UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION OF RECIRCULATION INLET NOZZLE INDICATIONS AT NINE MILE POINT NUCLEAR STATION, UNIT 2

DOCKET NO. 50-410

1.0 INTRODUCTION

During the recent refueling outage (RFO-4) Niagara Mohawk Power Corporation (NMPC, the licensee) performed augmented inservice inspections of piping in accordance with Generic Letter (GL) 88-01. An indication was found on each of two recirculation inlet nozzles (N2B and N2H) safe end-to-nozzle welds (2RPV-KB04 and 2RPV-KB10). These indications exceeded the allowable flaw size of the ASME Code, Section XI, IWB-3514.3 and required further evaluation. As discussed below, the licensee performed flaw evaluation and crack growth calculations in accordance with the ASME Code, Section XI, IWB-3640, assuming these indications are active intergranular stress-corrosion cracks. The results of the evaluation showed that operation with the indications present is acceptable for the next operating cycle of 17 months.

There is evidence that these indications might not be active intergranular stress corrosion cracks. However, the origin of these indications was not determined. The licensee stated that these two welds will be reinspected during the next RFO.

2.0 EVALUATION

General Electric (GE) performed the ultrasonic testing (UT) for the licensee using EPRI qualified examiners and procedures. GE used the Smart 2000 automated system with 45° shear wave, 45° and 60° refracted longitudinal wave search units. The scope of the examination followed the guidelines in GL 88-01. A non-geometric indication was found on two recirculation inlet nozzle to safe-end welds. In accordance with GL 88-01, the nozzle to safe-end welds are intergranular stress corrosion cracking (IGSCC) Category D welds. The indications were located on the nozzle side in the vicinity of the weld roots. Both indications were reported to have a maximum depth about 14% (0.2 inch) of the wall thickness. The circumferential lengths of the indications in welds 2RPV-KB04 (N2B) and 2RPV-KB10 (N2H) were reported to be 17.3 inches (about 38% of weld circumference) and 11.6 inches (about 25.7%), respectively. Manual sizing was also performed and its results are consistent with that derived from automatic examination data. The licensee reported that all 10 recirculation inlet nozzle to safe end welds and 30 out of 31 Category D welds were examined during this outage. The NRC staff has reviewed the licensee's

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inspection scope, methodologies and results, and has determined that the IGSCC inspection performed during this outage meets the guidelines in GL 88-01 and, therefore, is acceptable.

The licensee reported that during site construction, the recirculation inlet nozzle safe ends were redesigned to eliminate the alloy 600 crevice condition, and the original alloy 600 safe ends were replaced with the redesigned Type 316L safe ends. The nozzle end was buttered with alloy 182, using shielded metal arc welding (SMAW) process and post-weld heat treated together with the reactor vessel. Both the original and the redesigned safe end to nozzle welds were made of alloy 82. Based on the original safe end cut out drawing, some of the original safe end weld material might not be completely removed. The original safe end welds were fabricated by CBIN using manual gas tungsten arc welding (GTAW). This process was reported to be prone to the generation of inclusions in the weld metal as evidenced by the experience at the WNP-2 plant. Therefore, it is possible that the observed indications could be reflectors from the inclusions in the remaining original safe end weld materials. The licensee also reviewed the original construction radiographs of the subject welds. Similar indications were observed at the weld roots and showed good correlation with the UT data.

The licensee reviewed the ultrasonic examination results performed during the 1990 outage. During the 1990 examination these indications were evaluated as Acoustic Interface and ID Geometric reflectors because they were plotted on the original reactor pressure vessel (RPV) design configuration. When the modified safe-end configuration was considered for 1990 data, the indications were reported to be the same as those observed in 1995. The 1990 examination recorded only the A-Scan data while the 1995 examination recorded A-Scan, B-Scan and C-Scan data, which would yield more precise positional information. The licensee also reported that the indications did not show any significant changes in length and depth between the 1990 and 1995 examinations.

The licensee performed a flaw evaluation in accordance with the ASME Code, Section XI, IWB-3640, assuming the flaws were located in the remaining original alloy 82 weld metal close to the weld root. The axial loads corresponding to weight, seismic and pressure were considered in the evaluation. The stresses were calculated based on a design wall thickness of 1.25 inches. The upset condition has been shown to be the limiting condition. The current average water conductivity at Nine Mile Point Unit 2 is reported to be about 0.09 μs/cm which is below EPRI's water chemistry guidelines. The licensee's crack growth calculations included the use of a bounding crack growth rate of 5.0×10^{-5} inch/hour for a 17-month operating cycle (12410 hours). The results of the calculations showed that the final flaw sizes at the end of the cycle will not exceed the ASME Code allowable (72% of wall thickness) values.

The NRC staff had a concern regarding the assumed locations of the flaws because the licensee did not provide adequate discussions of the reasons that the subject indications could not be in the alloy 182 butter. At the staff's request, the licensee also performed a crack growth calculation assuming the

flaws were located in the alloy 182 butter and using a bounding crack growth rate of $5x10^{-5}$ inch/hour and a UT measured wall thickness of 1.44 inches. In this calculation, a thermal stress of 2.16 ksi was included because the alloy 182 butter was fabricated by the SMAW process. The results of the calculation showed that the final flaw size at the end of the cycle will not exceed the ASME Code allowable (60% of wall thickness). The staff has determined that the licensee's flaw evaluation and crack growth calculations are acceptable.

3.0 CONCLUSION

Based on its review of the licensee's inspection results, flaw evaluation and crack growth calculations, the NRC staff concludes that Nine Mile Point, Unit 2 can be safely operated for at least a fuel cycle of 17 months (12410 hours) in its present condition because the structural integrity of welds 2RPV-KB04 (N2B) and 2RPV-KB10 (N2H) will be maintained.

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