**Tennessee Valley Authority**, 1101 Market Street, Chattanooga, Tennessee 37402-2801

December 30, 2009

10 CFR 50.46

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

Watts Bar Nuclear Plant, Unit 1
Facility Operating License No. NPF-90
NRC Docket No. 50-390

Subject: **Watts Bar Nuclear Plant Unit 1 - Emergency Core Cooling System Evaluation Model Changes - Annual Notification and Reporting**

Reference: Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - Annual Notification and Reporting, dated July 2, 2008.

This letter provides the annual update report required by 10 CFR 50.46. The enclosed information addresses changes or errors in the WBN ECCS evaluation model that affect calculation of peak clad temperature (PCT). This report covers the period from WBN's last 10 CFR 50.46 annual report, which was submitted by the referenced letter, through September 2009. WBN's ECCS evaluation model is contractually maintained by Westinghouse Electric Company, who provided the enclosed updates.

The changes to the model that have been made since our last update are described in Enclosure 1. The changes listed in Enclosure 1 had no impact on the calculated PCT for WBN. This update includes the 20°F Cycle 9-specific penalty previously identified in the referenced letter. The PCT margin allocations resulting from the changes since the Analysis of Record are summarized in the rackup sheets provided in Enclosure 2, which includes both Cycle 9 and general rackup sheets.

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NRR

There are no regulatory commitments associated with this submittal. Please direct any questions concerning this matter to Kevin Casey, Senior Project Manager, at (423) 751-8523.

Respectfully,

FOR
R. M. Krich
Vice President
Nuclear Licensing

Enclosures:
1. Changes to the Evaluation Model
2. Rack-Up Sheets

cc (Enclosures):

NRC Regional Administrator – Region II

NRC Resident Inspector – Watts Bar Nuclear Plant

# ENCLOSURE 1

## Changes to Emergency Core Cooling System Evaluation Model

**ERRORS IN REACTOR VESSEL LOWER PLENUM SURFACE AREA CALCULATIONS (Non-Discretionary Change)**

**Background**

Two errors were discovered in the calculations of reactor vessel lower plenum surface area. The corrected values have been evaluated for impact on current licensing-basis analysis results and will be incorporated on a forward-fit basis. 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 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

**Estimated Effect**

The differences in vessel lower plenum surface area are relatively minor and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

**DISCREPANCY IN METAL MASSES USED FROM DRAWINGS**
**(Non-Discretionary Change)**

**Background**
Discrepancies were discovered in the use of metal masses from drawings. The updated reactor vessel metal masses and fluid volumes have been evaluated for impact on current licensing-basis analysis results and will be incorporated on a forward-fit basis. 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 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

**Estimated Effect**
The differences in the reactor vessel metal mass and fluid volume are relatively minor and would be expected to produce a negligible effect on large and small break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

**GENERAL CODE MAINTENANCE**
**(Discretionary Change)**

**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
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

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

## GENERAL CODE MAINTENANCE
**(Discretionary Change)**

### Background
A number of coding changes were made as part of normal code maintenance. Examples include additional information in code outputs, improved automation and diagnostics in the codes, increased code dimensions, and general code cleanup. All of these changes are considered to be Discretionary changes in accordance with Section 4.1.1 of WCAP-13451.

### Affected Evaluation Model(s)
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

### Estimated Effect
The nature of these changes leads to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

**HOTSPOT BURST TEMPERATURE LOGIC ERRORS**
**(Non-Discretionary Change)**

**Background**
The HOTSPOT code has been updated to incorporate the following corrections to the burst temperature logic: (1) change the rod internal pressure used to calculate the cladding engineering hoop stress from the value in the previous time step to the value in the current time step; (2) revise the average cladding heat-up rate calculation to reset selected variables to zero at the beginning of each trial and use the instantaneous heat-up rate when fewer than five values are available; and, (3) reflect the assumed saturation of ramp rate effects above 28°C/s for Zircaloy-4 cladding from Equation 7-66 of Reference 1. 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)**
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

**Estimated Effect**
Sample calculations for each change showed no effect on peak cladding temperature, leading to an estimated impact of 0°F for 10 CFR 50.46 reporting purposes.

**Reference(s)**
1. WCAP-12945-P-A, Volume 1 (Revision 2) and Volumes 2-5 (Revision 1), "Code Qualification Document for Best Estimate LOCA Analysis," S. M. Bajorek et al., March 1998.

**CCFL GLOBAL VOLUME ERROR**
**(Non-Discretionary Change)**

**Background**
An error was identified during the course of a recent Best Estimate Large Break LOCA analysis in which the volume between the core barrel and the baffle plates in the CCFL region above the active fuel length was modeled incorrectly. The corrected values have been evaluated for impact on the current licensing-basis analysis results. This error represents a non-discretionary change in accordance with Section 4.1.2 of WCAP-13451.

**Affected Evaluation Model(s)**
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM

**Estimated Effect**
The CCFL global volume modeling error has been generically evaluated to have a negligible impact on PCT for affected analyses and a penalty of 0 °F is assigned.

**DISCREPANCY IN METAL MASSES USED FROM DRAWINGS**
**(Non-Discretionary Change)**

**Background**
Discrepancies were discovered in the use of Lower Support Plate (LSP) metal masses from drawings. The updates LSP metal masses have been evaluated for impact on current licensing-basis analysis results and will be incorporated on a forward-fit basis. 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)**
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection
2004 Westinghouse Realistic Large Break LOCA Evaluation Model Using ASTRUM
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

**Estimated Effect**
The Lower Support Plate mass error is relatively minor and would be expected to have a negligible effect on the Best-Estimate large break LOCA analysis results, leading to an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

# ENCLOSURE 2

## Peak Clad Temperature Rackup Sheets

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# Cycle 9, RSG Composite

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | COD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | Clad Temp (°F) |
|---|---|
| **LICENSING BASIS** | |
| **Analysis-Of-Record PCT** | **1892** |
| **PCT ASSESSMENTS (Delta PCT)** | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | |
| 1 . Vessel Channel DX Error | -4 |
| 2 . MONTECF Decay Heat Uncertainty Error | 4 |
| 3 . Input Error Resulting in Incomplete Solution Matrix | 0 |
| 4 . Tavg Bias Error | 8 |
| 5 . Revised Blowdown Heatup Uncertainty Distribution | 5 |
| 6 . HOTSPOT Fuel Relocation Error | 65 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | |
| 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | -131 |
| 2 . Increased Accumulator Temperature Range Evaluation | 4 |
| 3 . 1.4% Uprate Evaluation | 12 |
| 4 . Increased Stroke Time for the ECCS Valves | 0 |
| 5 . Replacement Steam Generators (D3 to 68AXP) | -10 |
| 6 . PMID Violation Evaluation | 20 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | |
| 1 . None | 0 |
| **D. OTHER** | |
| 1 . None | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** 1865 |

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# Cycle 9, RSG

# Reflood 1

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | COD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | Clad Temp (°F) |
|---|---|
| **LICENSING BASIS** | |
| **Analysis-Of-Record PCT** | **1656** |
| **PCT ASSESSMENTS (Delta PCT)** | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | |
| 1 . Vessel Channel DX Error | 56 |
| 2 . MONTECF Decay Heat Uncertainty Error | 4 |
| 3 . Input Error Resulting in Incomplete Solution Matrix | 60 |
| 4 . Tavg Bias Error | 8 |
| 5 . Revised Blowdown Heatup Uncertainty Distribution | 5 |
| 6 . HOTSPOT Fuel Relocation Error | 0 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | |
| 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | -37 |
| 2 . Increased Accumulator Temperature Range Evaluation | 4 |
| 3 . 1.4% Uprate Evaluation | 12 |
| 4 . Increased Stroke Time for the ECCS Valves | 0 |
| 5 . Replacement Steam Generators (D3 to 68AXP) | -50 |
| 6 . PMID Violation Evaluation | 20 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | |
| 1 . None | 0 |
| **D. OTHER** | |
| 1 . None | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** 1738 |

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# Cycle 9, RSG

# Reflood 2

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | COD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | Clad Temp (°F) |
|---|---|
| **LICENSING BASIS** | |
| **Analysis-Of-Record PCT** | **1892** |
| **PCT ASSESSMENTS (Delta PCT)** | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | |
| 1 . Vessel Channel DX Error | -4 |
| 2 . MONTECF Decay Heat Uncertainty Error | 4 |
| 3 . Input Error Resulting in Incomplete Solution Matrix | 0 |
| 4 . Tavg Bias Error | 8 |
| 5 . Revised Blowdown Heatup Uncertainty Distribution | 5 |
| 6 . HOTSPOT Fuel Relocation Error | 65 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | |
| 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | -131 |
| 2 . Increased Accumulator Temperature Range Evaluation | 4 |
| 3 . 1.4% Uprate Evaluation | 12 |
| 4 . Increased Stroke Time for the ECCS Valves | 0 |
| 5 . Replacement Steam Generators (D3 to 68AXP) | -10 |
| 6 . PMID Violation Evaluation | 20 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | |
| 1 . None | 0 |
| **D. OTHER** | |
| 1 . None | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** 1865 |

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# RSG

# Composite

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | CQD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | Clad Temp (°F) |
|---|---|
| **LICENSING BASIS** | |
| **Analysis-Of-Record PCT** | **1892** |
| **PCT ASSESSMENTS (Delta PCT)** | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | |
| 1 . Vessel Channel DX Error | -4 |
| 2 . MONTECF Decay Heat Uncertainty Error | 4 |
| 3 . *Input Error Resulting in Incomplete Solution Matrix* | *0* |
| 4 . Tavg Bias Error | 8 |
| 5 . Revised Blowdown Heatup Uncertainty Distribution | 5 |
| 6 . HOTSPOT Fuel Relocation Error | 65 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | |
| 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | -131 |
| 2 . Increased Accumulator Temperature Range Evaluation | 4 |
| 3 . 1.4% Uprate Evaluation | 12 |
| 4 . Increased Stroke Time for the ECCS Valves | 0 |
| 5 . Replacement Steam Generators (D3 to 68AXP) | -10 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | |
| 1 . None | 0 |
| **D. OTHER** | |
| 1 . None | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** 1845 |

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# RSG

# Reflood 1

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | CQD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | | Clad Temp (°F) |
|---|---|---|
| **LICENSING BASIS** | | |
| | **Analysis-Of-Record PCT** | **1656** |
| **PCT ASSESSMENTS (Delta PCT)** | | |
| | **A. PRIOR ECCS MODEL ASSESSMENTS** | |
| | 1 . Vessel Channel DX Error | 56 |
| | 2 . MONTECF Decay Heat Uncertainty Error | 4 |
| | 3 . Input Error Resulting in Incomplete Solution Matrix | 60 |
| | 4 . Tavg Bias Error | 8 |
| | 5 . Revised Blowdown Heatup Uncertainty Distribution | 5 |
| | 6 . HOTSPOT Fuel Relocation Error | 0 |
| | **B. PLANNED PLANT MODIFICATION EVALUATIONS** | |
| | 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | -37 |
| | 2 . Increased Accumulator Temperature Range Evaluation | 4 |
| | 3 . 1.4% Uprate Evaluation | 12 |
| | 4 . Increased Stroke Time for the ECCS Valves | 0 |
| | 5 . Replacement Steam Generators (D3 to 68AXP) | -50 |
| | **C. 2008 ECCS MODEL ASSESSMENTS** | |
| | 1 . None | 0 |
| | **D. OTHER** | |
| | 1 . None | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | | **PCT =** 1718 |

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

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

# RSG

# Reflood 2

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | COD (1996) | **Analysis Date:** | 8/1/98 | **Limiting Break Size:** | Guillotine |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | Vantage + | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | | Clad Temp (°F) |
|---|---|---|
| **LICENSING BASIS** | | |
| **Analysis-Of-Record PCT** | | 1892 |
| **PCT ASSESSMENTS (Delta PCT)** | | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | | |
| 1 . Vessel Channel DX Error | | -4 |
| 2 . MONTECF Decay Heat Uncertainty Error | | 4 |
| 3 . *Input Error Resulting in Incomplete Solution Matrix* | | *0* |
| 4 . Tavg Bias Error | | 8 |
| 5 . Revised Blowdown Heatup Uncertainty Distribution | | 5 |
| 6 . HOTSPOT Fuel Relocation Error | | 65 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | | |
| 1 . Accumulator Line/Pressurizer Surge Line Data Evaluation | | -131 |
| 2 . Increased Accumulator Temperature Range Evaluation | | 4 |
| 3 . 1.4% Uprate Evaluation | | 12 |
| 4 . Increased Stroke Time for the ECCS Valves | | 0 |
| 5 . Replacement Steam Generators (D3 to 68AXP) | | -10 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | | |
| 1 . None | | 0 |
| **D. OTHER** | | |
| 1 . None | | 0 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** | 1845 |

**Westinghouse LOCA Peak Clad Temperature Summary for Appendix K Small Break**

**RSG**

**Plant Name:** Watts Bar Unit 1
**Utility Name:** Tennessee Valley Authority

**Analysis Information**

| | | | | | |
|---|---|---|---|---|---|
| **EM:** | NOTRUMP | **Analysis Date:** | 5/17/04 | **Limiting Break Size:** | 4 inch |
| **FQ:** | 2.5 | **FdH:** | 1.65 | | |
| **Fuel:** | RFA-2 | **SGTP (%):** | 12 | | |
| **Notes:** | Mixed Core - Vantage + / Performance + / RFA-2 | | | | |

| | | Clad Temp (°F) |
|---|---|---|
| **LICENSING BASIS** | | |
| **Analysis-Of-Record PCT** | | 1132 |
| **PCT ASSESSMENTS (Delta PCT)** | | |
| **A. PRIOR ECCS MODEL ASSESSMENTS** | | |
| 1 . None | | 0 |
| **B. PLANNED PLANT MODIFICATION EVALUATIONS** | | |
| 1 . Increased Stroke Time for the ECCS Valves | | 0 |
| **C. 2008 ECCS MODEL ASSESSMENTS** | | |
| 1 . None | | 0 |
| **D. OTHER** | | |
| 1 . Leaking SIS Relief Valve | | 120 |
| **LICENSING BASIS PCT + PCT ASSESSMENTS** | **PCT =** | 1252 |