



Richard A. Muench  
Vice President Engineering  
and Information Services

**MAR 22 2001**

ET 01-0015

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Mail Station P1-137  
Washington, D. C. 20555

Reference: Westinghouse Letter SAP-01-105, Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station Unit 1, 10 CFR 50.46 Annual Notification and Reporting for 2000

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 2000 model year that affect the Peak Cladding Temperature (PCT) for the 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 notification of 10 CFR 50.46 reporting information pertaining to the ECCS Evaluation Model changes that were implemented by Westinghouse for 2000 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 2000. Therefore, the report of the ECCS Evaluation Model changes is provided on an annual basis.

1001

The Attachment provides the calculated Large Break Loss of Coolant Accident (LOCA) and Small Break LOCA PCT margin allocations in effect for the 2000 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) 364-4034, or Mr. Tony Harris at (620) 364-4038.

Very truly yours,



Richard A. Muench

RAM/rlr

Attachment

cc: J. N. Donohew (NRC), w/a  
W. D. Johnson (NRC), w/a  
E. W. Merschoff (NRC), w/a  
Senior Resident Inspector (NRC), w/a

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

### **LOCBART - VAPOR FILM FLOW REGIME HEAT TRANSFER ERROR**

#### Background

As discussed in Reference 1, the Berenson model for film boiling is used in LOCBART to compute the cladding-to-fluid heat transfer coefficient for conduction across the vapor film in the vapor film flow regime, which occurs near the quench front and is assumed to consist of a conduction component and a radiation component. An error was discovered in LOCBART whereby the multiplier on this correlation was programmed incorrectly, resulting in a relatively minor underprediction of the cladding-to-fluid heat transfer coefficient. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

#### Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART  
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

#### Estimated Effect

Representative plant calculations using the LOCBART code showed that this error correction generally results in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small PCT benefit or penalty for other plants. The generic PCT assessments for this issue were derived from the representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose. This error correction results in a 9°F PCT penalty for Wolf Creek since Wolf Creek is categorized as an early-PCT/non-burst node limited plant.

### **LOCBART - CLADDING EMISSIVITY ERRORS**

#### Background

Section 2-17 of Reference 1, Section 3.2.5 of Reference 2, and Section 3-2 of Reference 3 describe expressions that are used to model radiation heat exchange between the rod, grid, and fluid during the reflood phase of the transient. It was discovered that the cladding surface emissivity values used with Equation 2-93 of Reference 1, Equation 3-47 of Reference 2, and Equation 3-8 of Reference 3 were substantially lower than the values that would be expected to exist during a large break LOCA reflood transient. A review of existing documentation was inconclusive as to the exact values that were intended for use with the equations, so a constant, representative value of 0.7 was used, based on the value used in WCOBRA/TRAC for a similar application (Reference 4).

These errors were determined to be a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

#### Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART  
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

#### Estimated Effect

Representative plant calculations using the LOCBART code showed that these error corrections generally result in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small PCT benefit or penalty for other plants. The generic PCT assessments for this issue were derived from the representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose. This error correction results in a 6°F PCT penalty for Wolf Creek since Wolf Creek is categorized as an early-PCT/non-burst node limited plant.

### **NOTRUMP - MIXTURE LEVEL TRACKING/REGION DEPLETION ERRORS**

#### Background

Several closely related errors have been discovered in how NOTRUMP deals with the stack mixture level transition across a node boundary in a stack of fluid nodes. First, when the mixture level attempts to transition a node boundary in a stack of fluid nodes, it can occasionally have difficulty crossing the interface (i.e., level hang). When a mixture level hang occurs at a node boundary, this leads to situations where the flow for a given time step is reset and becomes inconsistent with the matrix solution of the momentum equation for an excessive period of time. This results in local mass/energy errors being generated. In addition, it was discovered that the code was not properly updating metal node temperatures as a result of the implementation of the nodal region depletion logic which can be incurred when a fluid node empties or fills. It is noted that several aspects of these errors, namely mixture level tracking and flow resets, are not directly tied to erroneous coding; rather, they are a direct result of modeling choices made and documented in the original code development/licensing. These errors affect all code versions up to and including NOTRUMP Version 37.0. These error corrections were determined to contain both Discretionary and Non-Discretionary Change aspects in accordance with Sections 4.1.1 and 4.1.2 of WCAP-13451.

#### Affected Evaluation Models

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP  
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP  
(AP600 Implementation)

### Estimated Effect

The nature of this error leads to a bounding 13°F increase of the calculated PCT for all standard Evaluation Model (EM) applications such as is used for Wolf Creek.

### **REFERENCES**

1. WCAP-9561-P-A, "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients," M. Young, et al., March 1984.
2. WCAP-7437-L, "LOCTA-R2 Program: Loss of Coolant Transient Analysis," W.A. Bezella, et al., January 1970.
3. WCAP-10484-P-A, "Spacer Grid Heat Transfer Effects During Reflood," M. Young, et al., March 1991.
4. WCAP-12945-P-A Volume 1 (Revision 2) and Volumes II-V (Revision 1), "Westinghouse Code Qualification for Best Estimate Loss of Coolant Accident Analysis," S.M. Bajorek, et al., March 1998.

**\*\*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:	$F_Q=2.50$ , $F_{dH}=1.65$
SG Tube Plugging:	10%
Power Level:	3565 MW <sub>th</sub>
Limiting transient:	$C_D=0.4$ , Min. SI, Reduced Tav <sub>g</sub>

**A. ANALYSIS OF RECORD (Rerating 8/92)**

Peak Cladding Temperature (PCT): 1916°F (1)

**B. PRIOR PERMANENT ECCS MODEL ASSESSMENTS**  $\Delta PCT = 48^\circ F$  (2)

**C. 10 CFR 50.59 SAFETY EVALUATIONS**

- |  |                               |
|--|-------------------------------|
| 1. Loose Parts                           | $\Delta PCT = 20^\circ F$ (3) |
| 2. Containment Purge Evaluation          | $\Delta PCT = 0^\circ F$ (4)  |
| 3. Cycle 10 Fuel Assembly Design Changes | $\Delta PCT = 95^\circ F$ (5) |
| 4. Fuel Rod Crud                         | $\Delta PCT = 0^\circ F$ (6)  |

TOTAL 10 CFR 50.59 LARGE BREAK ASSESSMENTS  $\Delta PCT = 115^\circ F$

**D. 2000 10 CFR 50.46 MODEL ASSESSMENTS**  
(Permanent Assessment of PCT Margin)

- |  |                               |
|--|-------------------------------|
| 1. LOCBART Vapor Film Flow Regime<br>Heat Transfer Error | $\Delta PCT = 9^\circ F$ (11) |
| 2. LOCBART Cladding Emissivity Errors                    | $\Delta PCT = 6^\circ F$ (12) |

**E. TEMPORARY ECCS MODEL ISSUES**  $\Delta PCT = 0^\circ F$

**F. OTHER MARGIN ALLOCATIONS**

- |   |                                |
|---|--------------------------------|
| 1. Transition Core Penalty                              | $\Delta PCT = 0^\circ F$ (7)   |
| 2. Cold Leg Streaming Temperature Gradient              | $\Delta PCT = 0^\circ F$ (8)   |
| 3. Rebaseline of Limiting AOR Case (12/96)              | $\Delta PCT = -63^\circ F$ (9) |
| 4. Adjustment for LOCBART Zirc-Water Oxidation<br>Error | $\Delta PCT = -5^\circ F$ (10) |

**LICENSING BASIS PCT + MARGIN ALLOCATIONS** **PCT = 2026°F**

**CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES**  $\Sigma|\Delta PCT| = 15^\circ F$   
**SINCE LAST 30-DAY REPORT (LETTER ET 99-0045)**

Notes/References:

1. Westinghouse Topical Report WCAP-13456, "Wolf Creek Generating Station NSSS Rerating Licensing Report," October 1992.
2. Westinghouse to WCNOG letter SAP-00-104, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting for 1999," February 23, 2000.
3. Westinghouse to WCNOG letter SAP-90-148, "Wolf Creek Nuclear Operating Corporation, RCS Loose Parts Evaluation," April 18, 1998.
4. Westinghouse to WCNOG letter SAP-94-102, "Containment Mini purge Isolation Valve Stroke Time Increase," January 12, 1994.
5. Westinghouse to WCNOG 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 WCNOG 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. Transition core penalty applies on a cycle-specific basis for reloads utilizing both V5H (with IFMs) and STD fuel until a full core of V5H is achieved. Since a full core of V5H has been attained, the 50°F transition core penalty is no longer applicable and has been removed.
8. Westinghouse to WCNOG letter SAP-93-701, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting Information," January 25, 1993. [A PCT benefit of 2.5 degrees Fahrenheit was assessed; however, a benefit of zero (0) degrees Fahrenheit will be tracked for reporting purposes.]
9. Westinghouse to WCNOG 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. This assessment is a function of analysis PCT plus certain margin allocations and as such may increase/decrease with margin allocation changes.
11. Westinghouse to WCNOG 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.
12. Westinghouse to WCNOG 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 15, 2000.

**\*\*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:	$F_Q=2.50$ , $F_{dH}=1.65$
SG Tube Plugging:	10%
Power Level:	3565 MW <sub>th</sub>
Limiting transient:	3-inch Break

**A. ANALYSIS OF RECORD (Rerating 8/92)**

Peak Cladding Temperature (PCT):	1510°F (1)
----------------------------------	------------

**B. PRIOR PERMANENT ECCS MODEL ASSESSMENTS**  $\Delta PCT = 31^\circ F$  (2)

**C. 10 CFR 50.59 SAFETY EVALUATIONS**

1. Loose Parts	$\Delta PCT = 45^\circ F$ (3)
2. Cycle 10 Fuel Assembly Design Changes	$\Delta PCT = 1^\circ F$ (6)
3. Reduced Feedwater Inlet Temperature	$\Delta PCT = 10^\circ F$ (4)
4. Fuel Rod Crud	$\Delta PCT = 4^\circ F$ (5)
5. Auxiliary Feedwater Temperature Increase	$\Delta PCT = 16^\circ F$ (8)

TOTAL 10 CFR 50.59 SMALL BREAK ASSESSMENTS	$\Delta PCT = 76^\circ F$
--	---------------------------

**D. 2000 10 CFR 50.46 MODEL ASSESSMENTS**

(Permanent Assessment of PCT Margin)

1. NOTRUMP Mixture Level Tracking/ Region Depletion Errors	$\Delta PCT = 13^\circ F$ (9)
---	-------------------------------

**E. TEMPORARY ECCS MODEL ISSUES**

1. None	$\Delta PCT = 0^\circ F$
---------	--------------------------

**F. OTHER MARGIN ALLOCATIONS**

1. Cold Leg Streaming Temperature Gradient	$\Delta PCT = 7^\circ F$ (7)
--	------------------------------

<b>LICENSING BASIS PCT + MARGIN ALLOCATIONS</b>	<b>PCT = 1637°F</b>
---	---------------------

<b>CUMULATIVE ABSOLUTE MAGNITUDE OF PCT CHANGES SINCE LAST 30-DAY REPORT (LETTER ET 99-0024)</b>	<b><math>\Sigma \Delta PCT  = 35^\circ F</math></b>
--	---



Notes/References:

1. Westinghouse Topical Report WCAP-13456, "Wolf Creek Generating Station NSSS Rerating Licensing Report," October 1992.
2. Westinghouse to WCNOG letter SAP-00-104, "Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station, 10 CFR 50.46 Notification and Reporting for 1999," February 23, 2000.
3. Westinghouse to WCNOG letter SAP-90-148, "Wolf Creek Nuclear Operating Corporation, RCS Loose Parts Evaluation," April 18, 1990.
4. Westinghouse to WCNOG 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 WCNOG 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 WCNOG 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 WCNOG 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 WCNOG 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 WCNOG 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.