October 31, 2001

Mr. John H. Mueller
Chief Nuclear Officer
Niagara Mohawk Power Corporation
Nine Mile Point Nuclear Station
Operations Building, Second Floor
Lycoming, NY 13093

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 - INSPECTION RESULTS FOR CORE SHROUD SUPPORT WELDS H8 AND H9 (TAC NO. MB2528)

Dear Mr. Mueller:

By letter dated December 15, 2000, Niagara Mohawk Power Corporation (NMPC) provided the scope of the Refueling Outage 16 (RFO-16) core shroud reinspection at Nine Mile Point Nuclear Station, Unit No. 1 (NMP1). The NRC staff found NMPC's core shroud reinspection scope for RFO-16 acceptable by a safety evaluation transmitted by letter dated April 5, 2001.

By letter dated August 2, 2001, NMPC submitted its RFO-16 core shroud support weld examination results and the associated flaw evaluation for the detected flaws at NMP1. The NRC staff has reviewed this submittal. The NRC staff found that the limit load analysis for multiple flaws met the intent of the rules of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, that NMP1 could be operated without repair for weld H-9 for 10 years of operation, and that the proposed weld H-9 reinspection is acceptable. Details of the NRC staff's findings 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

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1

DETECTED FLAWS IN CORE SHROUD SUPPORT WELDS H-8 and H-9

NIAGARA MOHAWK POWER CORPORATION

DOCKET NO. 50-220

1.0 INTRODUCTION

By letter dated October 20, 1999, the U.S. Nuclear Regulatory Commission (NRC) staff issued to Niagara Mohawk Power Corporation (NMPC, the licensee) the results of its review of the Refueling Outage 15 (RFO-15) core shroud reinspection results at Nine Mile Point Nuclear Station, Unit No. 1 (NMP1). In that document, the staff requested NMPC to provide information regarding the scope of the core shroud reinspection at least 3 months before the start of RFO-16. Accordingly, NMPC provided such information by a letter dated December 15, 2000. By letter dated April 5, 2001, the NRC staff found NMPC's core shroud reinspection scope for RFO-16 acceptable.

By letter dated August 2, 2001, NMPC submitted its core shroud support weld examination results and the associated flaw evaluation for the detected flaws at NMP1. The ultrasonic (UT) examination of the core shroud support welds H-8 and H-9 was conducted during RFO-16. The UT indications in weld H-8 were considered structurally insignificant. However, the indications in weld H-9 were moderate, and an analytical flaw evaluation was performed by NMPC to demonstrate that the unit could be operated without repair of weld H-9 for at least 10 years.

Since the flaws detected by UT in weld H-8 indicated no growth and flaws detected by a separate set of enhanced visual examination (EVT-1) could not be confirmed by UT, the staff agrees with NMPC's conclusion that the flaws in weld H-8 are structurally insignificant. Therefore, the following evaluation focused on the flaws detected in weld H-9.

2.0 EVALUATION

2.1 Licensee's Evaluation

NMPC found 34 indications in its UT examination of weld H-9 during RFO-16 and determined that 4 are significant circumferential flaws. In the subsequent flaw evaluation, NMPC used the distributed ligament length (DLL) flaw evaluation methodology (documented in Topical Report "BWRVIP Core Shroud Distributed Ligament Length Computer Program," BWRVIP-20, EPRI Report No. AP-107283, December 1996) to perform the evaluation for weld H-9. The DLL

methodology is capable of analyzing a core shroud weld with multiple flaws using either the limit load or the linear elastic fracture mechanics (LEFM) analysis. Since the H-9 core shroud support weld experienced very low fluence, much lower than the LEFM threshold fluence of $3.0x10^{20}$ n/cm^2 as specified in Topical Report BWRVIP-01, Revision 1 (dated March 1995, and also referred to as GENE-523-113-0894, Rev. 1), NMPC performed only limit load evaluation for this weld. The results from the limit load analysis indicated that the calculated safety factor is 12.53 for the worst flaw in weld H-9, exceeding the Code-required value of 1.39 for the emergency and faulted conditions by a large margin. The safety factor was calculated using the stresses for the emergency and faulted conditions because these conditions were found to be limiting.

The limit load analysis employed an uncertainty of 0.427 inch (0.421 for the non-destructive examination, and 0.006 for tooling) in sizing the flaws and applied this uncertainty to both ends of the flaws. The crack growth corresponding to 10 years (approximately 80,000 hours) of operation was estimated using the bounding growth rate of $5x10^{-5}$ inch/hour. Based on the results from the limit load analysis, the licensee concludes that weld H-9 meets the structural margin requirements for continued operation after RFO-16 without repair for 10 years.

2.2 NRC Staff Evaluation

The licensee's flaw evaluation employed limit-load analysis. The NRC staff determined that the licensee's use of the limit load analysis for weld H-9 is appropriate because the methodology was selected according to the guidelines (based on fluence levels) established in Topical Report BWRVIP-01, Revision 1 (dated March 1995, and also referred to as GENE-523-113-0894, Rev. 1, "BWR Core Shroud Inspection and Evaluation Guidelines"). This topical report was approved by the NRC on June 16, 1995. Further, the limit load analysis for multiple flaws in a circumferential weld has been considered by the NRC staff as an extension from the limit load analysis for a single flaw in a circumferential weld specified in Appendix C of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), and has been accepted in previous submittals on core shroud flaw evaluations (e.g., the safety evaluation transmitted to NMPC by a letter dated October 30, 2000, for Nine Mile Point Nuclear Station, Unit No. 2). In the analysis, NMPC determined, without providing justification, that the emergency and faulted conditions were limiting. To demonstrate that this statement is incorrect, the NRC staff selected the worst-case flaw from NMPC's analysis, in which NMPC reported a safety factor of 12.53, approximately 9 times the Code-required safety factor of 1.39. The safety factor calculated by the NRC staff for this flaw under the normal and upset conditions is 20.52, approximately 7.4 times the Code-required safety factor of 2.77. Thus, contrary to what NMPC determined, the normal and upset conditions are more limiting than the emergency and faulted conditions after considering the large difference in Code-specified safety factors for these two cases (2.77 versus 1.39). However, as indicated above, since the calculated safety factors exceed the Code-required safety factors regardless whether the loading is normal and upset, or emergency and faulted, this mistake has no impact on the licensee's conclusion.

NMPC's length uncertainty for these welds is based on the General Electric demonstration of UT techniques for BWRVIP using phased array; this is acceptable on the basis of previously accepted methodology. NMPC's use of the bounding growth rate of $5x10^{-5}$ inch/hour is also acceptable, because it is based on a stainless steel crack growth rate correlation provided in

the NRC Technical Report, NUREG-0313, Revision 2, "Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping," issued January 1988. Further, NMP1 is currently operating with hydrogen water chemistry and noble metal chemical addition. This mitigated water chemistry environment will significantly reduce the crack growth rate and would provide additional margins to the results of NMPC's crack growth calculations, which used the bounding crack growth rate based on normal water chemistry environment. The proposed weld H-9 re-inspection is based on a 10-year operating interval, consistent with BWRVIP-38, "BWR Vessel and Internals Project, BWR Shroud Support Inspection and Flaw Evaluation Guidelines" (NRC's safety evaluation dated July 24, 2000), and is appropriate.

3.0 CONCLUSION

The NRC staff has reviewed NMPC's submittal. The NRC staff determined that the limit load analysis for multiple flaws meets the intent of the rules of the ASME Code. The calculated safety factor of 12.53 for the normal and upset conditions, and 20.52 for the emergency and faulty conditions at the end of 10 years of operation both exceed the Code-required safety factors of 1.39 and 2.77, respectively. The NRC staff agrees with NMPC's conclusion that NMP1 could be operated without repair for weld H-9 for 10 years of operation, and that the proposed weld H-9 re-inspection is consistent with BWRVIP-38.

Principal Contributor: S. Sheng

Dated: October 31, 2001

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Unit No. 1

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