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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REGULATION

FLAW EVALUATION OF RECIRCULATION LINE WELD 32-WD-050

NINE MILE POINT NUCLEAR STATION UNIT NO. 1

DOCKET NO. 50-220

1.0 INTRODUCTION

During the current refueling outage (RF014), the licensee performed inservice inspection on the recirculation system piping using ultrasonic examination. A rejectable indication was found in weld 32-WD-050 of Loop 12 of the Reactor Recirculation System. After discovery of this indication, eight more recirculation piping welds were inspected, no indication was found. Weld 32-WD-050 is a circumferential weld joining the downstream side of suction side block valve 32-376 to the pipe spool (28 inch outside diameter). The flaw indication is circumferentially oriented on the pipe inside diameter (ID) surface adjacent to weld 32-WD-050. The flaw is reported to have a length of 1.25 inch and a depth of 0.25 inch. The pipe wall thickness as measured by ultrasonic examination in the vicinity of the flaw is 1.1 inch.

The licensee replaced the recirculation system piping with materials resistant to intergranular stress corrosion cracking (IGSCC) in 1983. All piping welds made during this replacement were gas-tungsten-arc welds (GTAW). Special welding procedures were implemented to minimize sensitization of the pipe base material adjacent to the weld. In 1986, induction heating stress improvement (IHSI) process was applied to the recirculation system piping welds including weld 32-WD-050 to improve its resistance to IGSCC.

The licensee's plant records showed that during weld fabrication, the root pass of weld 32-WD-050 was repaired because an area of incomplete fusion was found by radiographic examination. The weld defect was removed by grinding and rewelded. Subsequent radiographic examination performed after repair and ultrasonic examinations performed after completion of weld fabrication and IHSI did not find any relevant indication. The location of the flaw indication found on weld 32-WD-050 is reported to be at the same root area that weld repair was performed during original weld fabrication.

To characterize the flaw indication further, the licensee performed additional radiographic examination and ultrasonic examination. The indication was sized by using the transducers of 45° shear, 60° refractive longitudinal and WYS-70. The apparent tip diffraction signals characterizing the IGSCC were observed but with relatively low amplitude. The licensee also re-examined the radiographic records taken in 1983 after weld repair with enhanced digitization of the film. The flaw indication could not be found on the radiographic film taken in 1983 or taken in the current outage.

The licensee stated that there is not enough information at this time to positively identify the root cause of the indication, because the indication may be a remnant of the original weld defect or an IGSCC flaw initiated from the ID surface of the repair area.

In a letter dated April 7, 1997, the licensee submitted a flaw evaluation of weld 32-WD-050 for NRC review and approval. Additional information was provided by licensee in conference calls held on April 1, 3, and 21, 1997. The results of the licensee's flaw evaluations have shown that Nine Mile Point Unit 1 can be safely operated for the next operating cycle (730 days) without repairing the weld 32-WD-050. The staff's review and conclusion are provided below.

2.0 EVALUATION

The licensee stated that the flaw evaluations were performed in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI and Generic Letter 88-01 guidance. The licensee performed crack growth evaluations for both fatigue and IGSCC. The licensee's method of evaluating the fatigue flaw growth followed the guidance in Paragraph C-3210 of Appendix C of the 1986 Edition of ASME Code Section XI. In determining the cyclic loadings, the thermal transients from twenty (20) cycles of startups and shutdowns and ten (10) cycles of seismic loads were assumed for the evaluation period. The results of the licensee's evaluation has shown that the fatigue flaw growth during the next operating cycle is insignificant and would not contribute to the final flaw size. The fatigue flaw growth at the end of the next fuel cycle is calculated to be less than 0.001 inch. The licensee's evaluation for fatigue flaw growth is acceptable because the Code guidance and methodology were followed.

The licensee used a computer program, SSFLAW, to evaluate the acceptability of IGSCC flaws in stainless steel piping per the requirements of ASME Code 1986 Edition of Section XI. The forces and moments from deadweight, thermal expansion and seismic (inertial and end effect) loading at the location of weld 32-WD-050 were taken from the Teledyne stress analysis (Teledyne Engineering Services Technical Report TR-5828-1, "Reactor Recirculation Piping Replacement analysis," dated May 25, 1983) performed during piping replacement. The Code Section XI IWB-3641 Tables were used to determine the allowable flaw size for normal plus upset conditions and emergency plus faulted conditions. The loads from pressure, deadweight and seismic forces were used in the calculation of the maximum allowable flaw size; but the secondary stresses (thermal stresses) were not included because weld 32-WD-050 is a GTAW weld. The maximum allowable flaw depth is determined to be 0.787 inch for the bounding normal and upset conditions. In calculating the crack growth, the loads used include operating pressure, dead weight, thermal expansion and as-welded residual stresses. The crack growth rate equation and the residual stress profile as delineated in NUREG-0313, Revision 2 were used in the calculations. The final flaw depth at the end of the next fuel cycle (730 days) is calculated to be 0.485 inches. Based on the final flaw depth, the final flaw length calculated in accordance with NUREG-0313, Revision 2 guidance is 4.7 inches (5.3% of weld circumference). The final flaw depth at

the end of the next fuel cycle is smaller than the Code allowable flaw depth of 0.787 inches.

The staff has reviewed the licensee's flaw evaluation and finds the results to be acceptable to support the safe operation of Nine Mile Point Unit 1 for the next fuel cycle (730 days) without repairing the subject flawed weld.

The staff performed an independent crack growth calculation for IGSCC in the subject flawed weld using a conservative crack growth model of a 360° circumferential surface flaw. The influence function used in the staff's calculation was based on that recommended in NUREG-313, Revision 2. The results of the staff's calculation showed that the final crack size at the end of the next fuel cycle will not exceed the Code allowable limit.

In a conference call held on April 17, 1997, the staff requested the licensee to reclassify the flawed weld 32-WD-050 from IGSCC Category A to Category F to ensure the subject weld will be inspected during the subsequent refueling outages. In accordance with Generic Letter 88-01 IGSCC, Category F welds are welds containing cracks that have been approved by analysis for limited service without repair and will be inspected every refueling outage. Category A welds are welds with no known cracks and are made of IGSCC resistant materials. Only 25% of the Category A welds will be inspected in a period of 10 years. In a letter dated April 21, 1997, the licensee agreed to reclassify the subject weld as a Category F weld in Nine Mile Point Unit 1's Inservice Inspection Program Plan. The subject weld may be returned to its original IGSCC Category only after the inspection results have adequately demonstrated that the subject flaw is a weld defect, not an IGSCC crack.

3.0 CONCLUSION

Based on a review of the licensee's submittal and the staff's independent crack growth calculation, the staff concludes that Nine Mile Point Unit 1 can be safely operated for the next fuel cycle (730 days) without repairing weld 32-WD-050, because the structural integrity of weld 32-WD-050 will be maintained. However, continued plant operation beyond the next fuel cycle will depend on the satisfactory evaluation of the re-inspection results or implementing acceptable repairs during the next refueling outage.

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