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SEP 24 2015

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10 CFR 50.73

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

Prairie Island Nuclear Generating Plant Unit 2
Docket 50-306
Renewed License No. DPR-60

Licensee Event Report (LER) 50-306/2015-001-01, 21 Fan Coil Unit Leak – Containment Declared Inoperable

Reference: Letter from Northern States Power Company, a Minnesota corporation (NSPM), d/b/a Xcel Energy to Document Control Desk, "Licensee Event Report (LER) 50-306/2015-001-00, 21 Fan Coil Unit Leak – Containment Declared Inoperable", dated May 4, 2015 (ADAMS Accession Number ML15125A159)

Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), encloses Licensee Event Report (LER) 50-306/2015-001-01, 21 Fan Coil Unit (FCU) Leak – Containment Declared Inoperable as a supplement to the referenced LER. This supplement revises the causal evaluation and associated corrective actions as a result of a new engineering analysis of the event that occurred on March 7, 2015.

Summary of Commitments

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

Kevin Davison
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island Nuclear Generating Plant, USNRC
Resident Inspector, Prairie Island Nuclear Generating Plant, USNRC
Department of Commerce, State of Minnesota

1717 Wakonade Drive East • Welch, Minnesota 55089-9642
Telephone: 651.388.1121

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NRR

ENCLOSURE

LICENSEE EVENT REPORT 50-306/2015-001-01

7 pages follow

NRC FORM 366 (01-2014) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 | EXPIRES: 01/31/2017

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Prairie Island Nuclear Generating Plant Unit 2	05000 - 306	1 OF 7

4. TITLE

21 Fan Coil Unit (FCU) Leak – Containment declared Inoperable

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
3	7	2015	2015	– 001 –	01	9	24	2015		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

Mode 4

10. POWER LEVEL

0%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☑ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Penny S. Oleson	651-267-1750

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE). ☑ NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

At 11:55 CST on March 7, 2015, Unit 2 was at Mode 4 when a small cooling water leak was identified on the 21 Containment Fan Coil Unit (FCU) east face U-bend on the northeast corner bottom bundle. Unit 2 Containment was declared inoperable per Technical Specifications (TS) 3.6.1, Condition A, Containment inoperable, applicable in MODES 1, 2, 3, and 4. Immediate actions were taken to isolate the FCU within 1 hour from the initial identification of the leak and Containment was declared operable at 1220 CST on March 7, 2015.

This condition is reportable under 10 CFR 50.72(b)(3)(v)(C): Any event or condition that at the time of discovery could have prevented the fulfillment of the safety function of structures or systems that are needed to control the release of radioactive material. ENS 50870 was submitted at 14:05 CST. The plant remains in a safe condition and there was no effect to the health and safety of the public. The NRC Resident Inspector was notified.

The cause has been determined to be under-deposit pitting corrosion resulting in through-wall leaks. The identified leaking faces were replaced on 03/13/2015. The remaining FCU faces subjected to under-deposit pitting corrosion are scheduled to be replaced during the next Unit 2 refueling outage Fall 2015 (2R29). Increased inspections of the FCUs will remain in effect until corrective actions have been implemented.

NARRATIVE

The Fan Coil Units (FCUs[1]) and associated Cooling Water (CL) system are expected to be leak tight inside containment. On March 7, 2015, the station identified the initial leak on the east lower face of the 21 FCU. Unit 2 Containment was declared inoperable due to a breach of the CL system inside containment (Reference AR 01469164 in the Corrective Action Program).

During subsequent inspections to validate the leak location and perform an extent of condition, additional leaks were identified on the east upper face of the 21 FCU. Once the CL system was isolated to the 21 FCU Containment, integrity was restored and the 21 FCU was declared inoperable.

On March 11, 2015, Unit 2 was in Mode 5. During an inspection of the 22 FCU, leakage was identified on the south upper face on a copper U-bend. No additional leaks were identified on the 22 FCU. Work orders were utilized to replace both the east upper and east lower 21 FCU faces along with the south upper 22 FCU face.

On March 13, 2015, a leak was reported on the 22 FCU east upper face during restoration. This was documented in the Corrective Action Program (AR 01469614 and 01469995). Subsequent pressure testing of the entire FCU face, including tube to tube sheet leak testing, did not identify any leaks. The pressure test parameters and results were entered into the Corrective Action Program (AR 01470172).

Due to prior FCU leaks, a scheduling task had been added as an interim action to increase frequency of inspections of Fan Coil Units for possible leaks (AR 01463696-01). The increased inspections for both Units started the week of April 1, 2015.

The 21 Containment FCU is considered part of the Containment boundary. There were potential nuclear, radiological, and industrial safety impacts in that this leak could have allowed a radiological release to the environment through the cooling water system in the event of a Design Basis Accident (DBA).

This event is reportable under 50.72(b)(3)(v)(C) as an event or condition that could have prevented fulfillment of a safety function of structures or systems that are needed to control the release of radioactive material.

EVENT ANALYSIS

The Containment Cooling System for each Unit consists of four FCUs located in the Reactor Containment Vessel. The FCU design has 8 faces (1 upper/1 lower per side) for a total of thirty-two faces per Unit. The FCU faces are heat exchangers that are cooled by cooling water or chilled water which cool and dehumidify air as it is pulled through the faces by the fan. The cooled air is then discharged through ductwork to either the containment dome or containment gaps.

[1] EIIS System Code - FCU

The FCUs use CL as the cooling medium which is not isolated in the event of a DBA. The FCUs (and associated CL system) are a pressure boundary for containment and are required to be operable during a DBA.

Failure Mode Analysis

The failure mode analysis for this casual evaluation was performed by Exelon Powerlabs. A report was provided that includes the evaluation methods and results of the analysis. The failure mode was determined to be under-deposit pitting corrosion.

The current Aerofin design of CFCU (Containment Fan Coil Units) faces, including those installed on the 21 CFCU, were redesigned from the previous Westinghouse faces to address an erosion issue with H-bends which caused small leaks. The design change certainly alleviated any concerns with erosion which was evident when the current Aerofin U-bends were removed from leaking faces after nearly 10 years of service and sectioned; no noticeable evidence of erosion was present. However, the Preventive Maintenance (PM) strategy to address corrosion was not a focus of the modification as there was no concern of through wall leaks on the CFCU face tubes. Corrosion within the CL piping leading to the FCUs was observed but not considered to be any worse than "normal" CL pipe corrosion within the plant and would be addressed by the Microbiologically Induced Corrosion (MIC) program.

An initial review of the CFCU PM activities by the MIC Program Owner for the past 10 years has determined that the lack of cleaning from 2005-2012 may NOT have had a significant adverse effect. However, initiating cleaning of the CFCU face tubes on a 2R frequency after performing no cleaning could have negatively impacted the passivation (protective) layer on the interior of the tubes. The passivation layer is naturally built up when the system is in service. This passivation layer was likely built up during the first 6-7 years when no cleaning was performed. Following the previous PM strategies the gaskets were replaced which exposed the internals to environmental conditions that would promote increased corrosion rate of the heat exchangers. A buildup of silt and debris was observed; therefore, cleaning of the copper tubes seemed obvious. This cleaning, after a buildup of the passivation layer and deposits, likely removed the protective layer but could not remove the deposits which had built up over the years. This also coupled with the extended "dry" layup discussed in the event timeline resulting from the SGR project may also have negatively affected the passivation layer of the CFCU face tubes.

The FCUs have two sources of cooling media, the CL system and Auxiliary & Containment Chilled water (ZX) system. The FCUs typically operate with ZX cooling from the spring to the fall timeframe. The FCUs will then switch to the CL system during the fall to spring timeframe. The CL system is treated with Sodium hypochlorite (industrial grade bleach) to control microbial activity within the system. The ZX system is treated with CL-2874, a molybdate and tolyltriazol corrosion inhibitor, to minimize corrosion within the system.

The CL system chemical treatment has recently undergone a transition to maintain a higher concentration of sodium hypochlorite. Increased monitoring has also been conducted to help determine the effectiveness of the chemical treatment. There is a negative consequence of using sodium hypochlorite in that it is known to chemically attack metal, copper in particular. However, it is generally accepted by industry experts that the

benefit of using sodium hypochlorite to control microbial activity outweighs the negative effects that it causes when used at low concentrations (less than 1 ppm Free Chlorine).

The ZX system chemical treatment has been inconsistent over the past 10 years. As mentioned previously, the ZX system is only aligned to the CFCUs during "summer operation." During these times, it has been preferred to treat ZX system with a corrosion inhibitor. The ZX system is prone to system leakage (in-leakage from CL) which complicates the chemical treatment of the system. There have been times where chemical treatment is not performed due to excessive leakage. The leakage occurs from the chilled water pump seals and the valves that connect the ZX system to the CL system. There is always a significant amount of system leakage where the chemical concentration within the ZX system steadily decreases over time. Chemical additions are made as needed to control the chemical concentration. The CL leakage is also apparent when operations tests the cross over valves for ZX and does not flush the FCUs prior to swapping back to the ZX system (very little benefit to due to the cross leakage).

SAFETY SIGNIFICANCE

The FCU is considered part of the Containment boundary and a leak could cause a breach to this boundary which could result in radioactive release from Containment into the CL system and off-site dose to the public during a DBA.

In the event of an accident, the cooling water supply and return isolation valves position to full open to satisfy their safeguards function. In the event of FCU or associated piping rupture, the containment remote manual motor operated isolation valves would be closed to prevent the entry of non-borated water into containment. Pressure against the closed isolation valves is maintained by equalizing lines. The water supply for this "seal" is provided by the cooling water system pumps (3 motor driven and 2 diesel driven) which take suction from the Mississippi River.

The Containment Air Cooling System is sized such that any three fan coil units will provide adequate heat removal capacity from the Reactor Containment during normal and full-power operation to maintain interior air temperatures below the maximum temperature allowable at any component, and to obtain temperatures below 104 degrees Fahrenheit in accessible areas during hot standby operation. The fan coil units are also used for emergency cooling under post-accident conditions.

On March 7, 2015 the CL leak was isolated within 1 hour from the initial confirmation of the leak. The leak was minimal and contained within the water box of the 21 FCU. The health and safety of the public were not affected.

Additional pressure tests were performed on both 21 and 22 FCUs to address all leaks. There is a moderate risk of having a recurrence of through wall tube leaks on the remaining 21 and 22 FCU faces affected by under-deposit pitting corrosion until the scheduled replacement during Unit 2 refueling outage in Fall 2015 (2 R29). Therefore, interim actions to address the condition include increased frequency of inspections for Unit 2 FCU leakage.

An extent of condition (EOC) analysis was performed to include both Unit 1 and Unit 2 CFCUs with the same design (90/10 copper/nickel tubes) and subject to the same conditions. This includes: 11 CNTMT

CFCU, 12 CNTMT CFCU, 13 CNTMT CFCU, 14 CNTMT CFCU, 22 CNTMT CFCU, 23 CNTMT CFCU, and 24 CNTMT CFCU. The EOC is vulnerable to similar failures. Given that corrosion has a direct correlation to time the Unit 2 FCUs are more vulnerable as they were installed first in 2005 followed by the Unit 1 FCUs in 2006. Currently, the FCUs are being inspected for leaks on a weekly basis to rapidly identify and mitigate any leaks. Any corrective actions taken to address the 21 CFCU and causes will include the EOC.

Any heat exchangers that may be identified as having unusual PM cleaning frequencies could be vulnerable to similar failures; therefore, a Condition Evaluation was conducted to perform this review (AR 01477721-15).

Finally, one CFCU face has been removed from the Unit 1 FCUs. An upper face was removed from the 11 CFCU due to a small leak near the tube to tube sheet connection. This face will have failure analysis performed to validate if Unit 1 FCUs are also experiencing the same rate of corrosion. An assignment was created to track this action. (AR 01477721-18).

CAUSE

The cause has been determined to be FCU through wall leaks caused by under-deposit pitting corrosion. The previous CFCU PM strategy did not acknowledge corrosion as a plausible failure mode. Also, the CL leakage into the ZX system continually dilutes chemical treatment efforts.

CORRECTIVE ACTION

Actions to Correct the Condition

i. **Immediate/Interim Actions**

- REPLACE 21 CFCU EAST UPPER & LOWER FACE, TUBE PLUGGING ON 21FCU, Completed March 13, 2015.
- 22 CFCU U-BEND LEAK ON SOUTH UPPER FACE, Completed March 13, 2015.

ii. **Final Corrective Actions**

- 21 CFCU: WO 494128 REPLACE UPPER AND LOWER 21 CFCU SOUTH FACE -Due 2R29
- 22 CFCU: WO 509209 REPLACE FACES ON 22 CFCU - Due 2R29
- 23 CFCU: WO 523283 REPLACE ALL 8 CFCU FACES ON THE 23 CFCU - Due 2R29
- 24 CFCU: WO 494654 REMOVE TMOD 23402, TUBE PLUGGING ON 24 CFCU - Due 2R29

- Track WO 494128, 509209, 523283 and 494654 to completion or cancelled status. System Engineer/Due December 15, 2015.

- Submit funding to replace all Unit 1 FCUs. Once submitted, track the approval of funding request. System Engineer/Due September 4. 2015.

Actions to Correct the Equipment Cause

i. **Interim Actions**

- Maintain CFCUs on ZX system. Containment Vent (ZC) and ZX System engineers to collaborate with Operations to discuss operation of CFCUs on ZX system continuously (including winter operation) and flushing system when restoring following surveillances. System Engineer/Complete August 5, 2015.

ii. **Final Corrective Actions**

- Heat Exchanger (HX) Program engineer to collaborate with MIC Program Engineer, ZC System Engineer and Chemistry to revise PM strategy for all CFCUs to address corrosion. PM strategies shall include layup process for PMs, Referencing EPRI Templates for HXs, Vendor recommendations and External OE for Industry Best Practices. HX Program Engineer/Complete August 20, 2015.

PREVIOUS SIMILAR EVENTS

The following events are FCU related; however, the cause of the 21 FCU leak is not similar to those previously reported.

LER 50-282/2015-002-00, 14 Containment Fan Coil Unit (FCU) Leak (lower head). The causal evaluation determined there is an inadequate design of cooling water (CL) connection to the FCU which allows for misalignment and leakage.

LER 50-282/2015-001-00, 14 Fan Coil Unit Leak (Lower face on northwest corner). The causal evaluation for this event determined that the 45 ft-lbs torque value chosen by site based on the 23 Containment FCU gasket leak, resulted in allowable torque margin to stop leakage post-maintenance, but did not prevent it from occurring on 14 Containment FCU in November 2014.

LER 50-306/2014-002-00, 23 Fan Coil Unit Lower Northeast Face Corner Gasket Leaking.
The 23 Containment FCU gasket leak is similar to the 14 Containment FCU header gasket leaks. The revised torqueing value of 45 ft-lbs under the CAPR was ineffective, that caused a leak to occur on 14 Containment FCU gasket.

On May 20, 2012, with Unit 2 in Mode 5, a leak was identified on 23 Containment FCU, CL flange, gasket. Per the Work Order, the gasket removed for the FCU to CL flange that was leaking on the 23 FCU was inspected and found to be in good condition. The CL pipe flanges were also inspected during the leak repairs. The sealing surfaces were experiencing heavy pitting. The Cooling Water

piping at this joint is constructed of carbon steel. Carbon steel is susceptible to corrosion and can cause pitting on unprotected surfaces. The most likely cause of the leak on the 23 FCU was pitting of the pipe flange mating surfaces.

On October 24, 2012, with Unit 1 in Mode 4, a gasket leak was identified on the #1 face of the 12 Containment FCU. The most likely cause of the leak on the 12 FCU was exceeding the service life of the header box gasket.