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L-PI-12-095
10 CFR 50.46

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
Renewed License Nos. DPR-42 and DPR-60

Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown - Error Identified in ECCS Evaluation Model, 10 CFR 50.46

As required by 10 CFR 50.46(a)(3)(ii), Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM") submits this 30-day report due to an error discovered in an emergency core cooling system (ECCS) evaluation model for Prairie Island Nuclear Generating Plant (PINGP) Units 1 and 2. The affected evaluation model is the 2004 Westinghouse Realistic Large Break Loss of Coolant Accident (LBLOCA) Evaluation Model using Westinghouse Automated Statistical Treatment of Uncertainty Method (ASTRUM), application to Pressurized Water Reactors (PWRs) with upper plenum injection.

The error occurred in the Westinghouse Performance Analysis and Design (PAD) code. The error is due to the non-explicit modeling of thermal conductivity degradation that occurs in the fuel as it accumulates exposure. The effect of the thermal conductivity degradation is that as the fuel gains exposure it is less able to transfer heat resulting in higher fuel pellet temperatures.

A generic analysis was performed by Westinghouse through the PWR Owners Group using approaches reviewed and accepted by the NRC. The results were used to establish a conservative plant specific peak cladding temperature (PCT) penalty. The plant specific penalty is 227 °F for Unit 1, and 340 °F for Unit 2. The current analysis retains considerable margin to the 2200 °F limit. The conservative nature of the PCT penalty coupled with the large amount of margin remaining provides assurance that compliance with 10CFR50.46 has been met, and that no reanalysis is necessary. The technical summary of this condition and updated PCT rack-up sheets are provided in the enclosures to this letter.

Summary of Commitments

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

A handwritten signature in black ink, reading "Joel P. Sorensen". The signature is written in a cursive style with a large, sweeping initial "J".

Joel P. Sorensen
Acting Site Vice-President, Prairie Island Nuclear Generating Plant
Northern States Power Company - Minnesota

Enclosures (2)

cc: Regional Administrator, Region III, USNRC
Project Manager, Prairie Island Nuclear Generating Plant, USNRC
Resident Inspector, Prairie Island Nuclear Generating Plant, USNRC

ENCLOSURE 1

ECCS EVALUATION MODEL CHANGES AND ERRORS

Prairie Island Nuclear Generating Plant, UNITS 1 AND 2

5 pages follow

PCT SUMMARY

	PI1 LBLOCA	PI1 SBLOCA	PI2 LBLOCA	PI2 SBLOCA
Analysis of Record Date	11/30/07	1/21/08	11/30/07	1/21/08
Analysis of Record PCT	1765	959	1623	965
Old Changes and Errors (absolute sum)	0	0	0	0
Last NRC Notification Date	6/26/12 (1)	6/26/12 (1)	06/26/12 (1)	6/26/12 (1)
Projected PCT From the Last NRC Notification	1765	959	1623	965
New Errors or Changes (from this Notification Only)	227	0	340	0
Total of Changes and Errors (absolute Sum)	227	0	340	0
New Projected PCT	1992	959	1963	1965

(1) These dates reflect the LBLOCA and SBLOCA 2011 annual report L-PI-12-046.

Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown

Background

Fuel pellet thermal conductivity degradation (TCD) and peaking factor burndown were not explicitly considered in the Prairie Island Unit 1 Best Estimate Large Break Loss-of-Coolant Accident (BE LBLOCA) Analysis of Record (AOR). Nuclear Regulatory Commission (NRC) Information Notice 2011-21 (Reference 1) notified addressees of recent information obtained concerning the impact of irradiation on fuel thermal conductivity and its potential to cause significantly higher predicted peak cladding temperature (PCT) results in realistic emergency core cooling system (ECCS) evaluation models. This evaluation provides an estimated effect of fuel pellet TCD and peaking factor burndown on the PCT calculation for the Prairie Island Unit 1 BE LBLOCA AOR. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451 (Reference 2).

Affected Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

A quantitative evaluation, as discussed in Reference 3, was performed to assess the PCT effect of fuel pellet TCD and peaking factor burndown on the Prairie Island Unit 1 BE LBLOCA analysis and concluded that the estimated PCT impact is 227°F for 10 CFR 50.46 reporting purposes. The peaking factor burndown, included in the evaluation, is provided in Table 1 and is conservative for the current cycle. Xcel Energy, Inc. and its vendor, Westinghouse Electric Company LLC, utilize processes which ensure that the LOCA analysis input values conservatively bound the as-operated plant values for those parameters and will be validated as part of the reload design process.

Table 1: Peaking Factors Assumed in the Evaluation of TCD

Rod Burnup (MWd/MTU)	FdH ^{(1),(2)}	FQ Transient ⁽¹⁾	FQ Steady-State
0	1.770	2.500	2.250
30,000	1.770	2.500	2.250
60,000	1.400	1.889	1.700
62,000	1.400	1.889	1.700

(1) Includes uncertainties.

(2) Hot assembly average power follows the same burndown, since it is a function of FdH.

References

1. NRC Information Notice 2011-21, McGinty, T. J., and Dudes, L. A., "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting From Nuclear Fuel Thermal Conductivity Degradation," December 13, 2011. (NRC ADAMS # ML113430785)
2. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.
3. OG-12-386, "For Information Only – Input Supporting the PWROG LBLOCA Program Regarding Nuclear Fuel Thermal Conductivity Degradation (PA-ASC-1073, Revision 0) (Proprietary/Non-Proprietary)," September 18, 2012.

Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break

Plant Name: Prairie Island Unit 1
Utility Name: Xcel Energy, Inc
Revision Date: 9/20/2012

Analysis Information

EM: ASTRUM (2004) **Analysis Date:** 11/30/2007 **Limiting Break Size:** Split
FQ: 2.5 **FdH:** 1.77
Fuel: 422 Vantage + **SGTP (%):** 10

Notes:

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	1765	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . None	0		
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2012 ECCS MODEL ASSESSMENTS			
1 . Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	227	2	(a)
D. OTHER*			
1 . None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT =	1992	
* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.			

References:

- 1 . WCAP-16890-P, Revision 1, "Best-Estimate Analysis of the Large-Break Loss-of-Coolant Accident for the Prairie Island Nuclear Plant Unit 1 Using ASTRUM Methodology," June 2008.
- 2 . LTR-LIS-12-414, "Prairie Island Units 1 and 2, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.

Notes:

- (a) This evaluation credits peaking factor burndown, see Reference 2.

Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown

Background

Fuel pellet thermal conductivity degradation (TCD) and peaking factor burndown were not explicitly considered in the Prairie Island Unit 2 Best Estimate Large Break Loss-of-Coolant Accident (BE LBLOCA) Analysis of Record (AOR). Nuclear Regulatory Commission (NRC) Information Notice 2011-21 (Reference 1) notified addressees of recent information obtained concerning the impact of irradiation on fuel thermal conductivity and its potential to cause significantly higher predicted peak cladding temperature (PCT) results in realistic emergency core cooling system (ECCS) evaluation models. This evaluation provides an estimated effect of fuel pellet TCD and peaking factor burndown on the PCT calculation for the Prairie Island Unit 2 BE LBLOCA AOR. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451 (Reference 2).

Affected Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

A quantitative evaluation, as discussed in Reference 3, was performed to assess the PCT effect of fuel pellet TCD and peaking factor burndown on the Prairie Island Unit 2 BE LBLOCA analysis and concluded that the estimated PCT impact is 340°F for 10 CFR 50.46 reporting purposes. The peaking factor burndown, included in the evaluation, is provided in Table 1 and is conservative for the current cycle. Xcel Energy, Inc. and its vendor, Westinghouse Electric Company LLC, utilize processes which ensure that the LOCA analysis input values conservatively bound the as-operated plant values for those parameters and will be validated as part of the reload design process.

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62,000	1.400	1.889	1.700

(1) Includes uncertainties.

(2) Hot assembly average power follows the same burndown, since it is a function of FdH.

References

1. NRC Information Notice 2011-21, McGinty, T. J., and Dudes, L. A., "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting From Nuclear Fuel Thermal Conductivity Degradation," December 13, 2011. (NRC ADAMS # ML113430785)
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Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break

Plant Name: Prairie Island Unit 2
Utility Name: Xcel Energy, Inc
Revision Date: 9/20/2012

Analysis Information

EM: ASTRUM (2004) **Analysis Date:** 11/30/2007 **Limiting Break Size:** Split
FQ: 2.5 **FdH:** 1.77
Fuel: 422 Vantage + **SGTP (%):** 25

Notes:

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	1623	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . None	0		
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2012 ECCS MODEL ASSESSMENTS			
1 . Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	340	2	(a)
D. OTHER*			
1 . None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1963		

* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.

References:

- 1 . WCAP-16891-P, "Best-Estimate Analysis of the Large-Break Loss-of-Coolant Accident for the Prairie Island Nuclear Plant Unit 2 Using ASTRUM Methodology," June 2008.
- 2 . LTR-LIS-12-414, "Prairie Island Units 1 and 2, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.

Notes:

- (a) This evaluation credits peaking factor burndown, see Reference 2.

ENCLOSURE 2

LBLOCA and SBLOCA Peak Clad Temperature Assessment Sheets

7 pages follow



Westinghouse Non-Proprietary Class 3

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September 20, 2012

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Our ref: LTR-LIS-12-414

**Prairie Island Units 1 and 2
10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity
Degradation and Peaking Factor Burndown**

Dear Sir or Madam:

The information documented in this letter is for Xcel Energy, Inc.'s use in making a determination relative to the reporting requirements of 10 CFR 50.46.

Attachments 1 and 2 to this letter document 10 CFR 50.46 reporting text and the estimated effects for the evaluations of burnup effects due to fuel pellet thermal conductivity degradation (TCD) and peaking factor burndown on the Prairie Island Units 1 and 2 Best Estimate Large Break Loss-of-Coolant Accident (BE LBLOCA) analyses of record, respectively. The evaluations use the method described in Reference 1. A revised LBLOCA Peak Cladding Temperature (PCT) rackup sheet for each unit is included in the attachments. Note that the "Future" rackup sheets remain unchanged from the previously transmitted sheets since evaluating Prairie Island Units 1 and 2 at Extended Power Uprate (EPU) conditions is outside the scope of the PWR Owners Group program (PA-ASC-1073).

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Approved: (Electronically Approved)* Eric P. Husser, on behalf of Amy J. Colussy, Manager LOCA Integrated Services I	

Reference 1: OG-12-386, "For Information Only – Input Supporting the PWROG LBLOCA Program Regarding Nuclear Fuel Thermal Conductivity Degradation (PA-ASC-1073, Revision 0) (Proprietary/Non-Proprietary)," September 18, 2012.

Attachment 1: Prairie Island Unit 1, 10 CFR 50.46 Reporting Text and Peak Cladding Temperature Rackup Sheet

Attachment 2: Prairie Island Unit 2, 10 CFR 50.46 Reporting Text and Peak Cladding Temperature Rackup Sheet

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Attachment 1

Prairie Island Unit 1

10 CFR 50.46 Reporting Text and Peak Cladding Temperature Rackup Sheets

(3 pages, including cover page)

Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown

Background

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60,000	1.400	1.889	1.700
62,000	1.400	1.889	1.700

(1) Includes uncertainties.

(2) Hot assembly average power follows the same burndown, since it is a function of FdH.

References

1. NRC Information Notice 2011-21, McGinty, T. J., and Dudes, L. A., "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting From Nuclear Fuel Thermal Conductivity Degradation," December 13, 2011. (NRC ADAMS # ML113430785)
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Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break

Plant Name: Prairie Island Unit 1
Utility Name: Xcel Energy, Inc
Revision Date: 9/20/2012

Analysis Information

EM: ASTRUM (2004) **Analysis Date:** 11/30/2007 **Limiting Break Size:** Split
FQ: 2.5 **FdH:** 1.77
Fuel: 422 Vantage + **SGTP (%):** 10
Notes:

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	1765	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . None	0		
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2012 ECCS MODEL ASSESSMENTS			
1 . Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	227	2	(a)
D. OTHER*			
1 . None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1992		

* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.

References:

- 1 . WCAP-16890-P, Revision 1, "Best-Estimate Analysis of the Large-Break Loss-of-Coolant Accident for the Prairie Island Nuclear Plant Unit 1 Using ASTRUM Methodology," June 2008.
- 2 . LTR-LIS-12-414, "Prairie Island Units 1 and 2, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.

Notes:

- (a) This evaluation credits peaking factor burndown, see Reference 2.

Attachment 2

Prairie Island Unit 2

10 CFR 50.46 Reporting Text and Peak Cladding Temperature Rackup Sheets

(3 pages, including cover page)

Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown

Background

Fuel pellet thermal conductivity degradation (TCD) and peaking factor burndown were not explicitly considered in the Prairie Island Unit 2 Best Estimate Large Break Loss-of-Coolant Accident (BE LBLOCA) Analysis of Record (AOR). Nuclear Regulatory Commission (NRC) Information Notice 2011-21 (Reference 1) notified addressees of recent information obtained concerning the impact of irradiation on fuel thermal conductivity and its potential to cause significantly higher predicted peak cladding temperature (PCT) results in realistic emergency core cooling system (ECCS) evaluation models. This evaluation provides an estimated effect of fuel pellet TCD and peaking factor burndown on the PCT calculation for the Prairie Island Unit 2 BE LBLOCA AOR. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451 (Reference 2).

Affected Evaluation Model

2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

Estimated Effect

A quantitative evaluation, as discussed in Reference 3, was performed to assess the PCT effect of fuel pellet TCD and peaking factor burndown on the Prairie Island Unit 2 BE LBLOCA analysis and concluded that the estimated PCT impact is 340°F for 10 CFR 50.46 reporting purposes. The peaking factor burndown, included in the evaluation, is provided in Table 1 and is conservative for the current cycle. Xcel Energy, Inc. and its vendor, Westinghouse Electric Company LLC, utilize processes which ensure that the LOCA analysis input values conservatively bound the as-operated plant values for those parameters and will be validated as part of the reload design process.

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62,000	1.400	1.889	1.700

(1) Includes uncertainties.

(2) Hot assembly average power follows the same burndown, since it is a function of FdH.

References

1. NRC Information Notice 2011-21, McGinty, T. J., and Dudes, L. A., "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting From Nuclear Fuel Thermal Conductivity Degradation," December 13, 2011. (NRC ADAMS # ML113430785)
2. WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting," October 1992.
3. OG-12-386, "For Information Only – Input Supporting the PWROG LBLOCA Program Regarding Nuclear Fuel Thermal Conductivity Degradation (PA-ASC-1073, Revision 0) (Proprietary/Non-Proprietary)," September 18, 2012.

Westinghouse LOCA Peak Clad Temperature Summary for ASTRUM Best Estimate Large Break

Plant Name: Prairie Island Unit 2
Utility Name: Xcel Energy, Inc
Revision Date: 9/20/2012

Analysis Information

EM: ASTRUM (2004) **Analysis Date:** 11/30/2007 **Limiting Break Size:** Split
FQ: 2.5 **FdH:** 1.77
Fuel: 422 Vantage + **SGTP (%):** 25
Notes:

	Clad Temp (°F)	Ref.	Notes
LICENSING BASIS			
Analysis-Of-Record PCT	1623	1	
PCT ASSESSMENTS (Delta PCT)			
A. PRIOR ECCS MODEL ASSESSMENTS			
1 . None	0		
B. PLANNED PLANT MODIFICATION EVALUATIONS			
1 . None	0		
C. 2012 ECCS MODEL ASSESSMENTS			
1 . Evaluation of Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown	340	2	(a)
D. OTHER*			
1 . None	0		
LICENSING BASIS PCT + PCT ASSESSMENTS	PCT = 1963		
* It is recommended that the licensee determine if these PCT allocations should be considered with respect to 10 CFR 50.46 reporting requirements.			

References:

- 1 . WCAP-16891-P, "Best-Estimate Analysis of the Large-Break Loss-of-Coolant Accident for the Prairie Island Nuclear Plant Unit 2 Using ASTRUM Methodology," June 2008.
- 2 . LTR-LIS-12-414, "Prairie Island Units 1 and 2, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.

Notes:

- (a) This evaluation credits peaking factor burndown, see Reference 2.