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U S Nuclear Regulatory Commission
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Prairie Island Nuclear Generating Plant Units 1 and 2
Dockets 50-282 and 50-306
License Nos. DPR-42 and DPR-60

Responses to NRC Requests for Additional Information Dated November 20, 2008 Regarding Application for Renewed Operating Licenses

By letter dated April 11, 2008, Northern States Power Company, a Minnesota Corporation, (NSPM) submitted an Application for Renewed Operating Licenses (LRA) for the Prairie Island Nuclear Generating Plant (PINGP) Units 1 and 2. In a letter dated November 20, 2008, the NRC transmitted Requests for Additional Information (RAIs) regarding that application. This letter provides responses to those RAIs.

Enclosure 1 provides the text of each RAI followed by the NSPM response.

If there are any questions or if additional information is needed, please contact Mr. Eugene Eckholt, License Renewal Project Manager.

Summary of Commitments

This letter contains no new commitments or changes to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on December 11, 2008.

Michael D. Wadley

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Enclosure (1)

cc:

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License Renewal Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC
Prairie Island Indian Community ATTN: Phil Mahowald
Minnesota Department of Commerce

Enclosure 1
NSPM Responses to NRC Requests for Additional Information
Dated November 20, 2008

RAI 4.7.1-1

Discuss the inspection history and results of the piping that has been approved for leak-before-break (LBB) at Prairie Island Units 1 and 2. Discuss the future inspection plans.

NSPM Response to RAI 4.7.1-1

The PINGP piping that has been approved for leak-before-break (LBB) includes the Unit 1 and Unit 2 primary loop (large-bore) piping and the Unit 1 pressurizer surge line. The associated piping and nozzle welds have been periodically examined in accordance with the requirements of ASME Section XI. A review of the past examination history dating back to the beginning of the third inservice inspection interval, which began December 17, 1993 for Unit 1 and December 21, 1994 for Unit 2, indicates that the piping was examined using surface and volumetric inspection techniques. A review of the surface examination results found that some minor surface indications (e.g., small rounded and linear indications) were identified. These indications were evaluated and dispositioned per the requirements of ASME Section XI. Some indications were removed (e.g., by light buffing), while others were found acceptable per Code, and left in place. A review of the volumetric examination results found that some geometric indications were identified but no volumetric indications required corrective action or repair/replacement.

This piping is currently subject to examination in accordance with ASME Section XI, 1998 Edition, including the 1998, 1999 and 2000 Addenda, and the approved Risk Informed Inservice Inspection (RI-ISI) Program. These examinations will continue until the end of the current (fourth) inspection interval. Under the current program, the associated piping and nozzle welds are volumetrically examined. Following completion of the current inspection interval, the PINGP ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program will be updated as required by 10 CFR 50.55a, and examinations will be conducted accordingly. In addition, future examinations of the cast austenitic stainless steel piping in the Unit 1 and 2 reactor coolant loops may also include enhanced volumetric examinations or component-specific flaw tolerance evaluations as deemed appropriate per the new Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program.

RAI 4.7.1-2

In Section 4.7.1, second paragraph, the applicant stated that primary coolant piping is made of cast austenitic stainless steel (CASS). In the fourth paragraph, the applicant stated that CASS is used in the pipe fittings. (a) Confirm that pipe fittings and straight sections of the primary coolant piping at Units 1 and 2 are all made of CASS. (b) Discuss the material used in fabricating the surge lines at Units 1 and 2.

NSPM Response to RAI 4.7.1-2

(a) The Unit 1 large bore primary coolant piping fittings (elbows) are fabricated from cast austenitic stainless steel (CASS) (i.e., ASTM A351). The Unit 1 large bore primary coolant piping straight sections are made from forgings (i.e., ASTM A376). All Unit 2 large bore primary coolant piping fittings and straight sections are fabricated from CASS (i.e., ASTM A351).

(b) The Unit 1 pressurizer surge line piping fittings and straight sections are fabricated from forged product forms (i.e.; ASTM A376, A403). The Unit 2 pressurizer surge line piping fittings and straight sections are fabricated from forged product forms (i.e.; ASTM A376, A403).

RAI 4.7.1-3

The applicant submitted LBB analyses for the Unit 1 pressurizer surge line. Confirm that LBB has not been implemented and LBB analyses have not been submitted to the NRC for the Unit 2 pressurizer surge line.

NSPM Response to RAI 4.7.1-3

Leak-Before-Break (LBB) technology has not been implemented and LBB analyses have not been submitted to the NRC for the PINGP Unit 2 pressurizer surge line.

RAI 4.7.1-4

Nickel-based Alloy 600/82/182 material in the pressurized water reactor environment has been shown to be susceptible to primary water stress corrosion cracking (PWSCC). (a) Identify any piping that has been approved for LBB for both units which contain Alloy 82/182 weld metal and Alloy 600 components. (b) If LBB piping contains Alloy 600/82/182 material, discuss any mitigation measures (such as weld overlays or mechanical stress improvement) that have been or will be implemented to reduce the effects of PWSCC on the LBB piping components. (c) Discuss the inspection history and future inspection frequency of the Alloy 81/182 dissimilar metal butt welds (see Question number 1 above).

NSPM Response to RAI 4.7.1-4

(a) PINGP has no piping that has been approved for Leak-Before-Break (LBB) which contains Alloy 82/182 weld metal or Alloy 600 components. Note that the Unit 2 pressurizer surge nozzle-to-safe end dissimilar metal weld is constructed of Alloy 82; however, this piping has not been approved for LBB.

(b) As previously stated, the LBB piping at PINGP does not contain any Alloy 600/82/182 material. However, to mitigate the effects of primary water stress corrosion cracking (PWSCC) on the Unit 2 pressurizer surge nozzle weld, a full structural weld overlay (FSWOL) on the pressurizer surge nozzle-to-safe end dissimilar metal and safe end-to-reducer stainless steel butt welds was recently installed during the PINGP Unit 2 refueling outage (2R25). The NRC authorized the installation of the FSWOL in a letter dated June 15, 2008 [ML081360646].

(c) The only Alloy 82/182 dissimilar metal butt weld in the pressurized water reactor environment at PINGP is the Unit 2 pressurizer surge nozzle-to-safe end dissimilar metal weld. This weld is located on the Unit 2 pressurizer surge line; this piping has not been approved for Leak-Before-Break (LBB).

The PINGP Unit 2 pressurizer surge nozzle-to-safe end weld was ultrasonically examined in November 2006 per ASME Section XI, Appendix VIII, Supplement 10. The examination met the ASME Section XI and EPRI MRP-139, "Primary System Piping Butt Weld Inspection and Evaluation Guidelines" requirements for examination coverage. No PWSCC indications were detected.

Ultrasonic examinations of the Unit 2 surge nozzle-to-safe end dissimilar metal weld were conducted in September 2008, prior to installation of the full structural weld overlay (FSWOL). The examinations were performed in accordance with ASME Section XI, Appendix VIII, Supplement 10. No recordable indications were identified.

In October 2008, following installation of the FSWOL, ultrasonic examinations (UT) were performed of the new overlay weld and the nozzle-to-safe end dissimilar metal weld. 100 percent of the Code required volume was achieved during the examinations. The UT examinations resulted in no recordable indications.

In a letter dated January 15, 2008 [ML081510906], NSPM proposed alternative requirements to ASME Section XI to provide for the installation and examination of the FSWOL in Alternative Request No. 2-RR-4-8, Revision 1. The NRC staff authorized the use of Alternative Request 2-RR-4-8, Revision 1, in a letter dated June 15, 2008 [ML081360646]. Enclosure 2, Table 2 of Alternative Request 2-RR-4-8, Revision 1, requires inservice examinations to be conducted ultrasonically with the examination volume defined in ASME Section XI, Nonmandatory Appendix Q, Figure Q-4300-1. Inservice examinations as described in Q-4300 will be performed in accordance with the requirements of MRP-139, with the additional requirement of at least one ultrasonic examination within ten years of the FSWOL application. Additionally, by letter dated May 7, 2008 [ML081280890], NSPM agreed that if indications were found in the pre-application ultrasonic examination, the first inservice examination will be performed during the first or second outage following FSWOL application. The MRP-139 guidance for ISI goes beyond current ASME Code inspection requirements for PINGP Unit 2. The NRC found that the inservice examination requirements in the May 7, 2008 letter, and Enclosure 2, Table 2 of Alternative Request 2-RR-4-8, Revision 1, were consistent with, or more conservative than, the ASME Code, Section XI, Appendix Q.

RAI 4.7.1-5

The applicant discusses Aging Management Program (AMP) B.2.1.41, *Thermal Aging Embrittlement Of Cast Austenitic Stainless Steel (CASS)*, in Appendix B of the license renewal application. However, Section 4.7.1 does not mention this AMP for managing the LBB piping that is made of CASS. Discuss how CASS material of the LBB piping will be managed because AMP B.2.1.41 does not seem to be used to monitor the CASS components in the LBB piping systems for thermal aging embrittlement.

NSPM Response to RAI 4.7.1-5

As specified in PINGP LRA Table 3.1.2-2 (Page 3.1-60), the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program manages reduction of fracture toughness due to thermal aging embrittlement of CASS piping and fittings in the Reactor Coolant System (RCS). This is consistent with NUREG-1801, Line Item IV.C2-4. The Unit 1 and 2 RCS piping and fittings constructed of ASTM A351-CF8M material are included in the scope of AMP B2.1.39, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program.

RAI 4.7.1-6

By letter dated May 19, 2000, the NRC forwarded to the Nuclear Energy Institute an evaluation of thermal aging embrittlement of CASS components [ML003717179]. In the NRC's evaluation, the staff provided its positions on how to manage CASS components. Discuss how the CASS components in the LBB piping at both units satisfy the staff positions in its evaluation dated May 19, 2000.

NSPM Response to RAI 4.7.1-6

The letter dated May 19, 2000, "License Renewal Issue No. 98-0030, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components," provided the NRC staff's evaluation and proposed resolution of the subject issue. As presented in the letter, the staff provided its position for management, during the license renewal period, of thermal aging embrittlement in primary system components constructed of cast austenitic stainless steel (CASS). This position has since been incorporated as an aging management program described in NUREG-1801, Chapter XI, Program XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS). The program includes (a) determination of the susceptibility of CASS components to thermal aging embrittlement and (b) for potentially susceptible components, aging management is accomplished through either enhanced volumetric examination or plant- or component-specific flaw tolerance evaluation.

As shown in LRA Table 3.1.2-2, PINGP relies on the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program to manage the reduction of fracture toughness in CASS Reactor Coolant (RC) System piping and fittings. As described in LRA Section B2.1.39, the PINGP Thermal Aging Embrittlement of CASS Program is a new program that will be consistent with the recommendations of NUREG-1801, Chapter XI, Program XI.M12, Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS).

The PINGP Thermal Aging Embrittlement of CASS Program scope includes the following CASS piping components which have been approved for Leak-Before-Break (LBB):

- Unit 1 large bore primary coolant piping fittings (elbows) which are constructed of statically cast ASTM A351, Type CF8M material.
- Unit 2 large bore primary coolant piping (straight sections) which is constructed of centrifugally cast ASTM A351, Type CF8M material.
- Unit 2 large bore primary coolant piping fittings (elbows) which are constructed of statically cast ASTM A351, Type CF8M material.

The PINGP Thermal Aging Embrittlement of CASS Program includes a determination of the susceptibility of CASS components to thermal aging embrittlement based on casting method, molybdenum content, and percent ferrite. After applying the screening criteria specified in the May 19, 2000 letter, Section 3.0 and NUREG-1801, XI.M12, Element 1, the following CASS components, in the scope of the program, were determined to be potentially susceptible to thermal aging embrittlement:

- A segment of straight RC System piping is potentially susceptible to thermal aging embrittlement due to its high molybdenum content and ferrite content which exceeds 20% by weight:
    - Unit 2 RC System 27.5" I.D. cold leg piping in Loop A, Heat Number C-1737
- The following RC System fittings are potentially susceptible to thermal aging embrittlement due to their high molybdenum content and ferrite content which exceeds 14% by weight:
    - Unit 1 RC System 27.5" ID x 35D Elbow, Heat No. 33676
    - Unit 1 RC System 31.0" ID x 90D Elbow w/ Splitter, Heat No. 13704
    - Unit 1 RC System 31.0" ID x 90D Elbow w/ Splitter, Heat No. 19114
    - Unit 2 RC System 27.5" ID x 35D Elbow, Heat No. 37758-2
    - Unit 2 RC System 31.0" ID x 40D Elbow, Heat No. 38992-3
    - Unit 2 RC System 31.0" ID x 90D Elbow, Heat No. 39231-2

For the CASS components determined to be potentially susceptible to thermal aging embrittlement, in accordance with criteria specified in the May 19, 2000 letter, Section 3.0, and in NUREG-1801, XI.M12, Elements 3 and 4, the program will provide enhanced volumetric examinations to detect and size cracks, or component-specific flaw tolerance evaluations will be performed. The program will provide enhanced volumetric examinations on the base metal determined to be limiting due to applied stress, operating time, and environmental considerations, using examination methods that meet the criteria of ASME Section XI, Appendix VIII. Alternatively, component-specific flaw tolerance evaluations will be performed using specific geometry and applied stress to demonstrate that the thermally-embrittled material has adequate toughness.

Per NUREG-1801, XI.M12, Element 5, the PINGP Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) Program will incorporate the inspection schedule of IWB-2400 or IWC-2400 for potentially susceptible CASS components using ASME examination methods for the detection of cracking. Alternatively, component-specific flaw tolerance evaluations will be performed. Consistent with the criteria specified in the May 19, 2000 letter, Section 3.0, and in NUREG-1801, XI.M12, Element 6, flaws detected in CASS components will be evaluated in accordance with the applicable procedures of IWB-3500 or IWC-3500 in Section XI of the ASME Code. Alternatively, flaw tolerance evaluation for components with ferrite content up to 25% will be performed according to the principles associated with IWB-3640 procedures for submerged arc welds disregarding the Code restriction of 20% ferrite in IWB-3641(b)(1). PINGP does not have RC System CASS piping with >25% ferrite. Per NUREG-1801, XI.M12, Element 7, repair and replacement of CASS components will be performed in accordance with the requirements of ASME Section XI, Subsection IWA-4000.

RAI 4.7.1-7

Explain whether the current fatigue crack growth analyses, as discussed in the fatigue crack growth section, are performed for 60 years. If not, discuss whether the current fatigue crack growth analyses, which are analyzed for 40 years, are applicable to 60 years. Provide the technical basis in detail.

NSPM Response to RAI 4.7.1-7

<u>Large Primary Loop Pipe Rupture for PINGP Units 1 and 2</u>

As reported in Section 6.0 of WCAP-10640-NP/WCAP-10639-P (for Unit 1) and WCAP-10928-NP/WCAP-10929-P (for Unit 2), the purpose of the fatigue crack growth analyses was to determine the sensitivity of the primary coolant system to the presence of small cracks. For the Unit 1 and Unit 2 large primary loop piping, a finite element stress analysis was completed for one of the highest-stressed cross sections of a plant typical in geometry and operational characteristics to any Westinghouse PWR system. Crack growths calculated in the selected region are representative of the entire primary loop. All normal, upset, and test conditions were considered, and circumferentially oriented surface flaws were postulated in the region, assuming the flaw was located in three different locations. Fatigue crack growth rate laws were used. The results of fatigue crack growth at 40 years for semi-elliptical surface flaws of circumferential orientation and various depths show that crack growth is very small at all three locations.

The TLAAs associated with the fatigue crack growth analyses are the normal, upset, and test conditions (i.e., NSSS design transients) that were used to calculate fatigue crack growth at 40 years. These design transients have not been changed or increased for license renewal as discussed in Section 4.3 of the PINGP LRA. The existing numbers of thermal and loading cycles for each transient remain valid for 60 years of plant operation. Therefore, the fatigue crack growth calculations reported in WCAP-10640-NP/WCAP-10639-P (Unit 1) and WCAP-10928-NP/WCAP-10929-P (Unit 2) remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Pressurizer Surge Line Rupture for PINGP Unit 1

As reported in Section 6.0 of WCAP-12876-NP/WCAP-12877-P, the purpose of the fatigue crack growth analyses for the PINGP Unit 1 pressurizer surge line was to determine the sensitivity of the pressurizer surge line to the presence of small cracks when subjected to the transients discussed in WCAP-12839, "Structural Evaluation of Prairie Island Unit 1 Pressurizer Surge Line, Considering the Effects of Thermal Stratification."

For the Unit 1 pressurizer surge line, fatigue crack growth analyses were performed at two locations where detailed fracture mechanics evaluations were completed: (1) surge line piping near the reactor coolant hot leg nozzle, and (2) surge line piping near the pressurizer surge nozzle. Various initial semi-elliptical surface flaws with a six-to-one aspect ratio were assumed to exist. The largest initial flaw assumed was one with a depth equal to 10% of the nominal wall thickness. A fatigue crack growth law for austenitic stainless steel in a PWR environment was developed and used in the crack growth analyses. The results of fatigue crack growth at 40 years for an initial flaw of 10% nominal wall thickness show that crack growth is very small at both locations.

The TLAAs associated with the fatigue crack growth analyses are the normal, upset, and test conditions (i.e., NSSS design transients) and pressurizer surge line transient sub-events (to reflect stratification effects) presented in WCAP-12839 that were used to calculate fatigue crack growth at 40 years. The NSSS design transients and pressurizer surge line sub-events have not been changed or increased for license renewal as discussed in Section 4.3 of the PINGP LRA. The existing numbers of thermal and loading cycles for each transient remain valid for 60 years of plant operation. Therefore, the fatigue crack growth calculations reported in WCAP-12876-NP/WCAP-12877-P remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

For additional technical details associated with the PINGP Leak-Before-Break Analyses, please refer to the proprietary Westinghouse WCAP reports (i.e., those designated with "-P" suffix above), which have been previously submitted to the NRC. See PINGP LRA, "Section 4.0 References," References 15, 17, and 19 on Page 4.7-8.

RAI 4.7.1-8

Discuss whether the Unit 1 pressurizer surge line has experienced temperature transients in which temperature differences exceeded the design transients used in the LBB analyses. If out-of-limit transients occurred, describe how the LBB analyses for the Unit 1 surge line were re-evaluated to determine their acceptability.

NSPM Response to RAI 4.7.1-8

In accordance with Section 1.1 of WCAP-12876-NP/WCAP-12877-P, the results of the pressurizer surge line thermal stratification evaluation described in WCAP-12839 were used in the leak-before-break (LBB) analyses of the Unit 1 pressurizer surge line. PINGP monitors thermal stratification in the pressurizer surge line by tracking the maximum temperature differential between the pressurizer water and the Reactor Coolant System (Loop B) hot leg during heatups and cooldowns to ensure compliance with the thermal stratification transients defined in WCAP-12839. There have been no instances in which temperature differences between the pressurizer and RCS have exceeded the design transients defined in WCAP-12839. In addition, the numbers of heatup and cooldown cycles experienced by the surge line are within the cycle limits specified in the analysis. Therefore, there have been no instances where the Unit 1 pressurizer surge line has experienced temperature transients that have exceeded the design transients used in the LBB analyses.

RAI 2.5

In the license renewal application, the applicant described the station blackout recovery paths for license renewal. As the licensee did not specifically exclude the associated control circuits and structures for the switchyard circuit breakers, it is assumed that these components are included in the scope of license renewal. In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 54.4(a)(3) and License Renewal Sections 2.1.3.1.3 and 2.5.2.1.1 of the Standard Review Plan, the control circuits and structures associated with the circuit breaker should be in the scope of license renewal. Please confirm that these components are within the scope of license renewal.

NSPM Response to RAI 2.5

The station blackout recovery paths for license renewal purposes are described in the PINGP LRA. The control circuits and structures associated with the station blackout recovery path switchyard circuit breakers are in the scope of license renewal.