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ENCLOSURE

SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

INDICATIONS IN THE CLADDING OF A SAFETY INJECTION ACCUMULATOR TANK

DOCKET NO. 50-390

1.0 BACKGROUND

While replacing a sample line nozzle in the bottom head of Safety Injection Accumulator Tank No. 3, TVA found crack indications on the roll-bonded stainless steel clad surface next to the repair. These indications were found only in the cladding; the new weld joining the nozzle to the tank was clear of any indications. Penetrant inspection to determine the extent of the condition showed more indications near the nozzle and next to the welds joining the lower head sections. Metallography of one of these areas showed a severely sensitized grain structure in the cladding.

TVA performed grinding on the indications as well as ultrasonic inspection from the inside surface of the tank, and found that the indications extended to the cladding-carbon steel interface, but not beyond. TVA determined that these flaws are unlikely to propagate into the carbon steel since they result from a severely sensitized grain structure in the stainless cladding.

2.0 DISCUSSION AND EVALUATION

By letters dated April 16, 1993 and August 3, 1993, TVA submitted information regarding the presence of the flaw indications in the cladding of Accumulator Tank No. 3. These submittals described TVA's disposition of these indications. TVA stated that it plans to disposition the indications under American Society for Mechanical Engineers (ASME) Code, Section XI, paragraph IWB 3510.1(d), which states that surface flaws within cladding are acceptable.

TVA attempted to repair the indications to meet ASME Section III requirements. TVA removed the cladding containing the indications and replaced it with weld metal. However, excavation to remove the indications and shrinkage stresses from welding continually generated new indications in the sensitized cladding in adjacent areas previously free of indications. As a result, TVA decided to finish the weld repair of the excavated areas by adding at least one layer of stainless steel weld material and dispositioning the remaining indications by a fracture mechanics analysis under Section XI of the ASME Code.

TVA performed fatigue crack growth and fracture mechanics analyses. These showed that the flaws in the cladding meet the acceptance criteria of Section XI by a wide margin. Hence TVA determined that the existing indications in the stainless steel could be left without grinding them out or repairing them. TVA reclad the carbon steel areas that were exposed during the repair process with one layer of stainless steel to prevent the carbon steel from being directly exposed to borated water. TVA inspected these reclad areas visually and by liquid penetrant in accordance with ASME III requirements.

Many of the flaws extend through the stainless steel cladding, exposing the carbon steel to the borated water environment. Service experience has shown that high concentrations of boron in water can corrode carbon steel. This has happened in boron injection tanks and at the outside of reactor vessel top head regions where the reactor coolant boiled and concentrated. However, there is no mechanism for the borated water to become concentrated in the accumulator. The boron content of the water in the accumulator ranges from 1900 to 2100 ppm, with the nominal concentration specified as 2000 ppm. Therefore, the water in the tank has basically the same chemistry as the primary coolant. The temperature is ambient and oxygen levels are kept to low levels by a nitrogen blanket so any corrosion would occur slowly.

TVA believes that the Section XI acceptance of flaws in the cladding is based on the assumption that the cladding is non-structural (i.e., not required to meet the design thickness requirements of the Code). Since the original design of the tanks had included the cladding to meet the design thickness requirements, TVA recalculated the thickness of the carbon steel necessary to meet Section III design requirements. These calculations showed that the carbon steel thickness alone meets the design requirements, and the cladding can be considered non-structural.

Furthermore, new calculations (ASME Section III, 1986, table NC 3321.1) showed that a minimum thickness of 1.06 inches is required in the vessel head region and 0.78 inch for a local region. Thickness measurements taken for the carbon steel in several of the reclad areas ranged from 1.17 to 1.07 inches. These thicknesses are slightly greater than the minimum thickness required for the overall head and well above the minimum required for a local area. Although TVA sampled a limited number of areas, it concluded, based on its knowledge of the manufacturing process for this part of the vessel, that these samples provide sufficient assurance that the head region meets the requirements for the use of this vessel for the design parameters specified.

TVA will monitor the condition of the tanks by verifying the borated water volume and the nitrogen cover pressure in the tanks every 12 hours as required by the Technical Specifications. Any decrease in pressure or volume will be accounted for.

3.0 CONCLUSION

TVA's evaluation showed that the cladding is not needed as part of the design thickness and can be considered non-structural. The flaws can be left as-is without grinding or repair under ASME Code Section XI; they are unlikely to propagate. The staff agrees with TVA's analysis and finds TVA's disposition of the cladding flaws acceptable.

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