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

June 1, 2020

Mr. Christopher R. Church
Senior Vice President and Chief
Nuclear Officer
Northern States Power Company - Minnesota
Monticello Nuclear Generating Plant
2807 West County Road 75
Monticello, MN 55362-9637

Mr. Scott Sharp
Site Vice President
Prairie Island Nuclear Generating Plant
Northern States Power Company - Minnesota
1717 Wakonade Drive East
Welch, MN 55089

SUBJECT: MONTICELLO NUCLEAR GENERATING PLANT AND PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2 - RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (EPID L-2019-LLR-0079)

Dear Mr. Church and Mr. Sharp:

By letter dated August 16, 2019, as supplemented by letter dated February 14, 2020, Northern States Power Company (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, requirements at Monticello Nuclear Generating Plant (MNGP) and Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with ASME Code, Section XI, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject moderate-energy carbon steel raw water piping. The NRC staff concludes that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of the proposed alternative for the remainder of the fifth 10-year ISI intervals of MNGP and PINGP, Units 1 and 2, or until such time the use of ASME Code Case N-789-3 is approved by the NRC, whichever completes sooner. All other ASME Code, Section XI requirements for

which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Senior Project Manager, Robert Kuntz at 301-415-3733 or via e-mail at Robert.Kuntz@nrc.gov.

Sincerely,

Nancy L. Salgado

Digitally signed by Nancy L. Salgado
Date: 2020.06.01 12:10:31 -04'00'

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-263, 50-282, and 50-306

Enclosure:
Safety Evaluation

cc: ListServ

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NOS. RR-014, 1-RR-5-12 AND 2-RR-5-12

ALTRENATIVE REQUEST TO USE ASME CODE CASE N-789-3

NORTHERN STATES POWER COMPANY

MONTICELLO NUCLEAR GENERATING PLANT AND

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

DOCKET NOS. 50-263, 50-282, AND 50-306

1.0 INTRODUCTION

By letter dated August 16, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19231A224) as supplemented by letter dated February 14, 2020 (ADAMS Accession No. ML20045E894), Northern States Power Company doing business as Xcel Energy (the licensee) submitted a proposed alternative request to use American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Case N-789-3, "Alternative Requirements for Pad Reinforcement of Class 2 and 3 Moderate-Energy Carbon Steel Piping for Raw Water Service, Section XI, Division 1," for the fifth inservice inspection (ISI) intervals of Monticello Nuclear Generating Plant (MNGP) and Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2.

The request stated that Code Case N-789-3 (N-789-3) was approved by ASME on April 27, 2017. The request also indicated that N-789-3 has not been approved yet in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," and, therefore, the application of N-789-3 requires specific NRC approval.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the request proposed an alternative (i.e., use of Code Case N-789-3) based on the hardship or unusual difficulty, including higher risks associated with plant shut-downs and extended technical specification (TS) actions, without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Regulation 10 CFR 50.55a(g)(4) requires that ASME Code Class 1, 2 and 3 components meet the ISI requirements, except the design and access provisions, set forth in Section XI of editions and addenda of the ASME Code, to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Regulation 10 CFR 50.55a(z)(2) states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the Nuclear Regulatory Commission (NRC) if the licensee demonstrates compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee proposed an alternative to the defect removal requirements of ASME Code, Section XI, Subsubarticle IWA-4420, due to hardship without a compensating increase in the level of quality and safety.

Based on the foregoing discussion and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Component(s) Affected

The affected components are ASME Code Class 2 and 3 moderate-energy carbon steel raw water piping systems. Moderate-energy piping systems are defined as the piping systems exposed to the maximum operating conditions that are less than or equal to 200 °F (93 °C) and less than or equal to 275 per square inch gauge (1.9 MPa). Raw water is defined as water such as from a river, lake, or well or brackish/salt water, which is used in plant equipment, area coolers, and heat exchangers.

3.2 Applicable ASME Code Section XI Edition and Addenda

The applicable code of record for MNGP and PINGP, Units 1 and 2, is the 2007 Edition with the 2008 Addenda of ASME Code, Section XI.

3.3 Applicable Code Requirement

ASME Code, Section XI, Article IWA-4000, provides provisions related to repair/replacement activities for ASME Code components (e.g., welding, brazing, defect removal, and metal removal by thermal means). Specifically, Subsubarticle IWA-4420, addresses the requirements for defect removal. If a defect has an unacceptable size, the defect is required to be removed by mechanical processing, thermal methods, welding or brazing.

3.4 Reason for Request

Article IWA-4000 requires that the replacement or weld repair of wall thinning conditions resulting from degradation be in accordance with the construction code. However, the repair and replacement provisions of Article IWA-4000 cannot always be utilized when degradation or leakage is identified during plant operations.

The proposed alternative would permit installation of technically sound temporary repairs to allow adequate time for evaluation, design, material procurement, planning and scheduling of an appropriate permanent ASME Code repair or replacement of the defective piping. The proposed alternative will also permit adequate time for considering the impact on system availability, maintenance rule applicability and availability of replacement materials in the repair/replacement activities.

Without the proposed repair option, compliance with the specified requirements of Article IWA-4000 would result in hardship or unusual difficulty, including higher risks associated with plant shut-downs and extended TS actions, without a compensating increase in the level of quality and safety.

3.5 Proposed Alternative and Basis for Use

As an alternative to the repair/replacement requirements of ASME Code, Section XI, the licensee proposed to use the provisions of Code Case N-789-3 for temporary repairs of degradation in moderate-energy Class 2 and 3 raw water piping systems. The scope of Code Case N-789-3 includes degradation due to erosion, corrosion, cavitation or pitting, but excludes conditions involving flow-accelerated corrosion, corrosion-assisted cracking or any other form of cracking. The defects within the scope of Code Case N-789-3 are typically identified by small leaks in the piping system or by pre-emptive, non-code-required examinations performed to monitor the degradation mechanisms and their effects.

Code Case N-789-3 was approved by the ASME Codes and Standards Committee on April 27, 2017. However, it has not been incorporated yet into RG 1.147, and thus is not available for application at nuclear power plants without specific NRC approval.

The proposed repair technique involves welding a metal reinforcing pad to the interior or exterior of the piping system to reinforce the degraded area. The repair will restore pressure boundary integrity by applying a pressure pad or pressure and structural integrity by applying a structural pad. The repair technique will be used when it is determined that the temporary repair method is suitable for the particular defect and type of degradation in accordance with Code Case N-789-3.

Code Case N-789-3 also requires that the cause of the degradation be determined, and that the extent and rate of degradation in the piping be evaluated to ensure there are no other unacceptable locations within the surrounding area of the repaired location. The area of evaluation is dependent on the degradation mechanism present. Code Case N-789-3 further requires that when welding a reinforcing pad to a leaking area, precautions such as installation of a gasket or sealant beneath the pad must be taken as necessary to prevent welding on wet surfaces.

Code Case N-789-3 further includes requirements for using actual or estimated corrosion rates for the design of reinforcing pads. For pressure pads, which rely on the underlying pipe for structural integrity and cannot be monitored for continued degradation, the pad design must use twice the corrosion rate measured at that location, or four times the worst-case corrosion rate for that or similar system at the plant site for the same degradation mechanism. In order to validate the corrosion rates used in the design of pressure pads, Code Case N-789-3 requires that areas containing pressure pads be visually observed at least once per month to monitor for evidence of leakage.

If the areas containing pressure pads are not accessible for direct observation, then monitoring will be accomplished by visual assessment of surrounding areas; ground surface areas above pressure pads on buried piping; or monitoring of leakage collection systems, if available.

Structural pads do not rely on the underlying degraded piping for structural integrity so the conservative multipliers identified above do not apply to structural pads. Additional provisions

including a maximum service life of one fuel cycle are required, thus providing reasonable assurance that structural and leakage integrity will be maintained for structural pads.

For all reinforcing pads, regardless of when during a fuel cycle they are installed, the repair will be considered to have a maximum service life of no later than the end of the next refueling outage, by which time an ASME Code-required repair or replacement must be performed. Detailed requirements for design, installation, examination, pressure testing and inservice monitoring of reinforcing pads are provided in Code Case N-789-3.

3.6 Duration of Proposed Alternative

At each of MNGP and PINGP Units, 1 and 2, the duration of the proposed alternative is until the end of the fifth 10-year ISI interval or until such time as the NRC approves Code Case N-789-3 in RG 1.147 or another document, whichever occurs first. The fifth 10-year ISI intervals of MNGP and PINGP Units, 1 and 2, are scheduled to end on May 31, 2022, December 20, 2024; and December 20, 2024, respectively. The NRC staff notes that the fifth ISI intervals of MNGP and PINGP, Units 1 and 2, have already started. Since 10 CFR 50.55a(z) specifies that NRC approval is necessary prior to implementation of a proposed alternative, the NRC staff's review of the request is relevant to the use of Code Case N-789-3 for the remainder of the fifth ISI interval at each plant.

The proposed repair per Code Case N-789-3 will be temporary. An ASME Code-required repair or replacement must be performed by the end of the next scheduled refueling outage following the temporary repair.

4.0 NRC STAFF EVALUATION

Code Case N-789-3 includes the provisions specified in Code Case N-789-2 for temporary repair of degradation in moderate-energy Class 2 and 3 raw water piping systems. In addition to the provisions in Code Case N-789-2, the following provisions are included in Code Case N-789-3: (1) provisions for applying reinforcing pads to mitigate internal degradation in weld neck flanges; and (2) provisions for applying prequalified structural pads in limited areas of tees.

RG 1.147 identifies ASME Code, Section XI Code Cases that are acceptable to the NRC staff with conditions as necessary. The current revision of RG 1.147 during the NRC staff's review, which is Revision 19, indicates the NRC staff's acceptance of N-789-2 with no condition. Therefore, the use of the provisions of N-789-2, which are also included in N-789-3, is consistent with RG 1.147. The NRC staff's evaluation of these provisions addressed in both Code Cases N-789-2 and N-789-3 are summarized in Section 3.7.1 through 3.7.8 below. In addition, the NRC staff's evaluation of the additional provisions added to Code Case N-789-3 is documented in Section 3.7.9 of this safety evaluation (SE) that is, provisions regarding the reinforcing pad repairs for weld neck flanges and areas adjacent to tee connections).

The following evaluation addresses the plant-specific alternative request for MNGP and PINGP, Units 1 and 2, but not to provide generic approval for use of Code Case N-789-3.

4.1 General Requirements

The proposed alternative requires that the reinforcing pad be applied in accordance with a repair/replacement plan satisfying the requirements of the ASME Code, Section XI, IWA-4150.

The proposed alternative also specifies that the design, materials, and installation requirements of the construction code and IWA-4000, except as stated in the Code Case, must be satisfied.

In addition, the proposed alternative identifies the following limitations: (1) the repair cannot be applied if the minimum required thickness of reinforcing pad necessary to satisfy the requirements of Section 3 of the Code Case is greater than the nominal thickness for the size and schedule of the piping; (2) additional reinforcement or repair on top of an existing reinforcing pad is prohibited; (3) reinforcing pads, including those installed during a refueling outage, shall not remain in service beyond the end of the next refueling outage; and (4) the repair is only applicable to piping not required to be ultrasonically examined for an ISI.

The NRC staff finds that the general requirements of the proposed alternative are based on the ASME Code requirements or adequate engineering principles for temporary piping repairs (such as no additional pad on an existing repair paid and the limited use of a repair pad up to the next refueling outage). Therefore, the NRC staff finds the general requirements acceptable.

4.2 Initial Evaluation

The proposed alternative includes the following provisions for initial evaluation: (1) prior to installing the reinforcing pad, the base metal be ultrasonically examined to determine the cause and rate of degradation; (2) if the cause of damage is determined to be flow-accelerated corrosion, corrosion-assisted cracking, or any other form of cracking, the licensee will not use this Code Case to repair the subject piping; and (3) an inspection be performed to determine the condition of the subject piping.

The NRC staff finds the provisions for initial evaluation acceptable because: (1) the provisions adequately include volumetric examination that can determine the cause and rate of the degradation and provide the conditions of degradation in the subject piping; and (2) the provisions also confirm that the mechanisms of the piping degradation are within the scope of the Code Case.

4.3 Design Requirements

The proposed alternative specifies that the reinforcing pads will be designed in accordance with the applicable requirements of the construction code or ASME Code, Section III (NC-3100; ND-3100; NC 3600; and ND-3600, including Appendix II). The NRC staff finds that these requirements refer to appropriate design criteria for piping systems and, therefore, are acceptable.

The NRC staff also finds that the proposed alternative clearly defines the types of pads (i.e., pressure pad and structural pad) such that each type of pad will be applied for a specific purpose of piping repair as further discussed below.

Paragraph 3.1(a)(1) in Code Case N-789-3 specifies that a pressure pad is designed to retain pressure and may be used only when the underlying piping is predicted to retain full structural integrity until the next refueling outage. The pressure is also designed with a corrosion rate of either two times the actual measured corrosion rate in that location or four times the estimated maximum corrosion rate for the system.

Paragraph 3.1(a)(2) in Code Case N-789-3 specifies that a structural pad is designed to achieve pressure plus structural reinforcement and may be used where the underlying piping is predicted not to retain full structural integrity until the next refueling outage.

For a structural pad, the corrosion rate will be estimated in accordance with paragraph 3.2(f) in Code Case N-789-3. The Code Case requires that the predicted maximum degradation of the reinforced piping until the next refueling outage be included in the design. The predicted degradation of the piping will be based on in-situ inspection of, and established data for, similar base metals in similar environments. Code Case N-789-3 also requires that, if the reinforcing pad is predicted to become exposed to the raw water, the predicted degradation of the reinforcing pad shall be based upon established data for base metals or weld metals with similar chemical composition to that used for the reinforcing pad. Code Case N-789-3 further requires inservice monitoring to ensure the structural integrity of the repaired pipe using a structural pad.

In addition, the proposed repair is limited to a maximum duration of one operating cycle. This relatively short duration of application is expected to limit the degradation. Code Case N-789-3 requires that the thickness of the reinforcing pad be sufficient to maintain required thickness until the next refueling outage. If the actual corrosion rate exceeds the projected corrosion rate during the operating cycle and a leak develops at or around the installed pad, the proposed inservice monitoring will be able to detect such leakage and the operator will be able to take corrective action.

As discussed above, the NRC staff finds that the design requirements of the proposed alternative provide reasonable assurance of the structural and leakage integrity of the repaired piping until the next refueling outage because: (1) the pressure pad is designed with reasonable safety factors to conservatively bound the estimated or actually measured corrosion rate for the subject piping; (2) the structural pad is designed to maintain the required thickness until the next refueling outage, and (3) periodic inservice monitoring is required to monitor additional degradation or leakage of the repaired piping (as further discussed in Section 3.7.8 of this SE). Therefore, the NRC staff finds these design requirements acceptable.

4.4 Water-Backed Applications

The proposed alternative requires that attachment welds on water-backed piping be applied using the shielded metal arc welding process with low hydrogen electrodes. The proposed alternative also requires that precaution be taken when welding a reinforcing pad to a leaking area (e.g., by installing a gasket or sealant beneath the weld). The NRC staff finds these provisions acceptable because the use of low-hydrogen electrodes minimizes hydrogen-induced cracking in the welds and the precautionary activities reasonable to prevent leaking conditions during the welding process.

For piping materials other than P-No. 1, Group 1, the proposed alternative requires a surface examination to be performed no sooner than 48 hours after completion of welding. The NRC staff notes that waiting 48 hours after welding ensures that, if delayed hydrogen cracking were to occur, it could be detected during the surface examination. Therefore, the NRC staff finds that the requirement for surface examination with the delayed time is acceptable.

4.5 Installation

The proposed alternative requires that a qualified welding procedure be used in accordance with the requirements of ASME Code, Section IX, and the construction code in addition to

requirements specified in N-789-3. The NRC staff finds these installation provisions refer to the relevant references for qualified welding procedures and, therefore, acceptable.

4.6 Examination

The proposed alternative requires a surface examination (liquid penetrant or magnetic particle) for the completed attachment weld of the reinforcing pad. The proposed alternative also requires that volumetric examination be performed on the pad, weld, and base metal after the reinforcing pad is welded to the pipe in accordance with ASME Code or the construction code. The NRC staff finds the examination and acceptance evaluation are consistent with the appropriate code provisions and, therefore, acceptable.

4.7 Pressure Testing

The proposed alternative requires that a system leakage test be performed in accordance with IWA-5000 prior to, or as part of, returning the system to service. In addition, reinforcing pads attached to piping that has not been breached shall be equipped with pressure taps for performance of pressure testing. The NRC staff finds that the proposed pressure testing is acceptable because it is consistent with the provisions of ASME Code, Section XI, IWA-5000, for piping system pressure testing.

4.8 Inservice Monitoring

For the structural pad, the proposed alternative requires that the pad be examined using ultrasonic or direct thickness measurement to record the thickness of the plate; the thickness at the attachment welds, including the underlying base metal; and, to the extent examinable, in a 3 inch wide band surrounding the repair as a baseline for subsequent monitoring of the repair. The proposed alternative also requires that the structural pad be monitored monthly for the first quarter and that the subsequent frequency be based on the results of the monitoring activities, but at least quarterly.

For the pressure pad, the proposed alternative requires that the areas containing the pad be visually examined monthly for evidence of leakage. If the areas containing the pressure pad are not accessible for direct observation, the proposed alternative requires that monitoring be accomplished by observing the surrounding areas or ground surface areas above pressure pads on buried piping; or by using leakage collection systems, if available.

The proposed alternative further requires that, if the results of the monitoring program identify leakage or indicate that the structural margins required by the Code Case will not be maintained until the next refueling outage, additional repair/replacement activities be performed prior to encroaching on the design limits. Such additional repair/replacement activities are not permitted on top of an existing reinforcing pad, as specified in paragraph 1(d) of Code Case N-789-3.

The NRC staff finds that the proposed inservice monitoring requirements are acceptable because: (1) the frequency and the examination method are adequate to monitor the structural integrity of the reinforcing pads; and (2) the acceptance criteria for the reinforcing pads are adequately defined.

4.9 Repairs for Weld Neck Flange and Tee Connection Locations

Code Case N-789-3 includes the provisions for temporary repairs of weld neck flanges. The NRC staff finds that the provisions of the proposed alternative are acceptable because: (1) a complete joint penetration weld is used to connect the reinforcing pad to the tapered, back side of the flange face, as described in Figure 3 of Code Case N-789-3; and (2) the complete joint penetration weld fully fills the gap between the end of the pad and the back side of the flange face.

Code Case N-789-3 also includes the provisions for temporary repairs of tee connections. The NRC staff finds that the provisions of the proposed alternative are acceptable because the repair provisions are applied only to the portions of the tees outside a specific distance from the branch connections, which ensures that the repair principles and provisions for straight pipe are also applicable to the subject portions of the tees.

4.10 Hardship Justification

The NRC staff finds that performing a plant shutdown to repair the subject piping would increase the potential of an unnecessary transient cycle, resulting in undue hardship. In addition, performing the ASME Code repair during normal operation could require extending TS actions, thus placing the plants at higher safety risk than warranted. Therefore, the NRC staff determines that compliance with the specified ASME Code repair requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.11 Summary

The NRC staff finds that the proposed alternative provides reasonable assurance that the temporary repair will maintain the structural integrity and leak tightness of the Class 2 and 3 moderate-energy carbon steel raw water piping because: (1) the scope of the application is clearly defined; (2) the pressure pad and structural pad will be designed in accordance with the construction code and ASME Code, Section III, and specific requirements as specified in N-789-3; (3) the degraded pipe will be examined and evaluated prior to the repair; (4) the examination results will be evaluated to verify the conditions of the repair; (5) the inservice monitoring will be performed to monitor the pipe wall thickness and potential degradation; and (6) pressure testing will be performed in accordance with IWA-5000 of ASME Code, Section XI.

5.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject moderate-energy carbon steel raw water piping. The NRC staff concludes that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of the proposed alternative for the remainder of the fifth 10-year ISI intervals of PINGP, Units 1 and 2, and MNGP or until such time the use of N-789-3 is approved by the NRC, whichever completes sooner. All other ASME Code,

Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: S. Min, NRR

Date: June 1, 2020

SUBJECT: MONTICELLO NUCLEAR GENERATING PLANT AND PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2 - RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (EPID L-2019-LLR-0079) DATED JUNE 1, 2020

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