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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

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

Supplement to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology – Response to Requests for Clarification (TAC Nos. ME2976 and ME2977)

References:

1. Letter from M. A. Schimmel, Northern States Power Company, a Minnesota corporation (NSPM), to Document Control Desk (Nuclear Regulatory Commission, NRC), License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology, L-PI-09-134, dated December 22, 2009, ADAMS Accession Number ML100200129.

2. Letter from M. A. Schimmel (NSPM) to Document Control Desk (NRC), Supplement to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology – Response to Request for Additional Information (TAC Nos. ME2976 and ME2977), L-PI-11-006, dated January 14, 2011, ADAMS Accession Number ML110140367.

In Reference 1, Northern States Power Company, a Minnesota corporation (NSPM), doing business as Xcel Energy, submitted a License Amendment Request (LAR) to apply leak-before-break (LBB) methodology to certain piping systems at the Prairie Island Nuclear Generating Plant (PINGP). As part of the review effort for this LAR, NSPM submitted additional information regarding PINGP Reactor Coolant System (RCS) leak detection capabilities in Reference 2.

In e-mails dated January 18 and 28, 2011, and based on an informal discussion on January 26, 2011, the NRC staff requested clarification of the information provided in Reference 2. The enclosure to this letter provides the requested clarification of PINGP RCS leakage detection capabilities. NSPM submits this supplement in accordance with 10 CFR 50.90.

The supplemental information provided in this letter does not impact the conclusions of the Determination of No Significant Hazards Consideration or Environmental Assessment presented in the Reference 1 submittal.

In accordance with 10 CFR 50.91, NSPM is notifying the State of Minnesota of this LAR supplement by transmitting a copy of this letter to the designated State Official.

If there are any questions or if additional information is needed, please contact Sam Chesnutt at 651-267-7546.

<u>Summary of Commitments</u>

This letter contains no new commitments and no revisions to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on FEB 23 2011

Mark A. Schimmel
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company - Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, PINGP, USNRC
Resident Inspector, PINGP, USNRC
State of Minnesota

ENCLOSURE

Response to NRC Requests for Clarification Provided in E-mails dated January 18 and 28, 2011, Related to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology at the Prairie Island Nuclear Generating Plant

This enclosure includes responses from the Northern States Power Company, a Minnesota corporation (NSPM), to requests for clarification of information regarding Reactor Coolant System (RCS) leakage detection capabilities at the Prairie Island Nuclear Generating Plant (PINGP). These requests were transmitted in e-mails dated January 18 and 28, 2011 (References 6 and 7), and addressed information previously submitted January 14, 2011 (Reference 5).

The information provided in this enclosure is associated with NSPM's License Amendment Request (LAR) submitted December 22, 2009 (Reference 1) regarding the use of Leak-Before-Break (LBB) methodology. To support review of Reference 1, the Nuclear Regulatory Commission (NRC) issued an RAI regarding, in part, RCS leakage detection capabilities (Reference 2). NSPM responded to the Reference 2 RAIs regarding RCS leakage detection in Reference 3. The NRC requested additional information in Reference 4, and the NSPM response was submitted in a letter dated January 14, 2011 (Reference 5).

This Enclosure quotes each request for clarification in italics and each question is followed by the NSPM response. Referenced documents are identified at the end of this Enclosure.

NRC Clarification Question 1 (from January 18, 2011 e-mail):

In the response to question 3.A., the licensee stated: "Additional moisture will then flow to the sump. Thus, a 0.2 gpm leak will be detectable by the containment sump run time monitors despite the effects of evaporation."

Is NSPM now crediting the containment sump run time monitor for LBB? If so, what is the expected response time once a 0.2 gpm flow reaches the sump?

NSPM Response to Clarification Question 1:

No. The containment sump run time monitor was described as one of the eight diverse monitoring methods that are available to detect RCS leakage at PINGP, but it is not being credited for LBB.

NRC Clarification Question 2 (from January 18, 2011 e-mail):

In the response to question 1.A., the licensee stated: "As part of the OBN resolution effort, NSPM performed a more detailed calculation of the response time capabilities of the containment particulate monitors, 1R-11 and 2R-11. The new calculation accounted for the additional activity contributed by the daughter products of noble gas decay, which were not previously included, while continuing to assume conservatively low circulating activity levels consistent with current normal plant operations. The results of this calculation show that the R-11 monitors in both Units 1 and 2 are capable of detecting a 1 gpm leak within 1 hour."

Daughter products of noble gas decay do not typically remain airborne indefinitely, and the credit of the daughter products appears to provide greater than an order of magnitude improvement in the responsiveness of the detector. Explain how the accumulation of daughter product activity was modeled in the detector response time determination. Also, describe any benchmarking or other testing that supports the results of the response time determination.

NSPM Response to Clarification Question 2:

The accumulation of daughter product activity in the containment atmosphere is modeled as follows:

- The accumulation of the parent noble gas is modeled using equations described in ISA 67.03-1982, "Standard for Light Water Reactor Coolant Pressure Boundary Leak Detection."
- The production and depletion of daughter products is modeled to reflect their radioactive decay properties.
- The behavior of particulate daughters is modeled using removal coefficients in NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments."

<u>Noble gas accumulation</u>

The accumulation of parent noble gas in containment due to RCS leakage is calculated using equation B-27 contained in ISA 67.03-1982, Section B.3.1, "Airborne radiation monitoring coolant leakage measurement." This equation computes the concentration of the parent nuclide in containment at any time following the onset of an RCS leak, with consideration of depletion of the nuclide due to decay.

<u>Radioactive decay process</u>

The production rate of the daughter particle at any instant in time is a function of the parent activity in containment at that instant and the decay constant of the parent. The depletion rate of the daughter due to decay at any instant is a function of the daughter activity at that instant and the daughter's decay constant. The calculation of daughter activity at any time requires integration of the overall expression over the time interval of interest. This calculation was performed by direct solution of the differential equation.

Particulate behavior

Once generated in the containment atmosphere, the behavior of the particulate daughters of noble gas decay is modeled using the removal coefficients from NUREG/CR-6189. While the removal coefficients in the NUREG are developed to model the deposition processes in effect in an accident environment, it is conservative to apply these factors to normal at-power reactor containment conditions because the aerosol removal mechanisms are much stronger in a post-accident environment. The processes of agglomeration, settling, and plateout of aerosols are time-dependent and are accounted for in the time dependent removal coefficient used in the model. Prairie Island maintains the airflow through the detector tubing at very low velocities to maintain laminar conditions, as recommended in HPS/ANSI N13.1-1999 for minimizing inertial impaction losses. Therefore, plateout in the tubing is considered negligible. The filter paper has a collection efficiency of 99.99% of particles greater than 0.3 micron size, so filter pass-through is considered inconsequential.

Particulates originating from the leaking coolant are modeled with an instantaneous 99.9% plateout at the source of the leak in accordance with ISA 67.03-1982. Noble gases are not subject to plateout at the site of the leak, and the daughter products of the noble gas decay are born in the well mixed containment air before being subject to removal by the time-dependent agglomeration and settling processes.

Source term

The coolant source terms used in the calculation of the R-11 response are obtained from recent plant data. For particulate in the coolant, values were averaged from radiochemistry samples performed in early 2010. The time period represented by these samples is one of excellent fuel performance and no known leaks. Due to the 99.9% plateout factor applied, particulate in the coolant was not a significant contributor to the results. For the noble gases, which generate the decay daughters that dominate the R-11 response, the source term was generated by drawing a conservative lower bound beneath all of the radiochemistry data for power conditions. Because the noble gases are a result of fissions of tramp uranium in the fuel clad rather than being due to fuel defects, it is anticipated that the lower bound noble gas activity source term will remain valid throughout future operating conditions. Fluorine-18 (F-18), an activation product that exists in high concentrations in Pressurized Water Reactor (PWR) coolant and which is known to generate particulate activity, has not been considered in Prairie Island's calculation of the R-11 response due to the difficulty in quantitative radiochemical analysis for F-18, and this adds conservatism to the results.

Detector efficiency

The detector efficiency used in the calculation of the R-11 response is conservative. The vendor supplied calibration data for detector efficiencies for three radionuclides:

Cesium (Cs)137	2.06E+5 cpm/μCi
Technetium (Tc) 99	1.08E+5 cpm/μCi
Strontium / Yttrium (Sr/Y) 90	4.93E+5 cpm/μCi

The Sr/Y-90 source used in the calibration emits two betas, one with an average energy of 196 keV and the other with an average energy of 934 keV, while the Cs-137 and Tc-99 sources have lower energy betas. The two dominant daughter products of noble gas decay considered in the R-11 response calculation are Rubidium (Rb)-88 and Cs-138. Rb-88 has a mean beta energy of 2051 keV and Cs-138 has a mean beta energy of 1240 keV. Since the nuclides of principal interest to this calculation have much more energetic betas than the Sr/Y-90 source, it can be concluded that the detector efficiency for Rb-88 and Cs-138 should be at least as high as for Sr/Y-90. However, for conservatism, and in order to allow the use of a single efficiency to represent the response of all the radionuclides present on the filter paper, a vendor-supplied nominal detector efficiency value of 3.50E+5 cpm/μCi was applied.

Detection

The instrument sensitivity and detection time for the postulated RCS leak is based on the criteria in ISA 67.03-1982 (included in Bibliography of Regulatory Guide (RG) 1.45, Revision 1), which specifies that the change in the process variable is statistically detectable at a 99% confidence if it exceeds 2.56 standard deviations of the background count rate distribution.

Benchmarking

The calculated response time of the newly installed R-11 instrumentation has not been tested or benchmarked to actual plant leakage events because an active leak of sufficient magnitude and duration has not been experienced.

NRC Clarification Question 3 (from January 28, 2011 e-mail):

As discussed during our January 26, 2011, telephone conversation, following is a supplemental request for clarification of your January 14, 2011, RAI response concerning Prairie Island's Leak-Before-Break license amendment request:

In the Response to NRC Question 1(a), which was provided in Enclosure 1 to the letter dated January 14, 2011, the R-11 monitor was described as having the ability to detect a 1 gallon per minute (gpm) leak within 1 hour, consistent with Regulatory Guide (RG) 1.45, Revision 1, "Guidance on Monitoring and Responding to Reactor Coolant System Leakage." In addition, the response described that a new calculation showed that the R-11 monitor is capable of detecting a 0.2 gpm leak within approximately 4 hours. However, Regulatory Positions 2 and 3 of RG 1.45, Rev. 1, state that:

- *leakage detection systems should have a response time of no greater than 1 hour for a leakage rate of 1 gpm*
- *leakage detection systems should provide output and alarms in the main control room*

- *procedures to convert the instrument output to leakage rate should be available to operators*
- *plant procedures should specify operator actions in response to leakage rates less than the limits set forth in the technical specifications*

Please clarify the meaning of the term "detect" in the response to NRC Question 1(a). The Glossary provided with RG 1.45, Rev. 1, may be helpful. In addition, based on plant operating and surveillance procedures, specify the expected maximum time for operators to determine that the 0.2 gpm leak rate has been exceeded using the R-11 instrument output, the leakage rate expected to correlate with the setpoint of any alarms associated with the R-11 instrument, and the operator actions specified for unidentified leakage exceeding 0.2 gpm based on the R-11 instrument output.

NSPM Response to Clarification Question 3:

Use of the containment radiological particulate monitor R-11 to detect and initiate effective responses to RCS leakage is clarified as follows.

Meaning of "detect"
The statements in the January 14, 2011 response to RAI Question 1(a) regarding the ability of the R-11 monitor to "detect" RCS leakage are based on the detection definition in ISA 67.03-1982, as discussed in the response to Clarification Question 2 above. This standard is included in the Bibliography section of RG 1.45, Revision 1. ISA 67.03-1982 specifies that, for a particulate radiation monitor, the "minimum detectable concentration" of a radioactive particulate aerosol is that which generates a net counting rate greater than 2.56 times the standard deviation of the background counting rate, at 99% statistical confidence.

It follows that the increase in containment activity resulting from a leak is detectable once it has increased above the minimum detectable concentration of the instrument. Therefore, the response time for the R-11 instrument to detect a leak of a given size is the calculated time from the onset of the leak to the time when the containment activity results in an increase in the count rate greater than 2.56 times the standard deviation of the background count rate. Such an increase would be discernable from background with 99% statistical confidence.

Time for operators to identify a 0.2 gpm leak
Plant operators review R-11 data every hour as part of the Emergency Response Computer System (ERCS) log check, and this would be an opportunity for an elevated count rate to be observed. When the ERCS computer is not available, the ERCS Computer Out of Service Log procedure is performed which requires R-11 data to be checked every 24 hours. The Radiation Monitor Panels are channel checked for operability every six hours, and this would be another opportunity to observe elevated count rates. In addition, operators trend and average R-11 data every 24 hours.

It is important to point out that plant operators use a number of indicators to make decisions regarding RCS leakage, although the NRC's question is specific to use of R-11 instrument output. It is expected that when an elevated R-11 count rate is observed, operators would look at other indications such as containment humidity, charging pump operation (an RCS leak would cause the charging pumps running with speed control in automatic to speed up), volume control tank levels, and pressurizer levels. Increased radiation indication on the R-11 monitor is an entry condition for the Reactor Coolant Leak Abnormal Operating Procedure. This procedure describes the symptoms associated with small reactor coolant leakage, the methodology for determining the path of such leakage, and the necessary corrective action. Also, an RCS inventory balance is performed every 24 hours as previously described in the Reference 3 response to Question E2-2, and this inventory balance can be performed at any time an operator suspects unidentified leakage.

Based on the R-11 instrument detection time provided in Reference 5, and on the procedure requirements and operator practices described above, the maximum time that it would take plant operators to determine that the 0.2 gpm leak rate has been exceeded is expected to be 24 hours.

Leakage rate associated with alarms

The alarm point established for the PINGP R-11 containment particulate monitor is a high radiation monitor alarm that is part of the Emergency Action Levels in the Emergency Plan. This alarm setpoint is not correlated to any specific RCS leakage rate.

Specified Operator actions

Current procedures require a trend analysis of R-11 indications once per 24 hours, and if R-11 activity is observed to increase by at least a factor of 3 above the 24 hour average and the source cannot be determined, then a Reactor Coolant Leakage Investigation is initiated.

Operators use a number of indicators to make decisions regarding RCS leakage, although the NRC question addressed the use of R-11 instrument output. Increasing R-11 instrument output is a direct entry into the Reactor Coolant Leak Abnormal Operating Procedure as described above. The RCS leakage test surveillance procedure includes a requirement that if the unidentified leakage rate exceeds 0.2 gpm, a Reactor Coolant Leakage Investigation is initiated. If this investigation determines that leakage inside containment exceeds 0.1 gpm, specified response actions include issuing an Action Request within the PINGP Corrective Action Program, performing the Reactor Coolant Leak Abnormal Operating Procedure if necessary, considering a containment entry to identify the source of the leakage, and taking further actions as required by the Technical Specifications for unidentified leakage.

References

1. Letter from M. A. Schimmel (NSPM) to Document Control Desk (NRC), "License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology," L-PI-09-134, dated December 22, 2009, ADAMS Accession Number ML100200129.

2. Letter from T. J. Wengert (NRC) to M. A. Schimmel (NSPM), "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Request for Additional Information Related to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology (TAC Nos. ME2976 and ME2977)," dated June 10, 2010, ADAMS Accession Number ML101550668.

3. Letter from M. A. Schimmel (NSPM) to Document Control Desk (NRC), "Supplement to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology – Response to Request for Additional Information (TAC Nos. ME2976 and ME2977)," L-PI-10-094, dated October 8, 2010, ADAMS Accession Number ML102810518.

4. Letter from T. J. Wengert (NRC) to M. A. Schimmel (NSPM), "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Request for Additional Information Related to Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology (TAC Nos. ME2976 and ME2977)," dated December 14, 2010, ADAMS Accession Number ML103280398.

5. Letter from M. A. Schimmel (NSPM) to Document Control Desk (NRC), "Supplement to License Amendment Request to Exclude the Dynamic Effects Associated with Certain Postulated Pipe Ruptures From the Licensing Basis Based Upon Application of Leak-Before-Break Methodology – Response to Request for Additional Information (TAC Nos. ME2976 and ME2977)," L-PI-11-006, dated January 14, 2011, ADAMS Accession Number ML110140367.

6. E-mail from T. Wengert (NRC) to S. Chesnutt (Xcel), "Prairie Island – Request for Clarification of January 14, 2011 Response Concerning Prairie Island Leak-Before-Break LAR," January 18, 2011.

7. E-mail from T. Wengert (NRC) to S. Chesnutt (Xcel), "Prairie Island – Supplemental Request for Clarification of January 14, 2011 Response Concerning Leak-Before-Break LAR," January 28, 2011.