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

November 5, 2019

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

SUBJECT: PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2 – PROPOSED ALTERNATIVE TO THE REQUIREMENTS OF THE ASME CODE (EPID: L-2019-LLR-0055)

Dear Mr. Sharp:

By letter dated June 13, 2019, as supplemented by letter dated September 16, 2019, 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 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)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable 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 alternative method proposed by the licensee in alternative request numbers 1-RR-5-10 and 2-RR-5-10 provides an acceptable level of quality and safety for the examination frequency requirements of the reactor pressure welds and nozzle welds at PINGP, Units 1 and 2. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes 1-RR-5-10 and 2-RR-5-10 until December 20, 2034, for PINGP, Units 1 and 2.

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

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,

/RA Scott P. Wall for/

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

Docket Nos. 50-282 and 50-306

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NOS. 1-RR-5-10 AND 2-RR-5-10

REGARDING REACTOR PRESSURE VESSEL WELDS AND NOZZLE WELDS

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2

DOCKET NOS. 50-282 AND 50-306

1.0 INTRODUCTION

By letter dated June 13, 2019 (Agencywide Document Access and Management System (ADAMS) Accession No. ML19164A166), as supplemented by letter dated September 16, 2019 (ADAMS Accession No, ML19259A020), Northern States Power Company (NSPM or the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1, for Category B-A and B-D examinations for Prairie Island Nuclear Generating Plant (PINGP), Units 1 and 2, reactor pressure vessel (RPV) welds and nozzle welds.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative to extend the fifth inservice inspection (ISI) interval at PINGP, Units 1 and 2, for Category B-A and B-D examinations so that the fifth ASME Code required examination can be performed in 2033 for Unit 1 and 2034 for Unit 2 on the basis that the alternative provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

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 will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in Section XI of the ASME Code.

Regulation 10 CFR 50.55a(z) states that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate that: (1) the proposed alternatives provide 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.

Enclosure

Based on the above, and subject to the following technical evaluation, the U.S. Nuclear Regulatory Commission (NRC) staff finds that regulatory authority exists for the licensee to request the use of and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Background

The NRC staff's review of this proposed alternatives assesses the consistency of the licensee's proposal with WCAP-16168-NP-A, Revision (Revision 3), "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" (ADAMS Accession No. ML11306A084). Henceforth, WCAP-16168-NP-A, Rev. 3 will be referred to as WCAP-A. WCAP-A provides a basis for the acceptability of the proposed inspection intervals for Category B-A and B-D components at U.S. pressurized water reactors (PWRs) designed by Westinghouse, Combustion Engineering and Babcock and Wilcox (B&W) through the use of risk-informed analyses and probabilistic fracture mechanics for a pilot plant of each design. WCAP-A also contains the NRC staff's safety evaluation (SE) of the Westinghouse proposal. The SE finds the proposal acceptable for use based on consistency with the principles contained in Regulatory Guide (RG) 1.174, Rev. 1, "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." However, the SE imposes a condition that requires licensees to provide plant-specific information in six areas to demonstrate the applicability of WCAP-A to the licensee's plant. The plant-specific information required by the condition is:

(1) Licensees must provide the 95th percentile total through-wall cracking frequency ($TWCF_{TOTAL}$) and its supporting material properties at the end of the proposed 20-year ISI interval. The 95th percentile $TWCF_{TOTAL}$ must be calculated using the methodology in NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)" (ADAMS Accession No. ML070860156), which is frequently referred as "the NRC PTS Risk Study." The RT_{MAX-X} and the shift in the Charpy transition temperature produced by irradiation defined at the 30 ft-lb energy level, ΔT_{30}, must be calculated using the latest revision of RG 1.99 or other NRC-approved methodology.

(2) Licensees must report whether the frequency of the limiting design basis transients during prior plant operation are less than the frequency of the design basis transients identified in the PWR Owners Group (PWROG) fatigue analysis as significant contributors to fatigue crack growth.

(3) Licensees must report the results of prior ISI of RPV welds and the proposed schedule for the next 20-year ISI interval. Each licensee shall identify the years in which future inspections will be performed, and the dates provided must be within plus or minus one refueling cycle of the dates identified in the implementation plan provided to the NRC in PWROG letter OG-10-238 (ADAMS Accession No. ML11153A033).

(4) Licensees with B&W plants must (a) verify that the fatigue crack growth of 12 heat-up/cool-down transients per year that was used in the PWROG fatigue analysis bounds the fatigue crack growth for all of its design basis transients and (b) identify the design bases transients that contribute to significant fatigue crack growth.

(5) Licensees with RPVs having forgings that are susceptible to underclad cracking and with $RT_{MAX\text{-}FO}$ values exceeding 240 °F must submit a plant-specific evaluation because the analyses performed in the WCAP-A are not applicable.

(6) Licensees seeking second or additional interval extensions shall provide the information and analyses requested in Section (e) of 10 CFR 50.61a, "Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events."

3.2 ASME Code Component Affected

The affected components are the subject plant RPV welds and full penetration nozzle welds. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI, are listed in alternative requests 1-RR-5-10 and 2-RR-5-10:

Exam Category	Item Number	Description
B-A	B1.11	Circumferential Shell Welds
B-A	B1.21	Circumferential Head Welds
B-A	B1.30	Shell-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Section

3.3 Applicable Code Edition and Addenda

For the fifth 10-year ISI interval at PINGP, Units 1 and 2, the Code of record for the inspection of ASME Code Class 1, 2, and 3 components is the 2007 Edition through 2008 Addenda of the ASME Code, Section XI.

3.4 Applicable Code Requirements

ASME Code, Section XI, Paragraph IWB-2411, "Inspection Program," requires volumetric examination of essentially 100 percent of the RPV pressure-retaining welds identified in Table IWB-2500-1, once each 10-year interval.

3.5 Licensee's Proposed Alternative

In alternative requests 1-RR-5-10 and 2-RR-5-10, the licensee proposed to perform ASME Code required volumetric examination for Category B-A and B-D examination items for the fifth ISI interval at PINGP, Units 1 and 2, during the extended fifth 20-year ISI interval in 2033 for PINGP, Unit 1, and 2034 for PINGP, Unit 2. The licensee stated that the proposed inspection dates for the two units is consistent with the schedule proposed in the PWROG letter OG-10-238.

3.6 Licensee's Basis for Alternative

The licensee stated that the alternative is based on a negligible change in risk, satisfying the risk criteria specified in RG 1.174. The licensee further states that the methodology used to conduct this analysis is based on the study defined in WCAP-A. This study focuses on risk assessments of materials within the beltline region of the RPV wall. Appendix A of the WCAP-A identifies the parameters to be compared between an applicant's plant and the appropriate pilot plant. These items include:

- Dominant PTS Transients in the NRC PTS Risk Study,
- TWCF,
- Frequency and Severity of Design Basis Transients, and
- Cladding Layers (single/multiple).

Tables 1a and 1b of alternative requests 1-RR-5-10 and 2-RR-5-10 provides the above parameters for PINGP, Units 1 and 2, and the Westinghouse pilot plant. Based on this information, the licensee concludes that the parameters for PINGP, Units 1 and 2, are bounded by the results of the Westinghouse pilot plant and implies that PINGP, Units 1 and 2, are qualified for the ISI interval extension.

For the most important parameter, TWCF, the licensee's calculated value is 7.86E-14 events per year for PINGP, Unit 1, and 2.82E-14 for PINGP, Unit 2, as compared to the WCAP-A TWCF of 1.76E-08 events per year for the Westinghouse pilot plant. The details of the TWCF calculation are presented in Tables 3a and 3b of the alternative requests.

Tables 2a and 2b of alternative requests 1-RR-5-10 and 2-RR-5-10 contain inspection results for PINGP, Units 1 and 2, showing that RPV examinations have been performed with satisfactory results.

3.7 Duration of Alternative

The licensee stated that the request is applicable to the PINGP, Units 1 and 2, ISI program for the fifth and sixth 10-year ISI intervals.

3.8 NRC Staff Evaluation

Since the WCAP-A methodology has already been accepted by the NRC staff, the current evaluation focused on the manner in which the licensee addresses the four critical parameters in Table A-1 of WCAP-A, Appendix A, and the six plant-specific information items specified in the NRC SE enclosed in WCAP-A (reproduced in Section 3.1 of this SE).

The NRC staff reviewed the licensee's evaluation of the four critical parameters in Section 5 of alternative requests 1-RR-5-10 and 2-RR-5-10. Regarding the PTS transients, the licensee identified the NRC letter report, "Generalization of Plant-Specific Pressurized Thermal Shock (PTS) Risk Results to Additional Plants" (ADAMS Accession No. ML042880482), as its plant-specific basis. This is acceptable because the SE in WCAP-A concludes that based on this letter report the PTS transient characteristics are generally applicable for plants from the same reactor vendor. Regarding the cladding layers, the licensee reports "single layer" for both PINGP units. This is also acceptable because it is consistent with the Westinghouse pilot plant.

The remaining two critical parameters are among the six plant-specific information items discussed below.

3.8.1 Plant-Specific Information Item (1)

Plant-specific information item 1 addresses TWCFs. Tables 3a and 3b of the submittal pertain to this item. As contained in the guidance provided in Appendix A in WCAP-A, Tables 3a and 3b, of the submittal contain a summary of the input parameters for all PINGP, Units 1 and 2, RPV materials and the resulting TWCFs for the controlling materials, respectively. The alternative proposed that the negligible changes in risk contained in Tables 3a and 3b demonstrate that PINGP, Units 1 and 2, are bounded by WCAP-A and are, therefore, acceptable. Specifically, Tables 3a and 3b of alternative requests 1-RR-5-10 and 2-RR-5-10 provide input chemistry data, unirradiated nil-ductility transition reference temperature (RT_{NDT}), neutron fluence values for all RPV materials, and output shifts and TWCFs for controlling RPV materials of each unit.

The NRC staff compared Tables 3a and 3b information with that in the license renewal application (LRA) for PINGP, Units 1 and 2, because these LRA values were accepted in NUREG-1960, "Safety Evaluation Report Related to the License Renewal of Prairie Island Nuclear Generating Plant Units 1 and 2," August 2011 (ADAMS Accession No. ML11235A622), and are considered as the current licensing basis values for 54 effective full power years (EFPYs). The NRC staff found that the fluence values in Tables 3a and 3b are 12.5 percent higher than the LRA values, but the chemistry contents and the initial RT_{NDT} values are identical to the LRA values. The NRC staff further found that identifying the source of the fluence update is unnecessary because the fluence change is moderate (< 12.5 percent) and the LRA shows very little embrittlement for the PINGP RPVs (RT_{PTS} is less half of the PTS screening criteria). The NRC staff finds that lightly embrittled RPVs will have very low TWCF values, and a fluence change much greater than 12.5 percent will not increase the TWCF values sufficiently to affect the final conclusion.

The part of Tables 3a and 3b titled "Outputs" shows that the calculated total TWCF is 7.86E-14 events per year for Unit 1 and 2.82E-14 for Unit 2. The TWCF values were obtained by the licensee using the WCAP-A methodology with inputs from the part of Tables 3a and 3b titled "Inputs." Tables 3a and 3b used RG 1.99, Revision 2, Position 1.1 (without surveillance data), or Position 2.1 (with surveillance data), to calculate RT_{MAX} (ΔT_{30} + unirradiated RT_{NDT} + 460 °F) for 54 EFPYs for all RPV beltline materials for PINGP, Units 1 and 2. Using Tables 3a and 3b input values, the NRC staff has verified the licensee's calculated ΔT_{30} values, RT_{MAX} values, and the resulting TWCFs for PINGP, Units 1 and 2 with one exception. The ΔT_{30} value for the RPV material in Region V for Unit 1 should be 115.88 °F, not 102.88 °F. The NRC staff found that the licensee added an initial RT_{NDT} of -13 °F to the ΔT_{30} value and reported the sum as ΔT_{30} value. However, since the RT_{MAX} calculation used the correct ΔT_{30} value (i.e., 115.88 °F) for this Region V material, the resulting TWCF is valid. In summary, the NRC staff determined that the TWCFs can support alternative requests 1-RR-5-10 and 2-RR-5-10 because they are several orders of magnitude lower than the value of 1.76E-08 for the Westinghouse pilot plant in the WCAP-A. Hence, the NRC staff concludes that the licensee has addressed Plant-Specific Information Item (1) satisfactorily and that the embrittlement of the PINGP RPVs is within the envelope used in the Westinghouse pilot plant analysis and determined by the NRC to be acceptable in its review of WCAP-A.

3.8.2 Plant-Specific Information Item (2)

The NRC staff then reviewed Plant-Specific Information Item (2) regarding the frequency of the limiting design basis transients. Tables 1a and 1b state that the heatup/cooldown cycles per year for PINGP, Units 1 and 2, are bounded by the heatup/cooldown cycles (7 per year) for the Westinghouse pilot plant. The NRC staff examined the heatup/cooldown design cycles for 60 years of operation in Table 4.1-8 of PINGP Updated Final Safety Analysis Report (ADAMS Accession No. ML18155A448), and verified the above Tables 1a and 1b statement. Therefore, the NRC staff found that the licensee has addressed Plant-Specific Information Item (2) satisfactorily.

3.8.3 Plant-Specific Information Item (3)

The NRC staff reviewed Plant-Specific Information Item (3) regarding the results of prior ISI of RPV welds and the proposed schedule for the extended ISI interval. Tables 2a and 2b in the submittal contain additional information pertaining to previous RPV inspections and the schedule for the future inspection. Specifically, Tables 2a and 2b indicated that four 10-year ISIs have been performed for PINGP, Units 1 and 2. There were indications identified in welds and forgings in the RPV beltline region for both units during the last ISI. Some were accepted because they meet the acceptance criterion in Table IWB-3510-1 of Section XI of the ASME Code. The remaining indications are within the inner $1/10^{th}$ or one inch of the vessel thickness and need further evaluation. Tables 2a and 2b show that the number of flaws depthwise for welds and forgings are within the limits of the scaled maximum number of flaws depthwise based on the 50.61a Table. Further, the response to the NRC's request for additional information clarified how the maximum number of flaws depthwise were scaled from the 50.61a Table, using plant-specific weld length and forging area. Therefore, the NRC staff determined that the licensee has addressed the first part of Plant-Specific Information Item (3) satisfactorily.

The request proposed to conduct the next RPV inspection in 2033 for Unit 1, and 2034 for Unit 2, before the ending date of the extended fifth 20-year ISI interval of December 20, 2034. Further, the NRC staff found that this date is consistent with the RPV inspection proposed in the PWROG letter OG-10-238. Therefore, the NRC staff determines that the licensee has addressed the second part of Plant-Specific Information Item (3) satisfactorily.

3.8.4 Plant-Specific Information Items (4), (5), and (6)

The request did not address Plant-Specific Information Items (4), (5), and (6). The NRC staff examined the specifics in each of these three Plant-Specific Information Items and confirmed that these information requirements are not applicable to PINGP, Units 1 and 2.

3.8.5 Clarification on Duration of Alternative

The licensee stated that the request is applicable to the PINGP Unit 1 and Unit 2 ISI program for the fifth and sixth 10-year ISI intervals. The NRC staff clarifies that once the extension of the fifth ISI interval to 20 years is granted, the ending date of the duration of alternative would be December 20, 2034. Since this date is the same as the ending date for the sixth 10-year ISI interval, the licensee's statement regarding the duration of alternative is correct.

3.8.6 Summary

The NRC staff has reviewed the licensee's submittal and determined that it has satisfied all Plant-Specific Information Items specified in the SE for WCAP-16168-NP-A, Revision 3. For the risk-informed parameter, $TWCF_{95\text{-}TOTAL}$, the NRC staff performed independent calculations to verify the input data and output results in Tables 3a and 3b of the submittal. The difference between the licensee's and staff's calculated $TWCF_{95\text{-}TOTAL}$ is insignificant. With the above information, the NRC staff determined that the proposed alternative is based on the WCAP-A methodology and the $TWCF_{95\text{-}TOTAL}$ values in Tables 3a and 3b of the submittal are bounded by the corresponding pilot plant parameter in the WCAP-A. Consequently, the licensee has demonstrated that the proposed alternative meets the guidance provided by RG 1.174, Revision 1, for risk-informed decisions and, therefore, will provide an acceptable level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the licensee has demonstrated that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of alternative requests 1-RR-5-10 and 2-RR-5-10 at PINGP, Units 1 and 2, for the extended fifth ISI interval for ASME Categories B-A and B-D items until December 20, 2034.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: S. Sheng, NRR

Date of issuance: November 5, 2019

SUBJECT: PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2 - RELIEF FROM THE REQUIREMENTS OF THE ASME CODE (EPID: L-2019-LLR-0055) DATED NOVEMBER 5, 2019

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