Hydro has been contracted (Contract CH0032) to supply and install the Powerhouse / Spillway Hydro-Mechanical Equipment under turnkey contract for the LCP. The bulk of this equipment is being manufactured in Sinohydro production facility in Jiajiang, China under a subcontract with Andritz Hydro.

Andritz Hydro will complete transportation of the equipment to site, assembly, erection and commissioning, and associated training of Nalcor’s operating personnel.

The purpose of this plant visit was to verify the status of Sinohydro’s work and to review their QA/QC process relative to the manufacturing of the equipment supplied under this contract.

2. Orientation meeting

The meeting started with an overview presentation of the Sinohydro’s history, products, and operations followed by an Andritz Hydro presentation on the status of the LCP hydro-mechanical equipment production.

Sinohydro was founded in 1966. The Jiajiang fabrication facility is one of the four subsidiaries of the company. It has a current staff complement of 998 people, which includes 123 engineers and 156 qualified welders. The company represented that it has total assets of $123,533,430.00 USD and annual sales revenues (year 2015) of $64,136,168.00 USD.

The main products of this fabrication facility are:

- Gate equipment (Radial gate, roller gate, trashrack, etc.)
- Hoists (Hydraulic hoist, winch hoist, gantry crane)
- Overhead cranes
- Ship lifts
- Cable cranes
- Penstocks

The overall scope of Sinohydro offered services includes engineering, fabrication, delivery, installation & commissioning. For the Lower Churchill Project, they are engaged only in the provision of equipment fabrication services. The company has the following certifications:

- ISO 3834-2 and ISO 3834-5 Quality requirements for fusion welding of metallic materials
- CWI certificate (2 persons) - American Welding Society
- ASME welder certificate

The Andritz Hydro presentation included a general overview of: (a) AH’s experience with hydro-mechanical equipment, (b) an overview of the fabrication at Sinohydro, and (c) AH’s quality management organization at the facility.

The overall scope of the LCP contract (CH0032), as aforementioned, includes Spillway equipment and Intake and Powerhouse equipment. The spillway scope is completed with all the gates installed and fully operational. The remaining scope for the Intake and Powerhouse at Sinohydro includes the fabrication of:

- 12 sets of Trashrack
- 12 sets of Intake Roller Gates
- 1 set (6 pcs) of Intake Bulkhead Stoplogs and a lifting beam
- 4 sets (16 pcs) of Draft Tube Stoplogs and a lifting beam

The status and schedule forecast of the remaining scope is as follows:

- Powerhouse - Draft Tube Stoplogs & Lifting Beam
  - Stoplogs 100 % finished and stored, Lifting Beam finished
- Intake - Bulkhead Stoplogs & Lifting Beam
  - Stoplogs and Lifting Beam 100 % finished
- Intake Roller Gates
  - Welding finished planned for November/December 2016
  - First bay finished planned end of November 2016
  - First bay gates will be shipped early spring 2017
- Intake Trashracks
  - Welding planned finished end of 2016
  - First bays finished spring 2017

The main components of the overall quality management program established by AH and followed by Sinohydro includes:

- Enhanced traceability throughout the fabrication process - complete tracing of each plate, each weld, each process, etc.
- Mechanical and chemical test for each plate by Sinohydro, AH and LCP except for stock with proven Mill certificate
- Extended NDE process and re-check by AH
- More witness and holding points by AH & LCP
- Higher requirement on surface quality (ASME/SSPC)
- High requirement on painting

The different NDE tests identified in the ITP, such as VT, UT, MT, and PT are performed by qualified NDE inspectors within Sinohydro team as well as within AH and LCP respective site teams. The ITP also outlines all witness
and holding points for AH and LCP inspection of the machining, pre-assembly, balance and function tests and painting.

3. Factory tour

The fabrication process follows a well-organized sequence of activities and moves through different working stations and shops. It starts with raw material handling and moves through the preparatory operations such as flame cutting and joints / edge preparation into the welding workshop. Machining and pre-assembly follow. The gates segments and stoplogs are then moved to the new sandblasting and painting chamber. The trashrack segments will be painted in the refurbished painting chambers. Finally, the process moves through packing operations and into the ready for shipment storage area. The required inspections, NDE and balance and function tests are performed following the logical sequence of the fabrication process.

- Personal Protection Equipment (PPE) was provided for the visit. We noted that the local workers were wearing Hard Hats and whilst not wearing safety glasses, gloves, Hi Viz vests and boots it was reported that the safety record was relatively good for China. It was also observed that the wire slings used for lifting were in poor condition. Subsequently Nalcor has issued a letter to Andritz requiring immediate corrective action.
- We observed welding of trashrack segments, gate segments machining and gate pre-assembly as well as segments preparation for sand blasting and painting.
- QC starts at each workstation by working to detailed design instructions.

4. Comments and Conclusions

The following conclusions and comments are presented:

- Andritz and Sinohydro staff key competencies, organization, project management and production facilities are appropriate for completion of the contracted scope of work.
- The IE found the workmanship of the manufacturing very good. It was apparent that the AH team and the Nalcor resident team (with the support of the home office team) have been effective in raising the level of quality of the overall workmanship. The end result is a much better product than this facility would generally produce.
- The manufacturing process has been carried out in compliance with the specified industry standards and contract's technical specifications and with good quality.
- The quality records of the inspected components showed a good traceability of the raw material upon its reception into the plant. In particular, steel plates were clearly marked and traced after flame cutting and during the manufacturing process.
- The contract schedule is more of a challenge. One area of concern is the bottlenecks that the machine shop and paint shop present. These two areas have limited output and the sheer number of work elements will present a logistical challenge. Reportedly, AH and Sinohydro has already recognized the problem. Outsourcing machining has started with the same resource who was machining some spillway roller gates. The process of Quality monitoring has been planned. The painting restrains will be addressed by the planed modification of two old painting chambers to meet the controlled environment that is required. The latest AH plan shows final QA release by end of Q2 2017 which satisfy the site needed dates.
APPENDIX NO. 1

Photographs

Photo 1: Flame cutting machine in operation

Photo 2: Edge preparation (grinding) for joint welding
Photo 3: VT re-inspection by AH

Photo 4: Machining of Intake Roller Gate segment seal clamp bar surface
Photo 5: Machining of Intake Roller Gate segment

Photo 6: Inspection of machining
Photo 7: Inspection of machining

Photo 8: MT inspection
Photo 9: Intake Roller Gate segment ready for pre-assembly

Photo 10: Pre-assembly of Intake Roller Gate
Photo 11: Balance and Function Test

Photo 12: Load Test of Lifting Beam
Photo 13: Intake Trashrack fabrication

Photo 14: Intake Trashrack segment ready for sandblasting and painting
Photo 15: Process quality checklist

Photo 16: Intake Roller Gate segments ready for sandblasting
Photo 17: Intake Roller Gate segment sent for sandblasting and painting after Pre-assembly

Photo 18: Cleaning before sandblasting
Photo 19: Intake Roller Gate segment in the painting chamber

Photo 20: Painting of Intake Roller Gate segment
Photo 21: Intake Roller Gate segment ready for packing

Photo 22: Completed lifting beams ready for packing. The beam on the background is for the intake stoplogs. The front one is for the draft tube stoplogs.
Photo 23: Packed sections ready for shipping