

November 7, 2002

LICENSEE: Entergy Operations, Inc. (Entergy)

FACILITY: Arkansas Nuclear One, Unit 1 (ANO-1)

SUBJECT: SUMMARY OF OCTOBER 16, 2002, MEETING AND FOLLOW-UP
DISCUSSION ON REACTOR VESSEL HEAD WELD REPAIRS

On October 16, 2002, the U.S. Nuclear Regulatory Commission (NRC) staff met with Entergy (at their request) to discuss the planned ANO-1 reactor vessel head weld repair technique. Meeting attendees are listed in Enclosure 1. Slides presented by Entergy during the presentation are in Enclosure 2. Preliminary information provided by the licensee the day before the meeting is in Enclosure 3.

By way of background, on October 7, 2002, during refueling outage 1R17, a small nodule of boric acid crystals was found in the area of control rod drive mechanism (CRDM) 56. This is the same nozzle that was found to be leaking during the previous refueling outage.

The licensee presented their 1R16 (spring 2001) findings/repair on CRDM 56, their 1R17 (current inspection) non-destructive examination (NDE) findings, their planned 1R17 weld repair evaluation, and their assurance of non-leakage for the planned repair.

The only flaw found during 1R16 was an axial flaw in the weld-to-nozzle interface of CRDM 56 and it extended above the J-weld in the nozzle. The flaw was repaired with Alloy 152 weld material filling the excavated area.

The licensee informed the staff that to date (in 1R17), they have performed a 100% bare metal visual examination of the head and found only one leaking nozzle (CRDM 56) and no evidence of wastage. They have also performed an ultrasonic testing (UT) examination of 20 nozzles (about 30%) and so far, all other nozzles show a constant state from the previous outages. CRDM 56 UT data shows six small indications with none having a circumferential component and no evidence of Alloy 52 cracking.

The licensee believes that they can perform an American Society of Mechanical Engineers Boiler and Pressure Vessel Code repair on CRDM 56 (or any other nozzle, if needed) and isolate the flaw from the primary water stress corrosion cracking (PWSCC) environment for two cycles of operation, at which time they plan to replace the head. Their repair plan options for flaw repair incorporate lessons learned, including those from the North Anna Power Station, Unit 2, repair effort, and they consist of the following to be used in combination or individually: a 360° J-groove weld and butter overlay, a 360° nozzle inlay or overlay, a 90° nozzle inlay, or a weld overlay on the nozzle outer-diameter surface to mitigate crack initiation. The J-weld overlay will be at least 3/8-inch thick with a 3-layer minimum, and it will have at least a 1/2-inch overlap onto the stainless steel cladding. The licensee indicated that these repairs were designed with detailed analysis performed by their consultants.

In addition, the licensee stated that test/industry data show that Alloy 52 integrity is established for more than two operating cycles using acceptable crack growth rates. The licensee provided two publicly-available papers to support their position: "Fracture Toughness, Tensile and Stress Corrosion Cracking Properties of Alloy 600, Alloy 690 and their Welds in Water," by C. M. Brown and W. J. Mills, Corrosion 90, 1996, pages 90/1-90/24; and "Effect of Water on Mechanical Properties and Stress Corrosion Behavior of Alloy 600, Alloy 690, EN82H Welds,

November 7, 2002

and EN52 Welds," by C. M. Brown and W. J. Mills, Corrosion - Volume 55, No. 2, 1999, pages 173-186. Also, the licensee believes that the planned repairs will remove all mechanistic failures that can create leak paths, and that alternative approaches (i.e., removing the entire crack) can pose new disadvantages.

The NRC staff commented that it appeared that the licensee carefully thought through the repair problem and committed to get back to the licensee with feedback on the planned repairs within one day. On October 17, 2002, the staff informed the licensee that they need to assume PWSCC in their crack growth rate calculations, and if the flaw evaluations show unacceptable results, that the inlay process be used as discussed at the meeting. In addition, the staff informed the licensee that it should perform a UT examination of the center nozzle (the licensee indicated they did not desire to perform a UT examination of this nozzle due to accessibility problems).

/RA/

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Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-313

Enclosures: As stated

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November 7, 2002

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MEETING ON ANO-1 REACTOR VESSEL HEAD WELD REPAIRS

OCTOBER 16, 2002

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March 2001