U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS

Report No: N/A

Organization: The Japan Steel Works, LTD.
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Nuclear Industry: The Japan Steel Works (JSW), LTD., is one of a limited number of manufacturers of large steel forgings and castings that are used for components such as reactor vessel heads and steam generators and clad steel plates for the nuclear industry worldwide.

Pilot Audit Dates: April 24 - 26, 2007

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Office of New Reactors

Enclosure

1.0 PILOT AUDIT SUMMARY

The purpose of this audit was to conduct a pilot of the new vendor inspection program manual chapter and draft inspection procedure, “Routine Inspections of Nuclear Vendors.” This pilot will lay the ground work for the NRC vendor oversight efforts as they relate to the construction of new reactors in the US, emphasizing the importance of suppliers providing high quality, safety-related products that meet NRC regulations to the US market. The audit allowed the NRC staff to become knowledgeable in the JSW scope of supply, manufacturing processes, and quality activities performed in support of safety related and ASME certified components supplied for US utilities. Additionally, the audit provided an opportunity for the NRC to review the quality activities being applied to the fabrication of replacement reactor pressure vessel head and steam generator forgings for US operating reactors.

The pilot audit was conducted at JSW’s facility in Muroran, Japan. The audit bases were:

- Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, and

- 10 CFR Part 21, "Reporting of Defects and Noncompliance."

2.0 PILOT AUDIT OBSERVATIONS AND OTHER COMMENTS

The JSW quality assurance manual (QAM), “Quality Assurance Manual for Fabrication of Items Without Design Responsibility and Manufacturing of Ferrous Materials for Nuclear Power Plants,” NQ-10003, Issue #2, Revision 8, dated February 20, 2007, describes the overall quality program used for the manufacturing of large components supplied to the US market. The In-Company Standard Procedures for Nuclear Applications (CSPs) implement the JSW quality assurance manual program requirements.

The NRC staff reviewed the ASME demonstration package associated with the Crystal River 3 (CR3) steam generator replacement project that was used for the recent ASME survey performed at JSW for renewal of its ASME NPT and NS nuclear certifications. The demonstration documents provided the complete process used by JSW for fabrication of ASME components, including descriptions of safety-related activities such as design specification reviews, document control system, testing, inspections, special processes such as welding and NDE, control of subcontractors, and nonconformance and corrective action activities. The ASME demonstration package included all the documentation necessary to support the fabrication of a replacement steam generator (RSG) lower head forging that was undergoing final inspection prior to shipment to the US. The NRC staff witnessed the liquid penetrant (PT) and magnetic particle (MT) non-destructive examinations (NDE) performed by JSW and witnessed by their authorized nuclear inspector (ANI) for the RSG lower head forging. The NRC staff verified that the ANI witnessed and properly signed all hold points and verified that the JSW personnel performing the tests were fully trained and qualified, and that the associated records were in order. In addition, the NRC staff reviewed the final certified material test report (CMTR) associated with RSG lower head forging.

The NRC staff became familiar with the JSW procurement control process as described in Section 4 of the JSW quality assurance manual. The JSW approved supplier list consists of 10

suppliers, 4 of which are JSW subsidiaries located at the Muroran Japan facility. The NRC staff noted that welding material is the only material that JSW currently procures. The NRC staff reviewed the audit plan and checklist for the welding material supplier and the JSW audit report of the welding supplier dated December 14, 2006. The NRC staff also reviewed JSW's control of purchased materials and services, as described in Section 7 of the quality assurance manual. Based on the NRC staff's review, the NRC staff noted that additional clarification was necessary on the JSW procedure associated with Section 7 of the quality assurance manual. Specifically, the procedure allowed JSW to qualify, without JSW verifying or auditing the implementation of the QA program, a vendor who holds an ASME Quality System Certificate or Nuclear Certification of Authorization or Accreditation for the intended services, materials or parts to be procured. This allowance is not consistent with NRC's Information Notice (IN) 86-21, IN 86-21 Supplement 1, and IN 86-21 Supplement 2, "Recognition of American Society of Mechanical Engineers Accreditation Program for N Stamp Holders." Upon discussion with JSW, it was determined that JSW has not implemented this program allowance for any ASME certificate holder who has been utilized as a sub-vendor. However, JSW was responsive and was evaluating how to modify its procedures to address the issue and had initiated changes prior to the NRC team leaving the site.

The NRC staff reviewed QAM Section 3, "Order and Engineering Control," QAM Section 8, "Identification and Control of Items and Services," QAM Section 9, "Control of Fabrication and Manufacturing Processes," and QAM Section 10, "Examinations, Tests and Inspections," to become familiar with pertinent activities associated with the fabrication of the CR3 RSG lower head forging. The NRC staff also reviewed the CSPs supporting these QAM section activities. The Process Control Check List (PCCL) is the document used by JSW to identify all the production and process operations to be performed for the component being fabricated, in the specific sequence of actions to be followed. No changes are allowed for the established sequence of production. The PCCL includes information such as: the process or operation name; hold points, the identification of applicable drawings, specifications and procedures; completion of operations and examinations by the responsible personnel, the inspection and work record number; and the review and sign off by JSW QA Engineering, the customer and the ANI.

The NRC staff's review of the CR3 RSG fabrication began with the customer purchase order requirements and traced through the complete fabrication process to final ANI witnessing activities for ASME NPT certification marking and records review. The team verified that the customer PO requirements invoked specific ASME Section III code requirements, ASME NCA-4000 for QA requirements and 10 CFR Part 21 for reporting of defects and noncompliance. As part of the PCCL review, the NRC staff sampled manufacturing/operations records such as:

- steel and ingot making (including heat number traceability records)
- heat analysis
- forging
- normalizing and tempering
- rough machining
- pre heating
- quenching and tempering
- marking of the test coupons and archive samples
- PT liquid penetrant examinations
- MT magnetic particle examinations

- UT ultrasonic examinations
- dimensional examinations
- final machining for inner and outer head surfaces, nozzles and manways
- final marking of ASME NPT

To close out the fabrication activities, the NRC staff reviewed the final ASME Code Data Report that included the signature of the JSW QA General Manager and the ANI. The JSW CMTR that included the detailed QA record checklist and all material CMTRs signed and stamped by the ANI were also verified.

The NRC staff became familiar with Section 13, "Handling, Storage, Shipping, and Preservation of Items and Materials," of the quality assurance manual and the associated procedures. The NRC staff noted that the inspection records identified items inspected, examined, inspection personnel, type of observation, results of acceptability, and reference to information on action taken in connection with nonconformances.

The NRC staff reviewed Section 15, "Nonconforming Materials," Section 16, "Corrective Action," and Section 18, "Audits," of the quality assurance manual and the associated CSP procedures. The NRC staff noted that in 2006, four nonconformity notices (NN) were issued at JSW with only one NN that contained a condition adverse to quality that a corrective action request (CAR) was issued. This was for a mis-machining of the CR3 RSG lower head forging. In 2007, two NNs were issued, with one CAR issued related to a training records discrepancy identified by the ANI.

JSW provided the NRC staff with a copy of its 10 CFR Part 21 procedure dated April 20, 2007. The NRC staff reviewed the procedure and noted that the procedure was consistent with the JSW scope of supply. However, the NRC staff identified one aspect of the procedure that required additional clarification related to JSW's capability to evaluate deficiencies that could cause a substantial safety hazard. The current revision, Revision 0, of the procedure did not account for situations where JSW would evaluate deviations to identify defects that could cause a substantial safety hazard and then report to the NRC. JSW's position in the procedure was that it would always notify its customers since JSW did not believe it would have the capability to perform evaluations to determine if a defect could cause a substantial safety hazard. Upon discussions with JSW, the NRC staff concluded that there may be limited cases where JSW could evaluate for reportability to the NRC. JSW began to enhance the affected procedures prior to the NRC staff leaving the site.

JSW currently has seven components being manufactured for US operating reactors and two that were recently shipped to the licensees' prime contractor for final preparation before being provided to the licensee. The components included an RSG lower head forging, described above, and reactor pressure vessel (RPV) closure heads. In addition, JSW was completing work on an Evolutionary Pressurized Reactor (EPR) nozzle shell for AREVA NP that did not have a plant name associated with the component. The pilot audit team was able to observe those components that had not been shipped in various stages of the fabrication process. Below is a list of JSW forged parts for US operating reactors.

Project	Part Name	PC. No.	Status as of Apr.24,'07	ASME Cert (NPT or MO)
Crystal River-3	RSG Lower Head	1	Shipped out	NPT
		2	Under final inspection	
Palo Verde-1	RPV Closure Head	1	Shipped out	MO
Palo Verde-2		2	Under forging operation	
Palo Verde-3		3	Waiting for pouring	
STP Unit 1	RPV Closure Head	1	Cleaning after preliminary heat treatment	MO
STP Unit 2	RPV Closure Head	1	Waiting for pouring	MO
Diablo Canyon-1	RPV Closure Head	1	Waiting for test coupon cutting	MO
Diablo Canyon-2		2	Waiting for pouring	MO

RSG = Replacement Steam Generator; RPV = Reactor Pressure Vessel
BWC = B&W Canada; MHI = Mitsubishi Heavy Industries
NPT = ASME Certified component; MO = ASME materials QSC supplier certification

Finally, the NRC staff toured the JSW Muroran fabrication facilities. Highlights of the tour included the observation of the forging of a 600 ton ingot being worked in the 14,000 ton press (the largest ingot that can be produced in the world and the largest press currently in operation in the world); observation of the rough forging for of the Palo Verde-2 replacement reactor vessel head after heat treatment; observation of the Diablo Canyon-1 replacement reactor vessel head as it was being setup in the machine shop for its initial machining operation; observation of the non-destructive examinations (NDE) being conducted by JSW and witnessed by the ANI for the CR3 RSG lower head; observation of NDE being performed on an EPR reactor vessel nozzle shell forging being manufactured for AREVA NP; and observation of measuring and test equipment calibration activities for mechanical tests, material chemical analysis, thermocouple calibrations, gauge calibrations, and the heat treatment ovens.

4.0 ENTRANCE AND EXIT MEETINGS

In the entrance meeting on April 24, 2007, the NRC staff discussed the scope of the pilot audit, outlined the areas to be reviewed, and established interfaces with JSW staff and management. In the exit meeting on April 26, 2006, the NRC staff discussed the results of the pilot audit and the two procedural clarifications described above with the JSW management and staff.

5.0 PILOT AUDIT RESULTS AND LESSONS LEARNED

Based on the results of the NRC's pilot audit at JSW, the NRC staff concluded that there is reasonable assurance that the ASME components produced by JSW are of a quality commensurate with their safety significance. The two areas for clarification that were identified by the NRC staff did not affect the overall quality of the products produced, and were limited to auditing and non-conformance evaluation processes that, once implemented, should strengthen the JSW quality assurance program. Enhancements to the affected procedures were initiated prior to the NRC staff's departure.

The NRC staff concluded that the final ASME Code Data Report and supporting documentation for the CR3 RSG lower head used by ASME for JSW re-certification were useful for an efficient and effective assessment of JSW's compliance with Appendix B to 10 CFR Part 50, and 10 CFR Part 21.

6.0 PARTIAL LIST OF PERSONS CONTACTED

Etsuo Murai	Dep. General Plant Manager	JSW ***
Junichi Taira	Manager, Quality Control Dept.	JSW ***
Tatsuo Okushita	Dep. Manager, Quality Assurance Group	JSW ***
Tsuyoshi Hatakeyama	Dep. Manager, Quality Assurance Group	JSW ***
Tsuyoshi Nakamura	Manager, Nuclear Engineering Group	JSW ***
Susumu Kumagai	Chief Engineer, Nuclear Eng. Group	JSW ***
Tomoharu Sasaki	Sr. Technical Manager, Nuclear Eng. Grp.	JSW ***
Yoichi Koyama	Dep. Tech Manager, Nuclear Eng. Grp.	JSW ***

* Attended Entrance Meeting
** Attended Exit Meeting
*** Attended Entrance & Exit Meeting