



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

October 19, 2018

Mr. Scott M. Sharp
Vice President
Northern States Power Company - Minnesota
Prairie Island Nuclear Generating Plant
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Welch, MN 55089-9642

Mr. Christopher Church
Site Vice President
Northern States Power Company - Minnesota
Monticello Nuclear Generating Plant
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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-2017-LLR-0143)

Dear Mr. Church and Mr. Sharp:

By letter dated November 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17333A775), as supplemented by letter dated May 11, 2018 (ADAMS Accession No. ML18131A223), Northern States Power Company (NSPM, the licensee), submitted a request in accordance with paragraph 50.55a(z)(2) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) at Monticello Nuclear Generating Plant (Monticello), and Prairie Island Nuclear Generating Plant (Prairie Island), Units 1 and 2. The proposed alternative would allow the licensee to use ASME Code Case N-513-4, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1," for the evaluation and temporary acceptance of flaws in moderate energy Class 2 and 3 piping in lieu of specified ASME Code requirements for the fifth 10-year inservice inspection (ISI) interval.

Specifically, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the 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.

As set forth in the enclosed safety evaluation, the NRC staff has determined that the proposed alternative provides reasonable assurance of structural integrity of the subject components and that complying with IWC-3120, IWC-3130, IWD-3120(b), and IWD-3400, of the ASME Code, Section XI, would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

Therefore, the NRC staff authorizes the use of the licensee's proposed alternative as described in its November 29, 2017, letter to use ASME Code Case N-513-4, at Monticello and Prairie Island, Units 1 and 2, for the fifth 10-year ISI interval. If the proposed alternative is applied to a flaw near the end of the authorized 10-year ISI interval, and the next refueling outage is in the subsequent interval, the licensee is authorized to continue to apply the proposed alternative to the flaw until the next refueling outage. Use of the ASME Code Case is authorized until such time as the ASME Code Case is published in a future version of RG 1.147 and incorporated by reference in 10 CFR 50.55a(b). At that time, if the licensee intends to continue implementing this ASME Code Case, it must follow all provisions of ASME Code Case N-513-4 with conditions as specified in RG 1.147 and limitations as specified in 10 CFR 50.55a(b)(4), (b)(5), and (b)(6), if any.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and authorized by NRC staff remain applicable, including a third-party review by the Authorized Nuclear Inservice Inspector. The NRC staff notes that approval of this alternative does not imply or infer NRC approval of ASME Code Case N-513-4 for generic use.

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

Sincerely,

A handwritten signature in black ink, appearing to read "David J. Wrona", with a horizontal line extending to the right.

David J. Wrona, 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: via ListServ



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE TO USE ASME CODE CASE N-513-4

NORTHERN STATES POWER COMPANY

MONTICELLO NUCLEAR GENERATING PLANT;

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2;

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

1.0 INTRODUCTION

By letter dated November 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17333A775), as supplemented by letter dated May 11, 2018, (ADAMS Accession No. ML18131A223), Northern States Power Company (NSPM, the licensee), submitted a request in accordance with Paragraph 50.55a(z)(2) of Title 10 of the *Code of Federal Regulations* (10 CFR) for a proposed alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) at Monticello Nuclear Generating Plant (Monticello), and Prairie Island Nuclear Generating Plant (Prairie Island), Units 1 and 2. The proposed alternative would allow the licensee to use ASME Code Case N-513-4, "Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1," for the evaluation and temporary acceptance of flaws in moderate energy Class 2 and 3 piping in lieu of specified ASME Code requirements for the fifth 10-year inservice inspection (ISI) interval.

Specifically, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the 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.

2.0 REGULATORY EVALUATION

The licensee proposes an alternative to the requirement of ASME Code, Section XI, Articles IWC-3000 and IWD-3000.

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI.

The regulation in 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used when authorized by the U.S. Nuclear Regulatory

Commission (NRC), if the licensee demonstrates that: (1) the proposed alternative provides an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, 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

3.1.1 ASME Code Component(s) Affected

The affected components are ASME Code Class 2 and 3 moderate energy piping systems, as described in Code Case N-513-4, Section 1 "Scope," whose maximum operating temperature does not exceed 200 degrees Fahrenheit and whose operating pressure does not exceed 275 pounds per square inch gauge.

3.1.2 Applicable Code Edition and Addenda

Table 1- Applicable Plants with Associated 10-year Intervals and ASME Code Editions

| Plant | ISI Interval | ASME Section XI Edition/Addenda | Interval Start | Interval End |
|------------------------|---------------------|--|-----------------------|---------------------|
| Monticello | Fifth | 2007 Edition/2008 Addenda | 9/1/2012 | 5/31/2022 |
| Prairie Island, Unit 1 | Fifth | 2007 Edition/2008 Addenda | 12/21/2014 | 12/20/2024 |
| Prairie Island, Unit 2 | Fifth | 2007 Edition/2008 Addenda | 12/21/2014 | 12/20/2024 |

3.1.3 Applicable Code Requirement

ASME Code, Section XI, IWC-3120 and IWC-3130, require that flaws exceeding the defined acceptance criteria be corrected by repair/replacement activities or evaluated and accepted by analytical evaluation. ASME Code, Section XI, IWD-3120(b), requires that components exceeding the acceptance standards of IWD-3400 be subject to supplemental examination, or to a repair/replacement activity.

3.1.4 Reason for Request

The licensee stated that ASME Code Case N-513-3 (currently approved for use in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 18, March 2017) does not allow evaluation of flaws located away from attaching circumferential piping welds that are in elbows, bent pipe, reducers, expanders, branch tees, and heat exchanger external tubing or piping. Code Case N-513-4 contains modifications that provide guidance for the evaluation flaws in these areas. The NRC staff has not approved Code Case N-513-4 in RG 1.147. Therefore, the licensee requested relief from the ASME Code to use N-513-4.

Moderately degraded piping could require a plant shutdown within the required action statement timeframes to repair observed degradation. The licensee stated that plant shutdown activities result in additional plant risk that would be inappropriate when a degraded condition is demonstrated to retain adequate margin to complete the component's function.

3.1.5 Licensee's Proposed Alternative and Basis for Use

The licensee's proposed alternative is to use ASME Code Case N-513-4 for the evaluation and temporary acceptance of flaws in moderate energy Class 2 and 3 piping in lieu of specified ASME Code, Section XI, requirements. In addition, the licensee's proposed alternative includes the determination of an allowable leakage rate by dividing the critical leakage rate by a safety factor of four.

The licensee stated that limitations in Code Case N-513-3, related to its use on piping components such as elbows, bent pipe, reducers, expanders, and branch tees and external tubing or piping attached to heat exchangers, have been addressed in Code Case N-513-4. The licensee provided a high level overview of the differences between Code Case N-513-3 and Code Case N-513-4 as listed below:

1. Revised the maximum allowable time of use from no longer than 26 months to the next refueling outage.
2. Added applicability to piping elbows, bent pipe, reducers, expanders, and branch tees where the flaw is located more than $(R_0t)^{1/2}$ (where R_0 is the outside pipe radius and t is the evaluation wall thickness) from the centerline of the attaching circumferential piping weld.
3. Expanded use to external tubing or piping attached to heat exchangers.
4. Revised to limit the use to liquid systems.
5. Revised to clarify treatment of Service Level load combinations.
6. Revised to address treatment of flaws in austenitic pipe flux welds.
7. Revised to require minimum wall thickness acceptance criteria to consider longitudinal stress in addition to hoop stress.
8. Other minor editorial changes to improve the clarity of the Code Case.

The licensee referenced "Proceedings of the ASME 2014 Pressure Vessels & Piping Conference, PVP2014, July 20-24, 2014, Anaheim, California, USA, PVP2014-28355, Technical Basis for Proposed Fourth Revision to ASME Code Case N-513," which was previously submitted to the NRC in a relief request dated January 28, 2016 (ADAMS Accession No. ML16029A003) to support the use of Code Case N-513-4. The licensee stated that the document provides discussion on significant changes in Code Case N-513-4 when compared to NRC approved Code Case N-513-3.

The licensee stated that the effects of leakage may impact the operability determination or the plant flooding analyses specified in paragraph 1(f) of Code Case N-513-4. For a leaking flaw, the licensee stated that the allowable leakage rate will be determined by dividing the critical leakage rate by a safety factor of four. The critical leakage rate is determined as the limiting leakage rate that can be tolerated and may be based on the allowable loss of inventory or the maximum leakage that can be tolerated relative to room flooding, among others. The licensee contends that applying a safety factor of four to the critical leakage rate provides quantitative measurable limits which ensure the operability of the system and early identification of issues that could erode defense-in-depth and lead to adverse consequences.

The licensee stated that Code Case N-513-4 utilizes technical evaluation approaches that are based on principles that are accepted in other code documents already acceptable to the NRC. The licensee also stated that application of this code case, in concert with safety factors on leakage limits, will maintain acceptable structural and leakage integrity while minimizing plant risk and personnel exposure by minimizing the number of plant transients that could be incurred if degradation is required to be repaired based on ASME Code, Section XI, acceptance criteria only.

3.1.6 Hardship Justification

As stated by the licensee, moderately degraded piping could require a plant shutdown within the required action statement timeframes to repair observed degradation. Plant shutdown activities result in additional plant risk that would be inappropriate when a degraded condition is demonstrated to retain adequate margin to complete the component's function. The licensee contends that use of an acceptable alternative analysis method in lieu of immediate action for a degraded condition will allow it to perform additional extent of condition examinations on the affected systems while allowing time for safe and orderly long term repair actions if necessary. Actions to remove degraded piping from service could have a detrimental overall risk impact by requiring a plant shutdown. The licensee stated that compliance with the current code requirements results in a hardship without a compensating increase in the level of quality and safety.

3.1.7 Duration of Proposed Alternative

The licensee requested use of the proposed alternative for the remainder of the current ISI interval for each unit, as stated in Section 3.1.2 above, or until such time as the NRC approves Code Case N-513-4 in RG 1.147 or other document. If a flaw is evaluated near the end of the interval, and the next refueling outage is in the subsequent interval, the proposed alternative permits the flaw to remain in service until the next refueling outage.

3.2 NRC Staff's Evaluation

The NRC staff evaluated the adequacy of the proposed alternative in maintaining the structural integrity of piping components identified in Code Case N-513-4. Code Case N-513-3, which is conditionally approved for use in RG 1.147, Revision 17, provides alternative evaluation criteria for temporary acceptance of flaws, including through-wall flaws, in moderate energy Class 2 and 3 piping. However, Code Case N-513-3 contains limitations that the licensee considers restrictive and could result in an unnecessary plant shutdown. Code Case N-513-3 is limited to straight pipe with provisions for flaws that extend for a short distance, at the pipe to fitting weld, into the fitting. Evaluation criteria for flaws in elbows, bent pipe, reducers, expanders, branch tees, and heat exchangers are not included within the scope of N-513-3; Code Case N-513-4

addresses these aforementioned limitations. Given that the previous revision of Code Case N-513-3 is conditionally approved for use in RG 1.147, Revision 17, the staff focused its review on the differences between Code Cases N-513-3 and N-513-4. The significant changes in N-513-4 include: (1) revised temporary acceptance period; (2) added flaw evaluation criteria for elbows, bent pipe, reducers/expanders, and branch tees, (3) expanded applicability to heat exchanger tubing or piping, (4) limited use to liquid systems, (5) clarified treatment of service load combinations, (6) revised treatment of flaws in austenitic pipe flux welds, (7) revised minimum wall thickness acceptance criteria to consider longitudinal stress in addition to hoop stress, and (8) revised leakage monitoring requirements. The NRC staff also evaluated the licensee's proposed limitation on the leakage rate and its hardship justification.

The NRC staff notes that many requirements specified in Code Case N-513-4 are not discussed in this safety evaluation (SE), but they should not be considered as less important. As part of the NRC-approved proposed alternative, all requirements in the code case must be followed. Any exceptions or restrictions to the code case that are approved in this SE also need to be followed.

3.2.1 Temporary Acceptance Period

Code Case N-513-3 specifies a temporary acceptance period of a maximum of 26 months. Code Case N-513-3 is accepted for use in RG 1.147, Revision 17, with the following condition, "The repair or replacement activity temporarily deferred under the provisions of this Code Case shall be performed during the next scheduled outage." Code Case N-513-4 includes wording that limits the use of the code case to the next refueling outage. The NRC staff finds that Code Case N-513-4 appropriately addresses the NRC condition on Code Case N-513-3 and, is therefore, acceptable.

3.2.2 Flaw Evaluation Criteria for Elbows, Bent Pipe, Reducers/Expanders, and Branch Tees.

Evaluation and acceptance criteria have been added to Code Case N-513-4 for flaws in elbows, bent pipe, reducers, expanders, and branch tees using a simplified approach which is based on the Second International Piping Integrity Research Group (IPIRG-2) program reported in NUREG/CR-6444 BMI-2192, "Fracture Behavior of Circumferentially Surface-Cracked Elbows," March 1996.

The flaw evaluation methodology in Code Case N-513-4 for piping elbows, bends, reducers and tees, is conducted as if the flaws in these components are in straight pipe by scaling hoop and axial stresses using ASME Code piping design code stress indices and stress intensification factors to account for the stress variations caused by the geometric differences. Equations used in the code case are consistent with the piping design by rule approach in ASME Code, Section III, NC/ND-3600. NUREG/CR-6444 shows that this approach is conservative for calculating stresses used in flaw evaluations in piping elbows and bent pipe. The code case also applies this methodology to reducers, expanders, and branch tees.

The NRC staff finds that the flaw evaluation and acceptance criteria in Code Case N-513-4 for elbows, bent pipe, reducers, expanders, and branch tees is acceptable because the flaw evaluation methods in the code case are consistent with ASME Code, Section XI, and ASME Code Section III, design by rule approach and provides a conservative approach as confirmed by comparing the failure moments predicted using this approach to the measured failure moments from the elbow tests for through-wall circumferential flaws conducted as part of the IPIRG-2 program.

3.2.3 Flaw Evaluation in Heat Exchanger Tubing or Piping

Code Case N-513-4 has been revised to include heat exchanger external tubing or piping provided that the flaw is characterized in accordance with Section 2(a) of the code case and leakage is monitored. Section 2(a) requires that the flaw geometry be characterized by volumetric inspection or physical measurement.

The NRC staff determined that the flaw evaluation criteria in Code Case N-513-4 for straight or bent piping, as appropriate, can be applied to heat exchanger external tubing or piping. The staff determined the methods for evaluating flaws in straight pipe are acceptable since they are currently allowed in Code Case N-513-3. For bent pipe, the acceptability is described in Section 3.2.2 above. Therefore, the NRC staff finds inclusion of heat exchanger external tubing or piping in the code case to be acceptable because only heat exchanger tubing flaws that are accessible for characterization and leakage monitoring may be evaluated in accordance with the code case, which provides acceptable methods for the evaluation of flaws.

3.2.4 Limit Use to Liquid Systems

Use of Code Case N-513-4 is specifically limited to liquid systems. The NRC staff finds this change acceptable since Code Case N-513-4 is not intended to apply to air or other compressible fluid systems.

3.2.5 Treatment of Service Load Combinations

Modifications in N-513-4 now make clear that all service load combinations must be considered in flaw evaluations to determine the most limiting condition, although previously implied in Code Cases N-513-3. Therefore, the NRC staff finds this change acceptable.

3.2.6 Treatment of flaws in austenitic pipe flux welds

Paragraph 3.1(b) of N-513-4 contains modifications which include a reference to ASME Code Section XI, Appendix C, C-6320, to address flaws in austenitic stainless steel pipe flux welds. The ASME Code, Section XI, Appendix C, C-6000, permits the use of elastic plastic fracture mechanics criteria in lieu of limit load criteria to analyze flaws in stainless steel pipe flux welds. Equation 1 of the code case was also revised to be consistent with ASME Code, Section XI, Appendix C, C-6320, so the equation can be used for flaws in austenitic stainless steel pipe flux welds. The NRC staff finds this acceptable because Code Case N-513-4 includes the appropriate methods for the evaluation of stainless steel pipe flux welds in accordance with ASME Code, Section XI.

3.2.7 Minimum Wall Thickness Acceptance Criteria to Consider Longitudinal Stress

Code Case N-513-4 includes revisions that require consideration of longitudinal stress in the calculation of minimum wall thickness. Previous versions of the code case only required the use of hoop stress. The NRC staff finds this acceptable because it will ensure that the more limiting of the longitudinal or hoop stress is used to determine minimum wall thickness.

3.2.8 Leakage Monitoring for Through-Wall Flaws

Code Case N-513-3 required through-wall leakage to be observed by daily walkdowns to confirm the analyzed conditions used in the evaluation remain valid. Code Case N-513-4

modifies this requirement by continuing to require that leakage be monitored daily but now allows other techniques to be used to monitor leakage such as using visual equipment or leakage detection systems to determine if leakage rates are changing. The NRC staff finds this change acceptable because the code case continues to require through-wall leaks to be monitored daily and the expanded allowable monitoring methods should have no adverse impact.

3.2.9 Leakage Rate

Code Case N-513-3, paragraph 1(d), states: "The provisions of this Case demonstrate the integrity of the item and not the consequences of leakage. It is the responsibility of the Owner to demonstrate system operability considering effects of leakage." Code Case N-513-4 modified the last sentence, now located in paragraph (f), to state: "It is the responsibility of the Owner to consider effects of leakage in demonstrating system operability and performing plant flooding analyses."

The licensee stated that the allowable leakage rate will be determined by dividing the critical leakage rate by a safety factor of four. The critical leakage rate is determined as the limiting leakage rate that can be tolerated and may be based on the allowable loss of inventory or the maximum leakage that can be tolerated relative to room flooding, among others. The licensee contends that applying a safety factor of four to the critical leakage rate provides quantitative measurable limits, which ensure the operability of the system and early identification of issues that could erode defense-in-depth and lead to adverse consequences.

Code Cases N-513-3 and N-513-4 do not contain leakage limits for components with through-wall flaws. The NRC staff finds that the licensee's approach of applying a safety factor of four to the critical leakage rate is acceptable because it will provide sufficient time for corrective measures to be taken before significant increases in leakage erodes defense-in-depth, which could lead to adverse consequences.

3.2.10 Hardship Justification

The NRC staff finds that performing a plant shutdown to repair the subject piping would cycle the unit and increase the potential of an unnecessary transient resulting in undue hardship. Therefore, the NRC staff determined 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.

3.3 Summary

The NRC staff finds that the proposed alternative will provide reasonable assurance of the structural integrity because: (1) Code Case N-513-4 addresses the condition in RG 1.147 for N-513-3, (2) flaw evaluations in component types added to N-513-4 are based on acceptable methodologies, and (3) the method for determining the allowable leakage rate is adequate to provide early identification of a significant increase in leakage. In addition, complying with ASME Code, Section XI, requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determined that the proposed alternative provides reasonable assurance of structural integrity of the subject components and that complying with IWC-3120, IWC-3130, IWD-3120(b), and IWD-3400, of the ASME Code, Section XI, would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

Therefore, the NRC staff authorizes the use of the licensee's proposed alternative as described in its November 29, 2017, letter, to use ASME Code Case N-513-4, at Monticello and Prairie Island, Units 1 and 2, for the fifth 10-year ISI intervals identified in Section 3.1.2 of this SE. If the proposed alternative is applied to a flaw near the end of the authorized 10-year ISI interval, and the next refueling outage is in the subsequent interval, the licensee is authorized to continue to apply the proposed alternative to the flaw until the next refueling outage. Use of the ASME Code Case is authorized until such time as the ASME Code Case is published in a future version of RG 1.147 and incorporated by reference in 10 CFR 50.55a(b). At that time, if the licensee intends to continue implementing this ASME Code Case, it must follow all provisions of ASME Code Case N-513-4 with conditions as specified in RG 1.147 and limitations as specified in 10 CFR 50.55a(b)(4), (b)(5), and (b)(6), if any.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and authorized by NRC staff remain applicable, including a third-party review by the Authorized Nuclear In-service Inspector. The NRC staff notes that approval of this alternative does not imply or infer NRC approval of ASME Code Case N-513-4 for generic use.

Principal Contributor: Robert Davis, NRR

Date of issuance: October 19, 2018

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-2017-LLR-0143), DATED
OCTOBER 19, 2018

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