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RA 07-0032

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

Reference: Westinghouse Letter LTR-LIS-07-148, dated March 7, 2007, 10 CFR 50.46 Annual Notification and Reporting for 2006 – BASH-EM and NOTRUMP-EM

Subject: Docket No. 50-482: 10 CFR 50.46 Annual Report of ECCS Model Changes

Gentlemen:

This letter provides the annual report for the Emergency Core Cooling System (ECCS) Evaluation Model changes and errors for the 2006 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 licensee 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 section 50.4. 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 section 50.46 requirements."

Wolf Creek Nuclear Operating Corporation (WCNOC) has reviewed the above reference that addresses 10 CFR 50.46 reporting information pertaining to the ECCS Evaluation Model changes that were implemented by Westinghouse for 2006. The review concludes that the effect of changes to, or errors in, the Evaluation Models on the limiting transient PCT is not significant for 2006. Therefore, the report of the ECCS Evaluation Model changes is provided on an annual basis.

Attachment I provides an assessment of the specific changes and enhancements to the Westinghouse Evaluation Models for 2006. These model changes and enhancements do not have impacts on the PCT and, generally, will not be presented on the PCT rack-up forms.


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Attachment II provides the calculated Large Break Loss of Coolant Accident (LOCA) and Small Break LOCA PCT margin allocations in effect for the 2006 WCGS evaluation models. The PCT values determined in the Small Break and Large Break LOCA analysis of record, combined with all of the PCT allocations, remain well below the 10 CFR 50.46 regulatory limit of 2200 degrees Fahrenheit. Therefore, WCGS is in compliance with 10 CFR 50.46 requirements and no reanalysis or other action is required.

No commitments are identified in this correspondence.

If you have any questions concerning this matter, please contact me at (620) 364-4126, or Ms. Diane Hooper at (620) 364-4041.

Sincerely,



Kevin J. Moles

KJM/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: J. N. Donohew (NRC), w/a
V. G. Gaddy (NRC), w/a
B. S. Mallet (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

BASH Minimum and Maximum Time Step Sizes
PAD Version 4.0 Implementation
NOTRUMP-EM Refined Break Spectrum

Enhancements/Forward-Fit Discretionary Changes

General Code Maintenance (BASH/NOTRUMP)

BASH Minimum and Maximum Time Step Sizes
(Non-Discretionary Changes With No PCT Impact)

Background

A review of some recent BASH-EM sensitivity calculations led to a recommendation to reduce the minimum and maximum time step sizes in BASH during reflood. These changes are being recommended for generic application and have been evaluated for impact on existing analysis results. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Model(s)

1981 Appendix K Large Break LOCA Evaluation Model with BASH

Estimated Effect

Sensitivity calculations using BASH and SMUUTH show that reducing the minimum and maximum time step sizes in BASH during reflood results in either a negligible change or a modest increase in the integral flooding rate for most cases, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes. One case showed a decrease in the integral flooding rate late in reflood and was evaluated for 10 CFR 50.46 impact on a plant-specific basis. For Wolf Creek Generating Station (WCGS), plant specific assessments conclude that implementation of these corrections leads to a conservative estimate of 0° F PCT effect for 10 CFR 50.46 reporting purposes.

PAD Version 4.0 Implementation
(Non-Discretionary Changes With No PCT Impact)

Background

A recent BASH-EM evaluation predicted an increase in the peak cladding temperature (PCT) for IFBA fuel that was attributed primarily to the use of fuel rod initial conditions based on PAD Version 4.0. This result called into question the basis for forward-fit implementation of PAD Version 4.0, and existing IFBA analyses based on PAD Version 3.4 were reviewed to identify conditions that could lead to similar behavior. For each potentially-affected analysis, the estimated PCT impact due to PAD Version 4.0 implementation was assessed on a plant-specific basis. 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 10 CFR 50.46 assessments for this issue were determined on a plant-specific basis, and for WCGS a 0° F PCT effect was assessed for 10 CFR 50.46 reporting purposes.

NOTRUMP-EM Refined Break Spectrum

(Non-Discretionary Changes With No PCT Impact)

Background

During the course of reviewing several extended power uprate and replacement steam generator Small Break LOCA (SBLOCA) analyses, the Nuclear Regulatory Commission (NRC) questioned the break spectrum analyzed in the NOTRUMP evaluation model (EM). The NRC was concerned that the resolution of the break spectrum used in the NOTRUMP EM (1.5, 2, 3, 4, and 6 inch cases) may not be fine enough to capture the worst break with regard to limiting peak clad temperature as per 10 CFR 50.46. That is, the plant could be SBLOCA limited with regard to overall LOCA results.

In response to this, Westinghouse performed some preliminary work indicating that in some cases more limiting results could be obtained from non-integer break sizes; however, the magnitude of the impact was far less than that shown in preliminary work performed by the NRC. Based on this, Westinghouse performed evaluations to determine if all currently operating plants would maintain compliance with the 10 CFR 50.46 acceptance criteria when considering a refined SBLOCA break spectrum. It should be noted that use of a refined break spectrum is not an error, but a change, since evaluating only integer break sizes has been the standard practice since the initial licensing of NOTRUMP.

Affected Evaluation Model(s)

1985 Appendix K Small Break LOCA Evaluation Model

Estimated Effect

Consistent with the method described in Reference 1, for plants with low SBLOCA peak cladding temperatures (PCTs) (i.e., less than 1700°F) and overall SBLOCA results that are significantly non-limiting when compared with large break LOCA (LBLOCA) results, no explicit refined break spectrum calculations were performed, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes. For plants with high SBLOCA PCTs (i.e., equal to or greater than 1700°F), explicit refined break spectrum calculations were performed, and PCT penalties were assessed, if necessary.

Reference

1. LTR-NRC-06-44, "Transmittal of LTR-NRC-06-44 NP-Attachment, 'Response to NRC Request for Additional Information on the Analyzed Break Spectrum for the Small Break Loss of Coolant Accident (SBLOCA) NOTRUMP Evaluation Model (NOTRUMP EM), Revision 1,' (Non-Proprietary)," July 14, 2006.

GENERAL CODE MAINTENANCE (BASH/NOTRUMP)

(Enhancements/Forward-Fit Discretionary Changes)

Background

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g., more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculated results. In addition, various updates were made to eliminate inactive coding, improve active coding, and enhance commenting, both for enhanced usability and to facilitate code debugging when necessary. 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 Models

1981 Appendix K Large Break LOCA Evaluation Model with BASH

1985 Appendix K Small Break LOCA Evaluation Model with NOTRUMP

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 PEAK CLAD TEMPERATURE (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 Tav _g

LICENSING BASIS

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

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. 2006 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 = 2043°F

CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES SINCE LAST 30-DAY REPORT (LETTER ET 99-0045)

Σ |ΔPCT| = 32°F

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.

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.

***** SMALL BREAK LOCA PEAK CLAD TEMPERATURE (PCT) MARGIN UTILIZATION *****

Evaluation Model:	1985 EM with NOTRUMP
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:	3-inch Break

LICENSING BASIS**Analysis of Record PCT**

Clad Temp (°F)	Ref.	Notes
1510	1	

MARGIN ALLOCATIONS (ΔPCT)**A. PRIOR PERMANENT ECCS MODEL ASSESSMENTS**

1. Effect of SI in Broken Loop	150	10	
2. Effect of Improved Condensation Model	-150	10	
3. Drift Flux Flow Regime Errors	-13	11	
4. LUCIFER Error Corrections	-16	11	
5. Boiling Heat Transfer Correlation Error	-6	12	
6. Steam Line Isolation Logic Error	18	12	
7. Axial Nodalization, RIP Model Revision and SBLOCTA Error Corrections Analysis	26	13	
8. NOTRUMP Specific Enthalpy Error	20	2	
9. SBLOCTA Fuel Rod Initialization Error	2	14	
10. NOTRUMP Mixture Level Tracking/Region Depletion Errors	13	15	
11. NOTRUMP Bubble Rise/Drift Flux Model Inconsistency Corrections	0	16	

B. PLANNED PLANT CHANGE EVALUATIONS

1. Loose Part Evaluation	45	3	
2. Cycle 10 Fuel Assembly Design Change	1	6	
3. Reduced Feedwater Inlet Temperature	10	4	
4. Fuel Rod Crud	4	5	(a)
5. Auxiliary Feedwater Temperature Increase	16	8,9	(b)
6. High Head SI Flow Reduction	35	17	

C. 2006 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	7	7
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LICENSING BASIS PCT + MARGIN ALLOCATIONS

PCT = 1672°F

**CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES
SINCE LAST 30-DAY REPORT (LETTER ET 99-0024)** $\Sigma |\Delta PCT| = 35^\circ\text{F}$

References:

1. Westinghouse Topical Report WCAP-13456, "Wolf Creek Generating Station NSSS Rerating Licensing Report," October 1992.
2. Westinghouse to WCNO letter SAP-96-705, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting," February 9, 1996.
3. Westinghouse to WCNO letter SAP-90-148, "Wolf Creek Nuclear Operating Corporation, RCS Loose Parts Evaluation," April 18, 1990.
4. Westinghouse to WCNO letter SAP-96-119, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Small Break LOCA Evaluation for Reduced Feedwater Temperature," May 30, 1996.
5. 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. (This penalty will be carried until such time it is determined to no longer apply).
6. 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.
7. 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.
8. Westinghouse to WCNO letter SAP-98-138, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Assessment of an Increase in Auxiliary Feedwater Temperature," July 23, 1998.
9. 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.
10. Westinghouse to WCNO letter SAP-93-718, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, Safety Injection in the Broken Loop," September 22, 1993.
11. 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.
12. Westinghouse to WCNO letter SAP-94-722, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting," August 18, 1994.
13. Westinghouse to WCNO letter SAP-94-727, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, SBLOCA Axial Nodalization," October 27, 1994.
14. 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.
15. 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.
16. Westinghouse to WCNO letter SAP-03-33, "10 CFR 50.46 Mid-Year Notification and Reporting for 2003," November 14, 2003.
17. Westinghouse to WCNO letter SAP-04-33, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, High Head Safety Injection Flow Rate Reduction -Final Evaluation," June 11, 2004.

Notes are on the next page.

Notes:

- (a) This penalty will be carried until such time it is determined to no longer apply.
- (b) This increase in auxiliary feedwater temperature was originally evaluated in Reference 8 as a 16°F penalty. However, this change was not implemented until the Cycle 12 reload. Reference 9 represents the transmittal of the Cycle 12 LOCA Reload Current Limits.