



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
ALTERNATIVE TO ASME SECTION XI CODE REPAIR REQUIREMENTS
TO USE CODE CASES N-504-1 AND N-606 FOR WELD OVERLAY REPAIRS

IES UTILITIES INC.

DUANE ARNOLD ENERGY CENTER (DAEC)

DOCKET NO. 50-331

1.0 INTRODUCTION

By letter dated November 11, 1999, IES Utilities Inc. (the licensee) proposed an alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, repair requirements pursuant to 10 CFR 50.55a(a)(3)(i). The licensee proposed the use of Code Case N-504-1, "Alternative Rules for Repair of Class 1, 2, 3 Austenitic Stainless Steel Piping," and N-606, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," to perform weld overlay repairs of flawed nozzle to safe-end welds in recirculation system piping at Duane Arnold Energy Center (DAEC).

During the current refueling outage (RFO) 16 for the DAEC, inspections of welds susceptible to intergranular stress-corrosion cracking (IGSCC) identified flaw indications on three recirculation riser nozzle to safe-end welds. The indications were identified while performing ultrasonic (UT) examinations using General Electric's SMART 2000 automated UT system with TOMOVIEW analysis software. Two indications were identified in weld RRB-F002. One indication was also identified in weld RRD-F002 and weld RRF-F002. The safe ends were fabricated from SB-166 (Alloy 600) material, also known as Inconel 600. The nozzle material is SA-508, Class 2 (P3 material, Group 3). The nozzle side of the weld was buttered with Alloy 182 material. The licensee's proposed weld overlay repair design has a portion of the overlay extended onto the recirculation riser nozzle. Since the nozzle was made of low alloy carbon steel, a temper bead welding technique as prescribed in Code Case N-606 was needed to fabricate the weld overlay on the recirculation riser nozzle. The temper bead technique is designed to avoid excessive hardening of the low alloy carbon steel material when welding is performed on this material without preheat and post-weld heat treatment.

Pursuant to 10 CFR 50.55a(a)(3)(i), proposed alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the NRC. The licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety.

2.0 EVALUATION

2.1 ASME Section XI Code Requirement

The licensee indicated that the 1989 Edition of ASME Section XI with no Addenda is the currently applicable ASME Code to DAEC. Article-4000, "Repair Procedures," of the subject

Section XI Code Edition provides rules and requirements for repair of the pressure-retaining boundary for Class 1 components and their supports. To perform a code repair, Subarticle IWB-4120 "Procedure" requires that defects will be removed from the degraded components prior to performing a repair by welding.

2.2 Proposed Alternative

The licensee proposed to use a combination of the requirements from ASME Code Cases N-504-1 for austenitic weld overlays using (Inconel) Alloy 52 and N-606 for temper bead welding as an alternative to the ASME Code, Section XI, IWB-4000, requirements for repair to perform temper bead weld overlay repairs on the flawed recirculation riser nozzle to safe-end welds at DAEC.

2.3 Licensee's Bases for the Proposed Alternative

The licensee's bases for the proposed alternative are summarized below:

- (1) Using Code Cases N-504-1 and N-606 for weld overlay repair of the flawed recirculation riser nozzle to safe-end welds is necessary because it is not practical to perform the code repair, which requires the removal of the defects initiated from the inside-diameter surface from the degraded components.
- (2) The overlay is designed as a full structural overlay in accordance with recommendations in NUREG-0313, Revision 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," and Code Case N-504-1 modified for use on the recirculation riser nozzle to safe-end welds. The overlay design assumes the subject nozzle welds to be completely cracked and will restore the code safety margins in the overlay repairs.
- (3) The weld overlay made of Inconel Alloy 52 is resistant to IGSSC and a beneficial residual stress field will result from shrinkage of the overlay weld.
- (4) The temper bead welding technique prescribed in Code Case N-606 is needed to fabricate the weld overlay on low alloy carbon steel component to avoid embrittlement of the low alloy carbon steel without the need for preheat and post-weld heat treatment.

2.4 NRC Staff Evaluation

The licensee's proposed alternative to the code repair using the austenitic weld overlay repair and temper bead welding requirements from Code Cases N-504-1 and N-606 is briefly discussed above. The NRC staff notes that Code Case N-504-1 has been approved by NRC and incorporated in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," for generic use. The licensee's proposed alternative extends the application of Code Case N-504-1 for welding P-43 materials (Inconel) on P-3 materials (low alloy carbon steel) rather than P-8 (stainless steel) materials. This is technically acceptable as long as the overlay design is based on the allowable stress limits for P-43 materials and the qualified welding procedures and personnel are used in welding fabrication. Furthermore, such extended application of Code Case N-504-1 was approved by the NRC on April 29, 1999, for a similar weld overlay repair performed on a feedwater nozzle to safe-end weld at the Perry Nuclear Power Plant.

Code Case N-606 has not yet been approved by the NRC for incorporation in RG 1.147. Code Case N-606 allows the use of the gas tungsten arc welding (GTAW) with temper bead technique without preheat or post-weld heat treatment for repair/replacement of boiling-water reactor control rod drive housing or stub tube. The NRC staff has performed a review of the subject code case and has determined that Code Case N-606 is acceptable for use for the repair of recirculation nozzle to safe-end welds.

On the basis of a review of the licensee's submittal, the NRC staff has determined that the proposed alternative to use Code Cases N-504-1 and N-606 with modifications for the weld overlay repair of the subject recirculation nozzle to safe-end welds at DAEC is acceptable because it will provide reasonable assurance of integrity based on maintaining the applicable code safety margins.

3.0 CONCLUSION

Based on a review of the licensee's submittal, the NRC staff concludes that the licensee-proposed alternative will result in an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the licensee's proposed use of Code Cases N-504-1 and N-606 with modifications as identified in the licensee's submittal to perform weld overlay repair of the flawed recirculation nozzle to safe-end welds at DAEC.

Principal Contributors: W. Koo
R. Hermann

Date: November 19, 1999