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RA 14-0038

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Reference: Westinghouse Letter LTR-LIS-14-103, dated March 17, 2014, "Wolf Creek 10 CFR 50.46 Annual Notification and Reporting for 2013"

Subject: Docket No. 50-482: 10 CFR 50.46 Annual Report of Emergency Core Cooling System (ECCS) Evaluation Model Changes

Gentlemen:

This letter provides the annual report for the Emergency Core Cooling System (ECCS) Evaluation Model changes and errors for the 2013 model year that affect the peak cladding temperature (PCT) for Wolf Creek Generating Station (WCGS). This letter is provided in accordance with the criteria and reporting requirements of 10 CFR 50.46(a)(3)(ii), as clarified in Section 5.1 of WCAP-13451, "Westinghouse Methodology for Implementation of 10 CFR 50.46 Reporting." Regulation 10 CFR 50.46(a)(3)(ii) states, in part, "For each change to or error discovered in an acceptable evaluation model or in the application of such a model that affects the temperature calculation, the applicant or holder of a construction permit, operating license, combined license, or manufacturing license shall report the nature of the change or error and its estimated effect on the limiting ECCS analysis to the Commission at least annually as specified in §50.4 or §52.3 of this chapter, as applicable. If the change or error is significant, the applicant or licensee shall provide this report within 30 days and include with the report a proposed schedule for providing a reanalysis or taking other action as may be needed to show compliance with §50.46 requirements."

Wolf Creek Nuclear Operating Corporation (WCNOC) has reviewed the notification and reporting requirements of 10 CFR 50.46 pertaining to the ECCS Evaluation Model changes that were implemented by Westinghouse for 2013 as described in the above Reference. The review concludes that the effect of changes to, or errors in, the Evaluation Models on the limiting transient PCT is not significant for 2013. Therefore, changes to the ECCS Evaluation Model are being reported as an annual report.

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Attachment I provides an assessment of the specific changes and enhancements to the Westinghouse Evaluation Models for 2013. These model changes and enhancements do not have impacts on the PCT and, generally, will not be presented on the PCT rack-up forms.

Attachment II provides the calculated Large Break Loss of Coolant Accident (LOCA) and Small Break LOCA PCT margin allocations in effect for the 2013 WCGS evaluation models. The PCT values determined in the Large Break and Small Break LOCA analysis of record, combined with all of the PCT allocations, remain below the 10 CFR 50.46(b)(1) regulatory limit of 2200°F. Therefore, WCGS is in compliance with 10 CFR 50.46 requirements and no reanalysis or other action is required.

This letter contains no commitments. If you have any questions concerning this matter, please contact me at (620) 364-4009 or Bill Muilenburg at 620-364-4186.

Sincerely,



Michael J. Westman

MJW/rlt

Attachment I – Assessment of Changes to the Westinghouse Emergency Core Cooling System (ECCS) Evaluation Models for Large and Small Break Loss of Coolant Accidents (LOCA)

Attachment II – Emergency Core Cooling System (ECCS) Evaluation Model Peak Cladding Temperature (PCT) Margin Utilization

cc: M. L. Dapas (NRC), w/a
C. F. Lyon (NRC), w/a
N. F. O'Keefe (NRC), w/a
Senior Resident Inspector (NRC), w/a

**ASSESSMENT OF CHANGES TO THE WESTINGHOUSE EMERGENCY
CORE COOLING SYSTEM (ECCS) EVALUATION MODELS FOR LARGE
AND SMALL BREAK LOSS OF COOLANT ACCIDENTS (LOCA)**

Non-Discretionary Changes With Peak Cladding Temperature (PCT) Impact

None.

Non-Discretionary Changes With No PCT Impact

LOCBART ROD-TO-ROD RADIATION HEAT TRANSFER COEFFICIENT (BASH)
SATAN6 FUEL ROD GAP HEAT TRANSFER COEFFICIENT CALCULATION (BASH)
BASH QUENCH FRONT MODEL INDEXING ERROR (BASH)
EVALUATION OF CHANGES TO GRID BLOCKAGE RATIO AND POROSITY (BASH)
SBLOCTA CLADDING STRAIN REQUIREMENT FOR FUEL ROD BURST (NOTRUMP)

Enhancements/Forward-Fit Discretionary Changes

GENERAL CODE MAINTENANCE (BASH)

Editorial Changes

None

Summary

LOCBART ROD-TO-ROD RADIATION HEAT TRANSFER COEFFICIENT

(Non-Discretionary Change with no PCT Impact)

Background

An error was discovered in the LOCBART code that impacts the calculation of the rod-to-rod radiation heat transfer coefficient. The error was corrected and test cases were performed to determine the potential impact on the results. The test case results demonstrated that correcting the code error had a negligible impact on calculated results. This change represents a Non-Discretionary change to the evaluation model as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large-Break LOCA Evaluation Model with BASH

Estimated Effect

Validation testing showed a negligible impact on calculated results, leading to an estimated PCT impact of 0°F.

SATAN6 FUEL ROD GAP HEAT TRANSFER COEFFICIENT CALCULATION

(Non-Discretionary Change with no PCT Impact)

Background

Two errors were identified in the SATAN6 calculation of the radiation term of the fuel rod gap heat transfer coefficient. First, an incorrect temperature is used in the cladding emissivity calculation; second, a geometrical term is missing from the radiation heat transfer coefficient calculation. These errors correspond to a closely related group of Non-Discretionary Changes as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

A set of hand calculations were completed showing a negligible impact on the fuel rod gap heat transfer coefficient in SATAN6, leading to an estimated effect of 0°F on PCT.

BASH QUENCH FRONT MODEL INDEXING ERROR

(Non-Discretionary Change with no PCT Impact)

Background

A condition was observed in calculations completed with the BASH computer code relating to an isotherm indexing variable in the quench front model that results in oscillatory quench front behavior above the peak power elevation for select cases. An updated version of the BASH computer code was used to estimate the effect of the quench front oscillations on the resulting core inlet flooding rate used by LOCBART for calculating the PCT. This represents a Non-Discretionary Change as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

An updated version of the BASH computer code was developed to assess the impact of the oscillations for all impacted analyses. The validation results show a negligible impact on the resulting core inlet flooding rate, leading to an estimated effect of 0°F on PCT.

EVALUATION OF CHANGES TO GRID BLOCKAGE RATIO AND POROSITY

(Non-Discretionary Change with no PCT Impact)

Background

A change in the methodology used to calculate grid blockage ratio and porosity for Westinghouse fuel resulted in a change to the grid inputs used in the 1981 Appendix K Large Break LOCA Evaluation Model with BASH (BASH-EM), which affects the grid heat transfer in the LOCBART fuel rod heatup calculation. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

The impact of the recalculated grid blockage ratio and porosity for 17x17 RFA and 17x17 RFA-2 fuel, used as input in the BASH-EM LOCBART model, was qualitatively evaluated as having a negligible impact on reported results, leading to an estimated PCT effect of 0°F.

SBLOCTA CLADDING STRAIN REQUIREMENT FOR FUEL ROD BURST

(Non-Discretionary Change with no PCT Impact)

Background

An error was discovered in the minimum local strain required for burst for ZIRLO^{®1} cladding in the SBLOCTA code. The coding does not enforce reaching the minimum percent local strain threshold prior to calculating fuel rod burst. However, a review of licensing basis analyses revealed no instances of this error impacting calculated results. Resolution of this issue represents a Non-Discretionary Change to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

Based on a review of current licensing basis analyses, and the phenomena and physics of a small break LOCA transient, it is concluded that this error has a negligible effect on small break LOCA analysis results, leading to an estimated PCT impact of 0°F.

¹ZIRLO is a registered trademark of Westinghouse Electric Company LLC, its affiliates and/or its subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

GENERAL CODE MAINTENANCE

(Enhancements/Forward-Fit Discretionary Changes)

Background

Various changes have been made to enhance the usability of the codes and to help preclude errors in analyses. This includes items such as modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. These changes represent Discretionary Changes that will be implemented on a forward-fit basis in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Model(s)

1981 Westinghouse Large-Break LOCA Evaluation Model with BASH

Estimated Effect

The nature of these changes leads to an estimated PCT impact of 0°F.

EMERGENCY CORE COOLING SYSTEM (ECCS) EVALUATION MODEL PEAK CLADDING TEMPERATURE (PCT) MARGIN UTILIZATION

***** LARGE BREAK LOCA PCT MARGIN UTILIZATION *****

Evaluation Model:	1981 EM with BASH
Fuel:	17x17 V5H w/IFM, non-IFBA, 275 psig
Peaking Factor:	FQ=2.50, FdH=1.65
SG Tube Plugging:	10%
Power Level:	3565 MWth
Limiting transient:	Cd=0.4, Min. SI, Reduced Tavg

LICENSING BASIS

	Clad Temp (°F)	Ref.	Notes
Analysis of Record (AOR) PCT	1916 °F	1	(a)

MARGIN ALLOCATIONS (ΔPCT)

A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS

1. Structural Metal Heat Modeling	-25	8	
2. LUCIFER Error Corrections	-6	10	
3. Skewed Power Shape Penalty	152	11	
4. Hot Leg Nozzle Gap Benefit	-136	11	
5. SATAN-LOCTA Fluid Error	15	2	
6. LOCBART Spacer Grid Single-Phase Heat Transfer Error	15	9	
7. LOCBART Vapor Film Flow Regime Heat Transfer Error	9	12	
8. LOCBART Cladding Emissivity Errors	6	13	
9. LOCBART Radiation to Liquid Logic Error Correction	17	14	
10. LOCBART Pellet Volumetric Heat Generation Rate	45	15	
11. PWROG TCD EVALUATION - Rebaseline of AOR	87	16	(e)
12. PWROG TCD Evaluation - Effect of TCD and Assembly Power/Peaking Factor Burndown	0	16	(e)

B. PLANNED PLANT CHANGE EVALUATIONS

1. Loose Parts Evaluation	20	3	
2. Effects of Containment Purging	0	4	
3. Cycle 10 Fuel Assembly Design Changes	95	5	
4. Fuel Rod Crud	0	6	

C. 2013 PERMANENT ECCS MODEL ASSESSMENTS

1. None	0		
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D. TEMPORARY ECCS MODEL ISSUES

0

E. OTHER

1. Cold Leg Streaming Temperature Gradient	0	8	(b)
2. Rebaseline of AOR (12/96)	-63	9	(c)
3. LOCBART Zirc-Water Oxidation Error	28	7	(d)

LICENSING BASIS PCT + MARGIN ALLOCATIONS **PCT = 2175 °F**

CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES **Σ |ΔPCT| = 0 °F**
SINCE LAST 30-DAY REPORT (LETTER ET 12-0023)

References:

1. Westinghouse Topical Report WCAP-13456, "Wolf Creek Generating Station NSSS Rerating Licensing Report," October 1992.
2. Westinghouse to WCNO letter SAP-97-102, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Annual Notification and Reporting," February 17, 1997.
3. Westinghouse to WCNO letter SAP-90-148, "Wolf Creek Nuclear Operating Corporation, RCS Loose Parts Evaluation," April 18, 1998.
4. Westinghouse to WCNO letter SAP-94-102, "Containment Mini purge Isolation Valve Stroke Time Increase," January 12, 1994.
5. Westinghouse to WCNO letter 97SAP-G-0009, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Safety Assessment for the Wolf Creek Generating Station with ZIRLO™ Fuel Assemblies," February 7, 1997.
6. Westinghouse to WCNO letter 97SAP-G-0075, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Wolf Creek Crud Deposition/Axial Offset Anomaly Safety Evaluation," September 29, 1997.
7. Westinghouse to WCNO letter 00SAP-G-0006, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Wolf Creek Cycle 12 LOCA Current Limits," February 10, 2000.
8. Westinghouse to WCNO letter SAP-93-701, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting Information," January 25, 1993.
9. Westinghouse to WCNO letter SAP-99-148, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 BART/BASH Evaluation Model Mid-Year Notification and Reporting for 1999," September 22, 1999.
10. Westinghouse to WCNO letter SAP-94-703, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting," February 8, 1994.
11. Westinghouse to WCNO letter SAP-95-716, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, LOCA Axial Power Shape Sensitivity Model," August 14, 1995.
12. Westinghouse to WCNO letter SAP-00-118, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Appendix K (BART/BASH/NOTRUMP) Evaluation Model, Mid-Year Notification and Reporting for 2000," June 30, 2000.
13. Westinghouse to WCNO letter SAP-00-150, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 BART/BASH Evaluation Model Mid-Year Notification and Reporting for 2000," December 2000.
14. Westinghouse to WCNO letter SAP-02-32, "10 CFR 50.46 BART/BASH Evaluation Model Mid-Year Notification and Reporting for 2002," June 2002.
15. Westinghouse to WCNO letter LTR-LIS-07-312, "10 CFR 50.46 Reporting Text for LOCBART Version 37.0 Issues and Revised PCT Rackup sheets for Wolf Creek," May 14, 2007.
16. Westinghouse to WCNO letter LTR LIS-12-515, "Wolf Creek, 10 CFR 50.46 Notification and Reporting for Fuel Pellet Thermal Conductivity Degradation and Peaking Factor Burndown," September 20, 2012.

Notes:

- (a) An evaluation was performed to support removal of the transition core penalty for Cycle 12 (Ref. 7).
- (b) A PCT benefit of < 2.5 °F was assessed, however, a benefit of 0 °F will be tracked for reporting purposes.
- (c) This previously unclaimed benefit was realized through prior rebaseline of the limiting case.
- (d) This assessment is a function of analysis PCT plus certain margin allocations and as such may increase/decrease with margin allocation changes.
- (e) This effect was estimated based on the bounding value from the available plant-specific calculations.

***** SMALL BREAK LOCA PCT MARGIN UTILIZATION *****

Evaluation Model:	1985 EM with NOTRUMP
Fuel:	17x17 RFA-2 w/IFM
Peaking Factor:	FQ=2.50, FdH=1.65
SG Tube Plugging:	10%
Power Level:	3565 MWth
Limiting transient:	4-inch Break

LICENSING BASIS

	Clad Temp (°F)	Ref.	Notes
Analysis of Record PCT	936 °F	1	

MARGIN ALLOCATIONS (Δ PCT)

A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS

1. None	0		
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B. PLANNED PLANT CHANGE EVALUATIONS

1. Loose Part Evaluation	45	2	(a)
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C. 2013 PERMANENT ECCS MODEL ASSESSMENTS

1. None	0		
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D. TEMPORARY ECCS MODEL ISSUES

1. None	0		
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E. OTHER

1. None	0		
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LICENSING BASIS PCT + MARGIN ALLOCATIONS	PCT = 981 °F
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CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES	$\Sigma \Delta \text{PCT} = 0 \text{ °F}$
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References:

1. WCAP-16717-P, Rev. 0, "Wolf Creek Generating Station (SAP), MSIV/MFIV Replacement Project, Small Break Loss of Coolant Accident Analysis Engineering Report," January 2007.
2. SAP-90-148/NS-OPLS-OPL-I-90-239, "Wolf Creek Nuclear Operating Corporation, RCS Loose Part Evaluation," April 1990.

Notes:

(a) This penalty will be carried to track the loose part which has not been recovered.