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

January 23, 2015

Karen D. Fili
Site Vice-President
Northern States Power Company – Minnesota
Monticello Nuclear Generating Plant
2807 West County Road 75
Monticello, MN 55362-9637

SUBJECT: MONTICELLO NUCLEAR GENERATING PLANT – ALTERNATIVE TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE, SECTION XI, EXAMINATION REQUIREMENTS FOR THE REACTOR PRESSURE SHROUD SUPPORT PLATE WELDS H8 AND H9 FOR THE FIFTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL (TAC NO. MF3551)

Dear Ms. Fili:

By letter dated February 28, 2014, as supplemented by letter dated October 10, 2014, Northern States Power Company, a Minnesota corporation (NSPM, the licensee), doing business as Xcel Energy, submitted a relief request (RR) RR-008 to the U.S. Nuclear Regulatory Commission (NRC). Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(ii), NSPM requested relief to use a proposed alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The proposed change in RR-008 would allow NSPM to revise the inspection requirements for examination coverage of shroud support plate welds H8 and H9 at the Monticello Nuclear Generating Plant (MNGP) from those based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, IWB-2420(b), regarding re-examination of previously detected flaws.

The NRC staff has reviewed the proposed alternative in RR-008 and determined, as set forth in the enclosed safety evaluation, that NSPM has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii), and remains in compliance with the ASME Code requirements. The staff concludes that the alternative provides reasonable assurance of the structural integrity of shroud support plate welds H8 and H9. Therefore, the proposed alternative specified in RR-008 is authorized in accordance with 10 CFR 50.55a(a)(3)(ii) for the fifth 10-year inservice inspection at MNGP that is expected to end on May 31, 2022.

If you have any questions, please contact Terry Beltz at (301) 415-3049 or via e-mail at Terry.Beltz@nrc.gov.

Sincerely,

David L. Pelton, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-263

Enclosure:
Staff Evaluation of Relief Request RR-008 for the Fifth 10-Year Inservice Inspection Interval

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR-008

REGARDING SHROUD SUPPORT PLATE WELDS H8 AND H9

FOR THE FIFTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL

MONTICELLO NUCLEAR GENERATING PLANT

NORTHERN STATES POWER COMPANY – MINNESOTA

DOCKET NO. 50-263

(TAC NO. MF3551)

1.0 INTRODUCTION

By letter dated February 28, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14064A191), as supplemented by letter dated October 24, 2014 (ADAMS Accession No. ML14286A001), Northern States Power Company - Minnesota (NSPM) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWB-2420(b). The relief would revise inspection requirements for examination coverage of shroud support plate welds H8 and H9 at the Monticello Nuclear Generating Plant (MNGP).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested to use the proposed alternative specified in relief request RR-008 on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety associated with reexamination of previously detected flaws in the aforementioned welds. The alternative specified in RR-008 would change the inspection program for the fifth 10-year inservice inspection interval at MNGP.

The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the licensee's proposed relief follows.

2.0 REGULATORY EVALUATION

Inservice inspection (ISI) of ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR, Section 50.55a(g), except where specific relief has been granted by the NRC pursuant to 10 CFR 50.55a(g)(6)(i). Paragraph 55a(a)(3) of 10 CFR 50 states that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if (i) the

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proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations also require that inservice examination of components and system pressure tests conducted during the first 10-year ISI interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval and subject to the limitations and modifications listed therein.

The ASME Code of record for the fifth 10-year ISI interval at MNGP is the 2007 Edition of the ASME Code, Section XI, with the 2008 Addenda.

3.0 TECHNICAL EVALUATION

The licensee provided information in support of its request for relief from ASME Code requirements. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee requests relief by demonstrating that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. This information was evaluated by the NRC staff, and the basis for disposition is documented below.

3.1 ASME Code Components

The components affected by RR-008 are core shroud support plate to core shroud weld (H8) and core shroud plate to reactor pressure vessel (RPV) weld (H9) under Examination Category B-N-2, "Welded Core Support Structures and Interior Attachments to Reactor Vessels," Item Numbers B13.30, "Interior Attachments Beyond Beltline Region," and B13.40, "Core Support Structure."

3.2 ASME Code Requirements (as stated by the licensee)

The 2007 Edition of the ASME Code, Section XI, with the 2008, Addenda IWB-2420(b) states the following:

> If a component is accepted for continued service in accordance with IWB-3132.3 or IWB-3142.4, the areas containing flaws or relevant conditions shall be reexamined during the next three inspection periods listed in the schedule of the Inspection Program of IWB-2400. Alternatively, acoustic emission may be used to monitor growth of existing flaws in accordance with IWA-2234.

3.3 Licensee's Hardship in Complying with the Requirements (as stated by the licensee)

In its application, the licensee states that gaining access to the lower plenum within the reactor vessel is unusually difficult due to the inherent design configuration of the reactor vessel internals with a welded core shroud and support assembly, fuel core and core support components, core instrumentation, sparger piping in the upper vessel regions, and jet pump assemblies in the annulus region. To gain further access would require extensive disassembly of the fuel cells or jet pumps.

The licensee further stated that in 2013, the general area dose rates on the refuel floor near the refuel cavity were approximately 1 to 3 millirem per hour (mrem/hr). Applying this general area dose rate to a lower time estimate of 200 hours for disassembly and reassembly of all 10 jet pump pairs, using 3 workers per shift at 2 shifts per day, the estimated dose would be 600 to 1800 mrem.

3.4 Licensee's Proposed Alternative (as stated by the licensee)

The licensee proposes to visually inspect all accessible areas of the topside and underside of both the H8 and H9 welds during each remaining refueling outage in the three periods of the MNGP Fifth ISI Interval (i.e., 2015, 2017, 2019, and 2021). NSPM intends to continue accessing the lower plenum via the jet pump inlets to perform the visual inspections. In addition to inspecting all accessible areas of the H8 and H9 welds for changes in the general condition of the welds, NSPM will select four areas with known, distinct indications on the underside of the shroud support plate in the H8 and H9 welds to monitor for any visually apparent changes in the flaw. The areas selected will include two locations on each weld, and will be located in different quadrants of the reactor vessel.

The selected locations will be mapped (by photo, video, or other effective method) and visually compared to the previous inspection. The flaw locations will be examined for visual evidence of new branching, visual evidence of length changes (e.g. flaws that once only covered a portion of the weld now completely cross the weld, etc.), and visual evidence of any flaws that extend into the reactor vessel low alloy steel or the shroud support plate itself. The accessible topside of the welds will also be inspected to verify no cracking has penetrated through the thickness of the weld (e.g. crack-like indications on the topside that could be connected to cracking on the underside). Based on the inspection results, NSPM will determine the need for additional evaluations or any resulting actions and implement them accordingly.

3.5 Licensee's Basis for the Proposed Alternative (as stated by the licensee in RR-008)

The licensee's proposed alternative is based, in part, on the premise that by performing detailed mapping and monitoring of a representative sample of the flaws and investigating more refined inspection techniques, MNGP can monitor the condition of the H8 and H9 welds and continue to meet the intent of IWB-2420(b).

The primary concern related to the H8 and H9 welds is uplift of the shroud support plate in the event of a design basis loss-of-coolant accident event. The uplift of the shroud support plate would be driven by the vertical seismic loads and reactor internal pressure differences across the plate. In a 2013 evaluation, using conservative flaw profiles and consideration of the loading acting upon the shroud support plate in the reactor vessel, only 18 percent of the total weld surface is required to be free of through-wall indications to overcome the uplift loads acting on the shroud support plate. Considering such extensive flaw profiles, the evaluations demonstrate that the structural integrity of the shroud support plate and its ability to resist uplift remain intact for at least 12 years and maintain the core coolant envelope.

In addition to the flaw tolerant design, hydrogen water chemistry (HWC) was implemented at MNGP in 1989, and online noble metal chemistry control was implemented in 2013. Therefore, the environment of the lower plenum is well-mitigated against flaw growth and initiation based on water chemistry controls.

Enclosure 2 of the application (ADAMS Accession No. ML14064A186) is an evaluation performed by Structural Integrity Associates, Inc., entitled, "Monticello Shroud Support Structure Flaw Evaluation Review and Support Plate Weld Inspection Recommendations." The evaluation provides supporting detail and technical justifications for the licensee's determination as to whether reduced inspection coverage is technically justifiable in lieu of the implicit requirement to inspect all flawed areas of the H8 and H9 welds as described in IWB-2420(b). This document recommends minimum inspection requirements based on the conservatisms built into the evaluations performed to date, water chemistry in the lower plenum of the reactor vessel, and crack growth potential of the flaws. The document also recommends a minimum inspection of 5 percent coverage of the bottom side of welds H8 and H9 in areas with known flaws with the objective of monitoring for unexpected change in flaw appearance.

It was noted in Enclosure 2 that, in 2013, MNGP was able to inspect 32 percent of the topside of the H8 weld, and 35 percent of the topside of the H9 weld, with no relevant indications. Based on a review of previously inspected regions on the underside of the H8 and H9 welds, the areas accessed through the jet pump inlets will be used to meet the 5 percent coverage recommendation. Therefore, all the performed and proposed inspections meet the minimum recommended inspection requirements stated above.

3.6 <u>Duration of the Licensee's Proposed Alternative</u>

The proposed alternative will be used for the fifth 10-year ISI Interval Program for MNGP that is expected to end on May 31, 2022.

3.7 <u>NRC Staff Evaluation</u>

3.7.1 Evaluation of Hardship

Section XI of the ASME Code requires the areas containing flaws or relevant conditions in the H8 and H9 welds be reexamined during the next three inspection periods listed in the schedule of the Inspection Program of IWB-2400. As indicated in Section 3.3 of this safety evaluation, access to the lower plenum is difficult due to inherent design configuration of the RPV internals with a core shroud and support assembly, fuel core and core support components, core instrumentation, sparger piping in the upper vessel regions, and jet pump assemblies in the annulus region. As a result, the licensee's previous ISI inspections of the H8 and H9 welds were limited to EVT-1 examination of the welds at 0 degree and 180 degree at the N1A and N1B recirculation suction nozzles, and a VT-3 examination of accessible areas of the H8 and H9 welds above and below the shroud support plate (e.g., the 2011 ISI Summary Report). The 2011 inspection coverage was approximately 17 percent of the entire vessel circumference length. This is consistent with BWRVIP-38, "BWR Shroud Support Inspection and Flaw Evaluation Guidelines," in which the licensee is required to inspect 10 percent of weld circumference for the H8 and H9 welds or the weld ligaments supported by a flaw tolerance analysis. The accessibility issue associated with the H8 and H9 welds of BWR RPVs have been recognized by the BWRVIP for a long time.

To support its request pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee needs to demonstrate that complying with the specified requirement would result in hardship without a compensating increase in the level of quality and safety. The licensee states that to gain additional inspection surfaces of the welds would require disassembly of the fuel cells or jet pumps, resulting in an increase in estimated dose of 600 to 1800 mrem.

Based on the above, the NRC staff determines that the inspections performed in accordance with the ASME Code, Section XI requirements, as described in Section 3.2 of this safety evaluation, would be an additional hardship for NSPM based on the estimated increase in occupational dose and overall radiological impact.

3.7.2 Evaluation of the Level of Quality and Safety

To demonstrate that the hardship is without a compensating increase in the level of quality and safety, the licensee proposed an alternative consisting of: (1) a flaw evaluation to support structural integrity of the component; (2) a VT inspection of all accessible areas of the topside and underside of the H8 and H9 welds during each remaining refueling outage in the fifth ISI interval, plus monitoring of four areas with known, distinct indications on the underside of the shroud support plate in the H8 and H9 welds, to validate the flaw evaluation conclusions; and (3) a VT inspection of the accessible topside of the welds to confirm that no cracking has penetrated through the thickness of the weld.

Flaw evaluation results supporting the relief request are provided in Enclosure 2 of the application, based on flaw evaluation results obtained in 2011 and 2013. These evaluations considered two hypothetical flaw configurations: (1) distributed through-wall flaws in the uninspected region and part-through-wall in the inspected region, and (2) a 360-degree circumferential flaw with a uniform crack depth of 75 percent through wall. These flaw configurations are very conservative because operating experience indicated no through-wall cracking was found in the H8 and H9 welds, and the approved crack growth model in BWRVIP-59-A, "Evaluation of Crack Growth in BWR Nickel Base Austenitic Alloys in RPV Internals," suggested that crack in these welds will not reach 66 percent of the wall thickness due to residual stress profiles. The limit load analysis is consistent with BWRVIP-76-A, "BWR Core Shroud Inspection and Flaw Evaluation Guidelines," and is, therefore, acceptable. Limit load analysis is a valid methodology for the H8 and H9 welds because these welds are under low neutron fluence and are unlikely to lose their material ductility during service.

The licensee's evaluation assumed that all lateral bending moments on the core shroud are supported by the shroud support legs. In Request for Additional Information (RAI) 1, the NRC staff requested justification for this assumption. The licensee's response dated October 10, 2014, provided an analysis showing that the shroud support legs supported 86 percent of the load. This is acceptable because the margins in Table 3, which are associated with the more realistic flaw configuration, are big enough to cover any effect due to the minor lateral moment on the H8 and H9 welds that was not considered in the analysis. As such, the NRC staff considers RAI 1 to be resolved. Representativeness of Table 3 results will be further discussed when the licensee's response to RAI 6 is evaluated.

On the material resistance side, RAI 3 requested the licensee provide basis for the flow stress used in the limit load analysis. The licensee's response stated that the flow stress is defined as $3S_m$ where S_m is from ASME Code, Section II design stress intensity for Alloy 600 material at

550°F. Since the flow stress is from the ASME Code, the NRC staff considers RAI 3 to be resolved.

RAI 6 requested further clarification regarding the acoustic (AC) loads on the jet pumps and the core shroud in the annulus region due to a recirculation suction line break. The licensee's response stated that the 2013 analysis conservatively considered twice the AC loads because complete information regarding whether the Mode of Characteristics (MOC) was used in the original AC load calculations for MNGP was not available at that time. Since the error identified in draft GE SC 12-20, "Error in Method of Characteristics Boundary Conditions Affecting Acoustic Loads Analyses," dated June 10, 2013, affected only plants using the MOC code, and the licensee later confirmed that MNGP did not use the MOC code in generating the AC loads, the NRC staff determined that using the 2011 analysis results (i.e., Table 3) is appropriate. As such, the NRC staff considers RAI 6 to be resolved.

The staff considers that other RAIs not specifically discussed in this safety evaluation have been resolved by the additional details provided by the licensee in its October 10, 2014, letter.

Based on the above, the NRC staff concludes that the flaw evaluation with the conservatively assumed flaw configuration in the H8 and H9 welds meets the ASME code, Section XI specified margin, and, therefore, provides reasonable assurance of structural integrity of the H8 and H9 welds. Further, since the licensee's proposed alternative inspections can validate the flaw evaluation, there is reasonable assurance of the continued structural integrity of the H8 and H9 welds.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity of shroud support plate welds H8 and H9 at MNGP. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii), and is in compliance with the ASME Code's requirements.

Therefore, the NRC staff determines that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. As such, the staff authorizes relief request RR-008 for the fifth 10-year ISI interval at the Monticello Nuclear Generating Plant that is expected to end on May 31, 2022.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in the subject request for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principle Contributor: S. Sheng, NRR

Date of issuance: January 23, 2015

If you have any questions, please contact Terry Beltz at (301) 415-3049 or via e-mail at Terry.Beltz@nrc.gov.

Sincerely,

/RA/

David L. Pelton, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-263

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Staff Evaluation of Relief Request RR-008 for the Fifth 10-Year Inservice Inspection Interval

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