December 21, 2004

Mr. James A. Spina
Vice President Nine Mile Point
Nine Mile Point Nuclear Station, LLC
P.O. Box 63
Lycoming, NY 13093

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 - EVALUATION OF A DETECTED SUBSURFACE FLAW IN REACTOR PRESSURE VESSEL CLOSURE HEAD MERIDIONAL WELD (TAC NO. MC0930)

Dear Mr. Spina:

By letter dated September 19, 2003, as supplemented on July 2, 2004, Nine Mile Point Nuclear Station, LLC, submitted an evaluation for a subsurface flaw in reactor pressure vessel closure head meridional weld RV-WD-005, which was identified by ultrasonic examination during Refueling Outage 17. The flaw evaluation was performed in accordance with IWB-3600, "Analytical Evaluation of Flaws," of Section XI of the 1989 Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code).

The Nuclear Regulatory Commission (NRC) staff has reviewed the submittals and has determined that the flaw evaluation is in accordance with the ASME Code and meets the acceptance criteria. Hence, the NRC staff agrees that the unit can be operated with the subsurface flaw in the reactor pressure vessel closure head meridional weld. Details of the NRC staff's review are set forth in the enclosed safety evaluation.

Sincerely,

/RA/

Peter S. Tam, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-220

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EVALUATION OF A SUBSURFACE FLAW IN REACTOR VESSEL CLOSURE HEAD WELD

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 (NMP1)

NINE MILE POINT NUCLEAR STATION, LLC

DOCKET NO. 50-220

1.0 INTRODUCTION

By letter dated September 19, 2003 (Accession No. ML032731422), Nine Mile Point Nuclear Station, LLC (the licensee) submitted an evaluation of a subsurface flaw, identified by ultrasonic examination during Refueling Outage 17, in the NMP1 reactor pressure vessel (RPV) closure head meridional weld RV-WD-005. This flaw did not meet the acceptance criteria of IWB-3500, “Acceptance Standards,” Section XI of the 1989 Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). Hence, the licensee performed a flaw evaluation in accordance with IWB-3600, “Analytical Evaluation of Flaws,” to demonstrate that NMP1 can be operated with the subsurface flaw in the RPV closure head meridional weld.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations*, Part 50.55a (10 CFR 50.55a), “Codes and Standards,” Item (g), “Inservice inspection requirements,” provides that components (including supports) which are classified as ASME Code Class 1, 2, and 3 meet the Section XI requirements of the ASME Code throughout the service life of a boiling- or pressurized-water nuclear power facility. Section XI of the ASME Code, IWB-2400, “Inspection Schedule,” specifies inservice inspection (ISI) requirements as to when and how much (i.e., percentage) to inspect each Code examination category of components. IWB-2500, “Examination and Pressure Test Requirements,” defines specific components within each Code examination category and specifies the appropriate inspection method and the acceptance standard to use for each component. IWB-3100, “Evaluation of Examination Results,” contains requirements on disposition of indications detected and characterized during the ISI inspection activities. When a flaw in a component does not meet the appropriate acceptance standard (IWB-3510 to IWB-3523), as specified in Table IWB-3410-1 of IWB-3100, IWB-3100 allows acceptance of the flaw for continued service without repair using the analytical evaluation of IWB-3600. For the current RPV closure head meridional weld flaw, the applicable flaw evaluation methodology is linear elastic fracture mechanics as described in Appendix A, “Analysis of Flaws,” of Section XI of the ASME Code (the Appendix A methodology).

Enclosure

3.0 TECHNICAL EVALUATION

The licensee's September 19, 2003, submittal provided a comprehensive RPV flaw evaluation methodology, which supplements the Appendix A methodology by including an approach to calculate the applied stress intensity factor ($K_{applied}$) for surface flaws due to cladding-induced stresses. The Appendix A methodology requires consideration of residual and cladding-induced stresses, but provides no guidance on how to accomplish it. However, since the detected flaw is characterized as a subsurface flaw, it is not necessary for the Nuclear Regulatory Commission (NRC) staff to review the licensee's supplemented approach for evaluating surface flaws. Consequently, the NRC staff requested the licensee to either demonstrate that the impact due to cladding stresses on the acceptability of the detected flaw according to the Section XI requirements is insignificant, or provide responses to the NRC staff's request for additional information (Accession No. ML041000372) on the licensee's supplemented approach, which might be referenced for future applications. In the response dated July 2, 2004 (Accession No. ML041950193), the licensee chose to demonstrate that the impact due to cladding stresses on the acceptability of the detected flaw according to the Section XI requirements is insignificant.

The licensee started its flaw evaluation by characterizing the flaw according to Figure IWA-3310-1. This procedure determined that the flaw is subsurface and is 7.0 inches long, 0.3 inch deep, and 0.2 inch under the clad-base metal interface. The flaw size characterized above is referred to as "initial flaw size" in the flaw evaluation discussed below. A fatigue crack growth is then performed using (1) the $K_{applied}$ value at the allowable flaw size, (2) the crack growth curve for ferritic steel in air environment from Appendix A to Section XI of the 1992 Edition of the ASME Code, and (3) 240 startup/shutdown cycles. The $K_{applied}$ calculation considers contributions due to pressure, thermal, residual, cladding, and bolt-up stresses and is consistent with the Appendix A methodology. The licensee's approach of using the $K_{applied}$ value at the allowable flaw size to calculate crack growth is more conservative than the Appendix A methodology because the allowable flaw size is larger than all progressing flaw sizes that Appendix A methodology used to calculate their $K_{applied}$ values. The licensee's approach results in more crack growth for each cycle, and more overall growth for 240 startup/shutdown cycles. Using the Code-specified crack growth curve for ferritic steel under air environment for subsurface flaws is consistent with the Appendix A methodology and is appropriate. This curve, referenced by the licensee from the 1992 Edition of the ASME Code, remains unchanged in the 2001 Edition of the ASME Code. Further, the licensee's consideration of 240 startup/shutdown cycles (i.e., more than 6 startup/shutdown cycles a year) is conservative to bound occurrence of secondary transients and is, therefore, acceptable to the NRC staff.

The allowable flaw size is the size of the largest flaw which meets the structural factor criteria of IWB-3600, using the stress analysis results corresponding to the limiting service level loading and the fracture toughness of the RPV head material at the detected flaw location. Instead of conducting a plant-specific calculation, the licensee used an allowable flaw size curve from the Oyster Creek flaw evaluation handbook (Structural Integrity Associates Report Number SIR-00-109, Revision 1, "Flaw Acceptance Handbook for Oyster Creek Reactor Pressure Vessel Shell-Weld Inspections," SI File No. NMP-05Q-114) to perform the last step of its flaw evaluation. To demonstrate the applicability of the handbook to the NMP1 RPV closure head meridional weld, the licensee examined the underlying methodology of the handbook and confirmed that (1) Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," was used for determining the reference temperature RT_{NDT}, and (2) K_{Ic} and K_{Ia} values were

determined using RT_{NDT} and the Appendix A K_{Ic} and K_{Ia} formulas. IWB-3611 and IWB-3612 were then applied to calculate the maximum $K_{applied}$ value that the RPV head weld flaw can sustain. Based on this maximum $K_{applied}$ value, the allowable flaw sizes for different assumed flaw aspect ratios can be calculated. Hence, the NRC staff concludes that the allowable flaw size calculation is in accordance with the Appendix A methodology.

The allowable flaw size calculation needs certain plant-specific information about the component. The licensee compared material properties, geometries, and stresses between the Oyster Creek and NMP1 RPV heads, and concluded that the handbook's allowable-flaw-size curves are directly applicable to the NMP1 RPV head. This comparison revealed that both RPV heads are made of the same material (SA-302 Gr. B) and the limiting RT_{NDT} for NMP1 RPV head material is lower than that of Oyster Creek, giving higher K_{Ic} and K_{Ia} values for NMP1. Further, the NMP1 RPV head dimensions and boltup hoop stresses are identical to those of Oyster Creek. Table 1 of the September 19, 2003, submittal presents boltup hoop stresses at similar locations from the NMP1 stress report, CENC-1142, "Analytical Report for Niagara Mohawk Reactor Vessel," the Oyster Creek stress report, CENC-1143, "Analytical Report for Jersey Central Reactor Vessel," and the handbook. Based on the identical stresses under the boltup condition for NMP1 and Oyster Creek, the NRC staff agrees with the licensee's conclusion that the handbook, which is based on the Oyster Creek stress report, applies to NMP1 RPV head. Appendix A methodology updates the crack size at the end of each transient cycle, and therefore the flaw size at the end of the last cycle is the final flaw size. This final flaw size is then compared with the allowable flaw size to determine acceptability of the detected flaw. The licensee's approach differs from Appendix A by including allowance for fatigue crack growth in the allowable flaw size curves so that a user can simply compare the initial flaw size with the "adjusted" allowable flaw size curve from the handbook to determine flaw acceptability.

Figure 4 of the September 19, 2003, submittal shows such a comparison, and the figure indicates that the initial flaw size of the detected flaw is below the "adjusted" allowable flaw size curve, indicating that the ASME requirements are satisfied with the Code-specified margins.

4.0 CONCLUSION

The licensee's flaw evaluation is consistent with the Appendix A methodology of Section XI of the ASME Code, and the resulting margins exceed the acceptance criteria in the Code. Therefore, the licensee's evaluation is acceptable, and the RPV head, with the flaw indication in its meridional weld, can be operated without repairing the flaw. The ASME Code specifies that future inspections of the area containing this flaw indication be performed according to IWB-2420, "Successive Inspections."

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Date: December 21, 2004

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