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

May 24, 1999

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

SUBJECT: SUPPLEMENTAL SAFETY EVALUATION REGARDING ALTERNATIVE REPAIR OF THE CORE SHROUD VERTICAL WELDS, NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 (TAC NO. MA4701)

Dear Mr. Mueller:

By letter and safety evaluation (SE) dated April 30, 1999, the U.S. Nuclear Regulatory Commission (NRC) staff approved an alternative repair plan for the core shroud vertical welds at Nine Mile point Nuclear Station, Unit No. 1 (NMP1). The letter and SE were in response to your letter dated February 3, 1999, as supplemented by letter dated April 14, 1999. Due to an oversight, our SE omitted an intended discussion regarding the NRC staff's evaluation of bypass leakage and downcomer flow characteristics of the contingency repair of vertical welds V4, V9, and V10. Accordingly, we are enclosing a supplemental SE to provide the omitted information.

In the enclosed SE, the NRC staff concludes that the acceptance criteria Niagara Mohawk Power Corporation (NMPC) has established for the bypass leakage will not affect the performance of the Emergency Core Cooling System, and that the proposed bypass leakage due to the repair of welds V4, V9, and V10 (or any lesser combination of these three welds) is acceptable. The NRC staff also concludes that installation of the repair clamps will not have a significant impact upon the downcomer flow characteristics and the associated pressure drop. Therefore, the NRC staff agrees with NMPC that the installation of the vertical weld clamps would not affect the recirculation flow of the reactor.

This supplemental SE does not affect the prior conclusions in our letter of April 30, 1999, regarding the acceptability of the contingency repair. Accordingly, the proposed repair, which was designed as an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, continues to provide an acceptable level of quality and safety, and to be acceptable in accordance with 10 CFR 50.55a(a)(3)(i).

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Template NRR-092

If you have any questions regarding this matter, please contact Darl Hood by phone on (301) 415-3049 or by electronic mail at dsh@nrc.gov.

Sincerely,

S. Singh Bajwa, Chief, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-220

Enclosure: Supplemental Safety Evaluation

cc w/encl: See next page

May 24, 1999

If you have any questions regarding this matter, please contact Darl Hood by phone on (301) 415-3049 or by electronic mail at dsh@nrc.gov.

Sincerely,

ORIGINAL SIGNED BY:

S. Singh Bajwa, Chief, Section 1
Project Directorate I
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Office of Nuclear Reactor Regulation

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cc w/encl: See next page

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Nine Mile Point Nuclear Station
Unit No. 1

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 126
Lycoming, NY 13093

Charles Donaldson, Esquire
Assistant Attorney General
New York Department of Law
120 Broadway
New York, NY 10271

Mr. Paul D. Eddy
State of New York
Department of Public Service
Power Division, System Operations
3 Empire State Plaza
Albany, NY 12223

Mr. F. William Valentino, President
New York State Energy, Research,
and Development Authority
Corporate Plaza West
286 Washington Avenue Extension
Albany, NY 12203-6399

Mark J. Wetterhahn, Esquire
Winston & Strawn
1400 L Street, NW
Washington, DC 20005-3502

Gary D. Wilson, Esquire
Niagara Mohawk Power Corporation
300 Erie Boulevard West
Syracuse, NY 13202

Supervisor
Town of Scriba
Route 8, Box 382
Oswego, NY 13126

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

SUPPLEMENTAL SAFETY EVALUATION BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO ALTERNATIVE REPAIR OF THE CORE SHROUD VERTICAL WELDS

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-220

1.0 INTRODUCTION

By letter dated February 3, 1999, as supplemented by letter dated April 14, 1999, Niagara Mohawk Power Corporation (NMPC and licensee) transmitted to the U.S. Nuclear Regulatory Commission (NRC) a proposed repair plan for the core shroud vertical welds at Nine Mile Point Nuclear Station, Unit No. 1 (NMP1). The repair plan was submitted as a contingency which, subject to NRC staff approval, would be installed if needed based upon inspection results. The contingency plan addressed shroud vertical welds V4, V9, and V10. The plan basically consists of the installation of a clamp (i.e., a plate with attached pins that are inserted into holes machined through the shroud on both sides of the flawed vertical weld) that would bridge across the flawed vertical weld and transmit the load normally transmitted through the vertical weld. Two clamps would be used for the V9 weld, two clamps for the V10 weld, and one clamp for the shorter V4 weld. The repair clamps can be installed on each weld independently; i.e., any one, two, or three welds can be repaired with these repair clamps. Because the proposed core shroud repair is not included under the definition for repair or replacement specified in Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), NMPC requested that the NRC staff approve the proposed core shroud repair as an alternative repair pursuant to 10 CFR 50.55a(a)(3)(i).

By letter and safety evaluation (SE) dated April 30, 1999, the NRC staff approved the alternative repair plan for the NMP1 core shroud vertical welds. Due to an oversight, that SE omitted an intended discussion regarding the NRC staff's evaluation of bypass leakage and downcomer flow characteristics. Accordingly, the purpose of this supplemental SE is to provide the omitted information.

2.0 BACKGROUND

NMP1 uses a Type 2 boiling water reactor (BWR 2) inside a Mark I containment. The NMP1 emergency core cooling system (ECCS) consists of an automatic depressurization system (ADS) and two trains of low pressure core spray. During a loss-of-coolant accident (LOCA), the core spray system transfers water from the suppression pool to the reactor vessel where the water cools the core and returns to the suppression chamber via the break. The NRC staff notes that maintenance of a 2/3 core coverage--the floodable volume after a LOCA required of some BWR designs--is not required to provide adequate core cooling at NMP1. However, significant bypass leakage through the shroud via the postulated through-wall cracking of

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vertical shroud welds and associated repairs could potentially affect the performance of the ECCS following a LOCA. NMPC designed the proposed repair such that any potential leakage from the vertical welds and their associated clamps will be insignificant in comparison to total core flow.

3.0 EVALUATION

The installation of a vertical weld clamp requires the machining of two through-wall holes into the core shroud, one hole on each side of the vertical weld. As depicted on Attachment 1 to the NRC staff's SE of April 30, 1999, vertical weld V4 is above the top guide between horizontal welds H1 and H2, which is a region where two-phase flow exists. Vertical welds V9 and V10 are above the core plate between horizontal welds H4 and H5. NMPC established the bypass leakage acceptance criteria for the vertical welds and their associated clamps such that any leakage will not exceed the minimum subcooling required for proper recirculation pump operation. Additionally, the core bypass flow leakage requirements assumed in the reload safety analysis will be maintained. NMPC's acceptance criteria are as follows:

> *The combined bypass leakage through welds V9 and V10 and their repair clamps shall be less than 0.25% of the total core flow (2% of the core bypass flow) for normal differential pressure.*
>
> *The combined bypass leakage of steam through weld V4 and its repair clamp shall be less than 0.08% of the recirculation (total core minus steam) flow for normal differential pressure.*

The acceptance criterion for vertical welds V9 and V10 ensures that the total postulated leakage from the combination of vertical weld repair clamps, postulated through-wall leakage of the entire length of vertical welds V9 and V10 (i.e., about 180 inches), and the assumed leakage from the tie-rod repair, is less than 1 percent of the total core flow. The NRC staff notes that the estimated leakage from the tie-rod repair was 0.54 percent. Therefore, the combined postulated leakage with the proposed vertical weld repairs would be 0.79 percent of the total core flow (i.e., 0.25 + 0.54 = 0.79) which meets the NMPC requirement. This criterion was established in two reports by General Electric (GE) Nuclear Energy: (1) GE-NE-B13-01739-05, Revision 1, titled "Nine Mile Point 1 Nuclear Power Station Safety Evaluation GE Core Shroud Repair Design," dated January 1995, and (2) GE-NE-B13-01869-043, Revision 1, titled "Assessment of the Vertical Weld Cracking on the NMP1 Shroud," dated April 1997. This criterion was previously reviewed by the NRC staff and discussed in letters and SEs dated March 31, 1995 (addressing the tie-rod repair of shroud horizontal welds), and May 8, 1997 (addressing a modification to the tie-rod repair).

The criterion for the combined bypass leakage of steam through vertical weld V4 and its associated clamp is based upon the design basis carryunder criterion established in GE Report GE-NE-B13-01739-05. This criterion was previously reviewed by the NRC staff as part of its review of the tie-rod repair. The acceptance criterion for vertical weld V4 ensures that the combined carryunder from the steam separators, shroud head leakage from the tie-rod repair, and the V4 repair at 85 to 100 percent rated core flow is less than the design value of 0.25 weight percent. The current carryunder from the tie-rod repair and the steam separators is 0.17 weight percent. NMPC took the difference between the design value carryunder and the current carryunder (i.e., 0.25 - 0.17) to determine the acceptance criterion of 0.08 weight percent of the recirculation flow.

NMPC's calculations demonstrated that the leakage flow rate from repaired weld V4 and its associated clamp would be 1.63 gpm. According to the above acceptance criterion, the allowable leakage for vertical weld V4 and its clamp is 96 gpm. Therefore, the calculated leakage due to the repair of vertical weld V4 is approximately 0.0014 weight percent of the recirculation flow. This calculated leakage is significantly less than the acceptance criterion for vertical weld V4 and is acceptable. Additionally, the calculated leakage flow rate for repaired welds V9 and V10 and their associated clamps would be 247 gpm. According to the acceptance criterion for vertical welds V9 and V10, the allowable leakage flow rate is 337 gpm. Therefore, the calculated leakage due to the repair of vertical welds V9 and V10 is approximately 0.18 percent of the total core flow and is acceptable. Both of the calculated leakages are within the established design acceptance criteria for bypass leakage. On the basis of the established acceptance criteria and the calculated leakage, the NRC staff concludes that the proposed bypass leakage will not affect the performance to the ECCS following a LOCA. Therefore, the NRC staff finds the proposed bypass leakage due to the repair of vertical welds V4, V9, and V10 (or any lesser combination of these three welds) to be acceptable.

NMPC evaluated the upper annulus downcomer flow characteristics with the vertical weld clamp installed at vertical weld V4. The downcomer flow characteristics and the associated pressure drop affect the total core/recirculation path driving head produced by the net downcomer elevation head and recirculation head. NMPC evaluated the available flow area in the upper annulus downcomer, which contains four tie-rod assemblies, core spray piping, shroud head guide pin lugs, and shroud head bolts. NMPC's calculations demonstrated that the installation of the vertical weld clamps will decrease the available downcomer flow area by approximately 2.5 percent in the upper annulus region. NMPC also provided the corresponding pressure drop associated with the decrease in downcomer flow area. The pressure drop was calculated to be 0.006 psi for normal operation, and 0.044 psi for the recirculation line break condition. The NRC staff considers these pressure drops to be insignificant. The NRC staff notes that the region between the top guide and core plate, where vertical welds V9 and V10 reside, has a greater downcomer flow area than the upper annulus region. Therefore, the vertical weld clamps at V9 and V10 will have less of an effect on the downcomer flow characteristics and pressure drop than the clamp at V4. Based on the NMPC's analysis, the NRC staff concludes that the installation of the vertical weld clamps will not have a significant impact on the downcomer flow characteristics and the associated pressure drop. Therefore, the NRC staff agrees with NMPC that the installation of the vertical weld clamps would not affect the recirculation flow of the reactor.

4.0 CONCLUSION

The NRC staff has reviewed the proposed bypass leakage and downcomer flow characteristics of the contingency repair of vertical welds V4, V9, and V10. The NRC staff concludes that the acceptance criteria established for the bypass leakage will not affect the performance of the ECCS. The NRC staff finds the proposed bypass leakage due to the repair of vertical welds V4, V9, and V10, including any lesser combination of repair of these three vertical welds, to be acceptable. Additionally, the NRC staff concludes that the installation of the vertical weld clamps on welds V4, V9, and V10, including any lesser combination of these three, will not have a significant impact upon the downcomer flow characteristics and the associated pressure drop. Therefore, the NRC staff agrees with NMPC that the installation of the vertical weld clamps would not affect the recirculation flow of the reactor.

This supplemental SE does not affect the prior conclusions in the NRC staff's letter of April 30, 1999, regarding the acceptability of the contingency repair. Accordingly, the proposed repair, which was designed as an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, continues to provide an acceptable level of quality and safety, and to be acceptable in accordance with 10 CFR 50.55a(a)(3)(i).

Principal Contributor: K. Kavanagh

Date: May 24, 1999