UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SUPPLEMENTAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO THE WELD OVERLAY REPAIR OF THE RWCU NONREGENERATIVE HEAT EXCHANGER 3-1204AB TUBESIDE INLET NOZZLE

DRESDEN NUCLEAR POWER STATION, UNIT 3

COMMONWEALTH EDISON COMPANY

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1.0 INTRODUCTION

On August 9, 1996, while performing a walkdown inspection, leakage from through-wall cracks was found on a tubeside inlet nozzle to reactor water clean up (RWCU) "B" train nonregenerative heat exchanger 3-1204BB. The heat exchanger nozzles were visually accessible because all insulation was removed in preparation for a scheduled replacement of nonsafety RWCU piping during the upcoming refueling outage (D3R14). The nonsafety RWCU piping is susceptible to intergranular stress corrosion cracking (IGSCC). During the walk down inspection, Dresden, Unit 3, was operating with RWCU "A" train heat exchanger. Subsequent to the inspection of RWCU heat exchanger in the "A" train, leakage from through-wall cracks was also found on a similar tubeside inlet nozzle to nonregenerative heat exchanger 3-1204AB. The observed leakage from both nozzles was reported to be small. The cracked nozzles were made of SA-312 TP 304 stainless steel material and were furnace sensitized during post-weld heat treatment of the carbon steel channel of the heat exchanger. The licensee attributed the observed cracking to be IGSCC.

The licensee repaired the tubeside inlet nozzle on the nonregenerative heat exchanger 3-1204AB in the "A" train with a full structural weld overlay. Dresden, Unit 3, is currently in a refueling outage (D3R14). During the refueling outage, the licensee is removing the entire "A" train RWCU heat exchanger and replacing the "B" train RWCU piping and heat exchanger with IGSCC-resistant materials.

The licensee submitted its weld overlay design for repair of the tubeside inlet nozzle on RWCU nonregenerative heat exchanger 3-1204AB to the NRC on September 16, 1996. Additional information regarding the weld overlay repair was provided in the licensee's letters dated September 20, 1996, and January 14, 1997.

This safety evaluation provides written confirmation of the staff's verbal acceptance of Dresden Unit 3 operation with the weld overlay. The staff had reviewed the licensee's weld overlay repair prior to restart of Dresden, Unit 3, and had determined that the subject repair was acceptable for short-term operation.

ENCLOSURE

2.0 EVALUATION

The licensee stated that the weld overlay installed on the inlet nozzle of the nonregenerative heat exchanger 3-1204AB was designed as a standard overlay in accordance with the guidelines of NUREG-0313, Revision 2 "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping." Both the piping and the nozzle were made of 6-inch schedule 80 SA-312 TP 304 stainless steel material. In designing the overlay, both the circumferential and axial flaws were assumed to be through-wall. Because the subject nozzle was furnace sensitized and susceptible to IGSCC, the circumferential flaw was assumed to be 360 degrees around the full circumference and the length of the axial flaw was assumed to be equal to the length of the nozzle.

The thickness of the weld overlay was determined using the methodology prescribed in the American Society of Mechanical Engineers [ASME] Boiler and Pressure Vessel Code (Code), Section XI, IWB 3600 and Appendix C of the 1989 Edition. Because the subject piping and the heat exchanger are nonsafety-related components, only the normal operating loads are considered. The operating loads applied in the evaluation consisted of pressure load and the load from the weight of the piping, water, and insulation. The design pressure (1300 psi) and temperature (575 degrees Fahrenheit) were used in the overlay design calculation. Safety factors of 2.7 and 3.0 were applied on load for circumferential and axial flaw, respectively. The required weld overlay thickness was calculated to be 0.24-inch. The length of the overlay was designed to cover the full length of the nozzle and the nozzle to pipe weld. To ensure sufficient stress redistribution beyond the ends of the flaw, the overlay also required an extension of 0.867-inch beyond the center line of the nozzle to pipe weld with an end slope no greater than 45 degrees. The other end of the overlay was designed to attach to the full penetration weld which would join the nozzle to the heat exchanger tube shell. The overlay is required to have as-deposed delta ferrite content of at least 7.5 FN to ensure its resistance to IGSCC.

The weld overlay was fabricated by using a GTAW welding process. W/ER308L and W/ER309L filler materials were used for the seal (first) layer and subsequent structural layers, respectively. The licensee reported that the as-fabricated overlay dimensions and the delta ferrite content on the first structural layer met the design requirements. The shrinkage resulting from weld overlay was measured at four azimuthal locations. The maximum shrinkage was reported to be 1/4 inch. This amount of shrinkage is acceptable because the results of the licensee's pipe stress evaluation has shown that it has no impact on meeting the Code-allowable pipe stresses in the affected RWCU piping system. After completion of the weld overlay repair, a hydrostatic pressure test at 1500 psi was performed. No leakage was found at the overlay or at any of the RWCU "A" train heat exchanger nozzles.

During the staff review two concerns were identifed. One concern was that there was no water in the piping during overlay fabrication and the other concern was that ultrasonic inspection was not performed on the overlay after

completion of fabrication. Water backing during overlay fabrication is desirable because it will establish compressive residual stresses on the inside diameter (ID) surface of the weld, which would prohibit crack initiation and growth on the ID surface and thus, prolong the life of the overlay repair. The purpose of the ultrasonic inspection of the completed overlay is to ensure that no flaws or cracks have propagated into the overlay as a result of the process. The staff has determined that these two concerns have been adequately addressed because the weld overlay is designed as a full structural repair that would provide an adequate safety margin for a service period not exceeding 6 months, and the successful hydrostatic testing performed by the licensee prior to restart of the unit ensured the structural integrity of the overlay for the short-term service.

The licensee stated that the RWCU containment isolation valves at Dresden, Unit 3, have been upgraded to meet the provisions of Generic Letter (GL) 89-10, Supplement 3, "Consideration of the Results of NRC-Sponsored Test of Motor Operated Valves." The NRC regional inspectors and headquarters staff conducted a closeout inspection at Dresden, Unit 3, of GL 89-10 activities during the week of December 16 through 20, 1996. During the inspection, the staff verified the capability of the subject RWCU motor-operated valves (MOVs) and did not identify any operability concerns with these MOVs. Based on the inspection results, the staff concluded that the licensee's actions and plans regarding MOVs 1201-1 and 1201-2, used to isolate the RWCU system at Dresden, Unit 3, satisfy the provisions of GL 89-10. The results of the NRC closeout inspection will provide assurance that the RWCU piping system can be isolated for safe shutdown in the unlikely event that excessive leakage occurs at the repaired weld.

3.0 CONCLUSION

Based on the above evaluation, the staff determined that the design and fabrication of the subject weld overlay repair at Dresden, Unit 3, met the guidelines in NUREG-0313, Revision 2, and the structural integrity of the repair was maintained during the short-term operation, of Dresden, Unit 3, from September 1996 until March 1997.

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