February 4, 2009

NOTE TO: File

FROM: Marlayna Vaaler, Project Manager ***/RA/***
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2 - TELECONFERENCE SUMMARY REGARDING THE REFUELING OUTAGE 25 REACTOR PRESSURE VESSEL WELD INSPECTION RESULTS (TAC NO. ME0233)

On October 16, 17, 21, and 23, 2008, the U.S. Nuclear Regulatory Commission (NRC) staff participated in conference calls with representatives from the Carolina Power & Light Company (the licensee) regarding the refueling outage 25 reactor pressure vessel (RPV) weld inspection results at the H.B. Robinson Steam Electric Plant, Unit No. 2 (HBRSEP).

On October 16, 2008, the licensee announced that during the inspection of reactor coolant system (RCS) butt welds, several "indications" were located using detection scans. Specifically:

+ The licensee inspected the RCS hot and cold leg nozzles in accordance with the Electric Power Research Institute's (EPRI) MRP-139, "Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guidelines," and the corresponding Progress Energy "Alloy 600 Strategic Plan."

+ The licensee used state-of-the-art "phased-array" ultrasonic technology that is much more sensitive to material conditions than the previous technology; the phased-array technology uses a probe positioned on the inside surfaces of the welds.

+ Regarding the indications found, the licensee stated that "some appear to be inner diameter connected and axial, and some 'circumferential-like.'" (The licensee stressed that the subject indications represent only "something" that was detected by the detection scans, and do not necessarily represent actual flaws. Whether actual flaws exist will be determined through follow-up scans and data analyses.)

+ Characterization/sizing scans of the indications are in progress; data analysis will follow.

+ The licensee submitted a related American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, inservice inspection (ISI) relief request to "use the qualification requirements for weld examinations conducted from the inside piping surface contained in ASME Code Case N-695 and Code Case N-696, along with the vendors' Root Mean Square error achieved under the Performance Demonstration Initiative (PDI) at the EPRI Nondestructive Examination (NDE) Center." (Reference: HBRSEP Serial RNP-RA/08-0048, dated June 6, 2008)

Preliminary Inspection Results

HBRSEP performed augmented ultrasonic examinations of the hot leg and cold leg nozzles in accordance with MRP-139 as part of the fall 2008 outage activities. MRP-139 calls for the nozzle to safe end dissimilar metal weld (DMW) of the hot leg nozzles to be examined by the end of 2009 and the cold leg nozzles to be examined by the end of 2010.

The hot and cold leg nozzle butt welds at HBRSEP are made of Alloy 182 material. The welds were inspected in 2001 using conventional ultrasonic testing (UT) from the inside surface. The techniques used in 2001 were not qualified to ASME Code, Section XI, Appendix VIII requirements, and no indications were found at that time.

The weld inspections during the fall 2008 outage were based on Appendix VIII-qualified automated phased array UT. Personnel from EPRI-PDI provided independent verification. The inspection was performed from the inside surface of the pipe.

After discovery of the initial indications, the licensee performed an eddy current exam of the inside surface of the nozzles between October 17 – 19, 2008, to determine whether the UT indications were connected to the inside surface of the pipe.

Initial construction radiography testing did not indicate the presence of indications in the welds.

Manufacturing

The carbon steel nozzles were welded using Alloy 182 weld metal to the stainless steel safe end. The nozzles were clad with stainless steel to within one inch of the weld. After welding, the exposed carbon steel nozzle was back cladded using Alloy 182 weld metal. The last operation performed on the weld was a shop heat treatment.

The inside diameter of the outlet nozzle is about 29 inches and the wall thickness is approximately 2.6 inches. The inside diameter of the inlet nozzle is about 27.5 inches and the wall thickness is approximately 3.3 inches.

Flaw orientation, location, and number

The preliminary information on the indications that were detected is as follows:

Hot Leg Nozzles

A 1 axial indication located in the DMW
Other axial indications were detected in the cladding

B 2 axial indications located in the DMW
2 axial indications located in the interface between the DMW and the safe end
Other axial indications were detected in the cladding

C 3 axial indications located in the DMW
1 axial indication located in the interface between the DMW and the safe end
Other axial indications were located in the cladding

Cold Leg Nozzles

A No indications detected.

B 1 axial indication was detected in the DMW
Other circumferential indications were detected in the nozzle cladding

C One "circumferential-like" indication was detected in the interface between the DMW and the safe end
Other axial indications were detected in the nozzle cladding

As of October 16, 2008, the licensee was in the process of gathering more information to characterize these indications and determine what analysis and/or corrective actions will be needed. If repair is needed, the licensee is contemplating an inlay/onlay repair method using Alloy 52, which is regarded as being more resistant to cracking than Alloy 182.

Staff's Concern

The staff's initial concern was whether the indications were inside diameter (ID) surface connected. If any of the indications were ID-surface connected, then the licensee would have to determine if the indications should be attributed to stress corrosion cracking (SCC). If any of the indications were concluded to be SCC initiated, then HBRSEP would be the second U.S. nuclear plant (after V.C. Summer) to have discovered SCC in the primary coolant loop piping. The staff believes that no U.S. pressurized water reactors (PWRs) have found SCC in cold leg temperature butt welds. Any finding of SCC in this area would have generic implications.

Activities Planned Ahead (after the October 16, 2008, conference call)

From approximately October 17 – 19, 2008, the licensee characterized the indications. In addition, the licensee performed eddy current inspection to determine whether any of the indications are ID-surface connected. By October 21, 2008, the licensee planned to provide a cross section of the weld joint showing the material and configuration, as well as a table listing the identification, flaw orientation, flaw length, flaw depth, and if the flaw is surface breaking of all the discovered indications. The staff will have another phone call with the licensee to discuss inspection results and plans for analysis and/or repairs. In addition, the licensee will submit the final flaw evaluation sometime after the outage is completed. The plant is scheduled to start up on October 30, 2008.

Follow-up Activities from the October 17, 2008 Phone Call

+ The staff asked the licensee to send a summary of the indications detected in the hot leg and cold leg vessel nozzles during the current outage. The licensee provided an existing write up summary shortly after the call.

+ The staff asked the licensee to summarize the differences between the inspections performed in 2001, performed through October 16, 2008, and currently being performed.

In 2001, UT system called EDAS was used by the Southwest Research Institute to inspect the nozzle welds. The licensee did not find any indications during the 2001 inspection. The EDAS

UT system was not qualified to meet ASME Code, Section XI, Appendix VIII, and was not qualified subsequently. Compared to the phased array techniques used during the fall 2008 inspection, limited data was gathered by EDAS, and the data can only be portrayed in two dimensions. Phased array UT data can be portrayed in three dimensions. The EDAS data from 2001 is being reexamined to determine whether any indications are present in the data.

The data gathered through October 16, 2008, was based on a procedure and probes qualified under the ASME Code, Section XI, Appendix VIII for detection. Additional UT scans are underway using a procedure and probes qualified for sizing. This data will be collected by the end of the day on October 18, 2008; the evaluation of this data will be made October 19 and 20, 2008. Depending upon the results, the licensee will provide the staff with its plans for monitoring and/or repairs during a subsequent phone call.

The staff informed the licensee that if it concludes that the indications are ID-connected and attributed to SCC, the NRC would be interested in them taking boat samples. The staff emphasized that this was important for the industry, particularly if cracking is determined to exist in the vessel cold leg nozzle, since indications of cracking in cold leg loop piping welds have not been previously seen in the U.S. PWRs. The licensee stated it had not ruled out taking a boat sample, but at this point did not see the need for taking boat samples.

Follow-up Activities from the October 21, 2008 Phone Call

The staff held a phone call with personnel from HBRSEP to discuss their progress in NDE data collection and evaluation. The licensee had finished gathering UT and eddy current (EC) data on the reactor vessel hot leg and cold leg nozzle welds.

Based on preliminary analysis of the NDE data, the licensee has found a number of relevant axial indications in the hot leg and cold leg dissimilar metal welds, in the cladding, or in the adjacent safe end material. The licensee found a small number of relevant circumferential indications in some of the hot leg and cold leg nozzle cladding.

The licensee performed EC of all the dissimilar metal welds and, based on preliminary evaluation of the EC data, found no indications. The lack of EC indications means that none of the indications are surface connected. EC has been shown to be a reliable technique for identifying SCC in steam generators and Japanese and Swedish nuclear entities have successfully used EC to identify SCC in dissimilar metal welds.

Because these indications appear by UT to be fairly close to the inside surface, by the proximity rules of the ASME Code, Section XI for flaw evaluation, they have to be treated in analysis space as though they are surface connected. The licensee has performed flaw evaluations for these indications (using a hand book approach that was developed for this plant prior to the outage). The flaws were analyzed for SCC and fatigue. The conclusions of the analysis were that all the flaws can be left in service for at least 36 months and they will continue to meet the ASME Code, Section XI required margin on flaw stability. The ASME Code requires in such cases that the welds receive three successive reexaminations. The licensee indicated that they will determine whether to perform the three successive reexaminations or mitigate the welds.

The licensee stated that at this time it considers the flaws to be fabrication-induced.

Follow-up Activities from the October 23, 2008 Phone Call

The conclusions from the last call on October 21, 2008, have not changed. That is, in addition to the UT examinations, the licensee performed surface examinations with EC and concluded that there are no surface connected flaws in the vessel nozzle welds or adjoining base metal.

Prior to the call, the licensee sent an updated summary of the indications. The updated summary expanded on answers to questions asked by the staff during the October 21, 2008, phone call and contained new information on the inspections performed in 2001. The staff asked additional questions on the inspections performed in 2001 and on the connection between the current flaw analyses and license renewal aging management concerns.

The licensee expects the data to be finalized next week. If any changes are experienced as a result of finalizing the data, the licensee will contact the staff. Otherwise, the staff expects to close out the discussion on these inspection results. Finally, based on a request from the staff, a letter reporting this information will be provided to the NRC within 30 days of completion of the current refueling outage and is expected to include a copy of the non-proprietary "Handbook on Flaw Evaluation," which is WCAP-15621-NP, Revision 1, August 2008.

Conference Call Participants

Participants in the phone calls related to the HBRSEP RPV weld inspection results included:

HBRSEP:

Eric McCartney – Director of Site Operations
Chuck Baucom – Support Services Manager
Curt Castell – Licensing Supervisor
Dana Covill – Principal Engineer
Warren Farmer – Engineering Manager

Progress Energy Corporate:

John Caves – Manager Nuclear Technical Services
Joe Donahue – Vice President Engineering

NRC Region II:

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Brendan Collins – Engineering Branch 3
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