



Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

April 25, 2013

10 CFR 50.46

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

Watts Bar Nuclear Plant, Units 1 and 2
Facility Operating License No. NPF-90
Construction Permit No. CPPR-92
NRC Docket Nos. 50-390 and 50-391

Subject: **10 CFR 50.46 - 30-Day Report and Annual Report for 2012**

- References:
1. TVA Letter to NRC, "10 CFR 50.46 Annual Report for Model Year 2011," dated April 25, 2012 [ML12117A261]
 2. TVA Letter to NRC, "10 CFR 50.46 - 30-Day Special Report," dated October 18, 2012 [ML12296A254]
 3. TVA Letter to NRC, "Supplement to 10 CFR 50.46 - 30-Day Special Report," dated February 13, 2013 [ML13046A002]
 4. TVA Letter to NRC, "10 CFR 50.46 - 30-Day Report for Watts Bar, Unit 1," dated March 19, 2013 [ML13080A405]
 5. NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplement 24, published September 2011 [ML11277A148]

The purpose of this letter is to provide a 30-day report of changes and errors to the calculated peak cladding temperatures (PCTs) for the Watts Bar Nuclear Plant (WBN) Unit 1 Emergency Core Cooling System (ECCS) evaluation models. This report also serves as the 2012 annual report of the status of the ECCS models and calculated PCTs for WBN Units 1 and 2. This report is required in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," paragraph (a)(3)(ii). The annual report is due by April 30, 2013.

The enclosed report provides a summary of the changes and errors to the calculated PCTs for the limiting ECCS analyses, including the changes made since submittal of the previous annual report (Reference 1) and subsequent 30-day reports (References 2, 3, and 4) for WBN Unit 1.

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In addition, based on Nuclear Regulatory Commission (NRC) acceptance of the ECCS Large Break Loss of Coolant Accident (LBLOCA) and Small Break LOCA (SBLOCA) analyses for WBN Unit 2, as documented in Reference 5, the enclosed report includes the initial 10 CFR 50.46(a)(3)(ii) annual reporting of the ECCS evaluation model analyses of records (AORs) and calculated PCTs for WBN Unit 2.

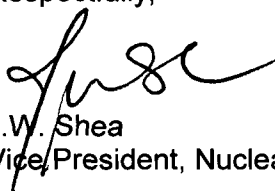
The PCT changes and errors identified for WBN Unit 1 in the Reference 4 report submitted on March 19, 2013, when expressed as the cumulative sums of the absolute magnitudes, exceed 50 degrees Fahrenheit (°F). In accordance with 10 CFR 50.46(a)(3)(ii), a holder of an operating license or construction permit is required to report changes and errors affecting the ECCS LBLOCA and SBLOCA evaluation models to the NRC within 30 days when the cumulative sum of the absolute magnitudes of the resulting PCT changes exceeds 50°F. The licensee is also required to include with the report a proposed schedule for providing a re-analysis or taking other action, as may be needed, to show compliance with the 10 CFR 50.46 requirements.

This report constitutes a 30-day report for WBN Unit 1 because previously unreported changes and errors affecting the ECCS LBLOCA and SBLOCA evaluation model analysis of record (AORs) for Unit 1 were identified in the 2012 annual summary report of PCT changes provided to Tennessee Valley Authority (TVA) by the Westinghouse Electric Company (WEC). The WEC 2012 annual summary report is dated March 4, 2013. A 30-day report is required for WBN Unit 1 because the cumulative sum of the absolute magnitudes of the previously reported changes to the LBLOCA baseline PCT exceeds the 50°F threshold for 30-day reporting. The timeliness for the TVA review and reporting of this 30-day report is being examined under the TVA Corrective Action Program. This report also satisfies the 2012 annual reporting requirements. Combining these reports avoids coincident reporting of essentially duplicative information for WBN Unit 1. No special 30-day reporting is required for WBN Unit 2 because the two reported errors affecting the Unit 2 ECCS LBLOCA evaluation model AOR do not exceed the 50°F threshold.

The enclosed report demonstrates that the calculated PCTs for the ECCS LBLOCA and SBLOCA AORs for WBN Units 1 and 2 are well below the limit of 2200°F. This provides the requisite demonstration of compliance with the 10 CFR 50.46 requirements. Therefore, TVA has concluded that no schedule for re-analysis or other action to show compliance is required.

There are no regulatory commitments in this letter. Please direct questions concerning this report to Clyde Mackaman at (423) 751-2834.

Respectfully,


J.W. Shea
Vice President, Nuclear Licensing

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cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant

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In accordance with the reporting requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.46(a)(3)(ii), the following is a summary of the limiting design basis loss of coolant accident (LOCA) analysis results established using the current Watts Bar Nuclear Plant (WBN) Emergency Core Cooling System (ECCS) evaluation models for Units 1 and 2. This report describes the changes and errors affecting the calculated peak cladding temperatures (PCTs) since the last annual report, including changes and errors identified since the most recent 30-day report of significant PCT changes was submitted.

The last 10 CFR 50.46 annual report for WBN Unit 1 was submitted to the United States Nuclear Regulatory Commission (NRC) on April 25, 2012 (Reference 1). A 10 CFR 50.46 - 30-Day Report for WBN Unit 1 was submitted to the NRC on March 19, 2013 (Reference 2). As indicated in these previous reports, Westinghouse Electric Company (WEC) WCAP-14839, Revision 1, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Watts Bar Nuclear Plant" (Reference 5), is the current Best Estimate Large Break LOCA (BE LBLOCA) analysis of record (AOR) for Unit 1, with a baseline PCT of 1892 degrees Fahrenheit (°F). The current Small Break LOCA (SBLOCA) AOR for Unit 1 is WTV-RSG-06-015, "LOCA & Non-LOCA Analysis Summary for Replacement Steam Generator for WBN Unit 1" (Reference 6), with a baseline PCT of 1132°F.

This report constitutes the first annual report for WBN Unit 2 in accordance with 10 CFR 50.46(a)(3)(ii). Unit 2 is holder of Construction Permit No. CPPR-92, and is currently in the latter stages of construction, with the application for an Operating License under review by the NRC. The NRC has approved the ECCS design features and associated LBLOCA and SBLOCA analyses. As documented in NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplement 24 (Reference 13), the NRC staff concluded that TVA has demonstrated compliance for WBN Unit 2 with the requirements set forth in 10 CFR 50.46; 10 CFR Part 50, Appendix K; and General Design Criteria (GDC) 4, 27, and 35.

The current BE LBLOCA AOR for WBN Unit 2 is WEC WCAP-17093-P, "Best-Estimate Analysis of the Large-Break Loss of Coolant Accident for Watts Bar Unit 2 Nuclear plant Using the ASTRUM Methodology" (Reference 14), as supplemented for the effects of thermal conductivity degradation (TCD) and peaking factor burndown. The BE LBLOCA AOR for Unit 2, as supplemented, was accepted by the NRC as documented in Reference 13, and results in a baseline PCT of 1727°F. The current SBLOCA AOR for Unit 2 is WBT-D-1460, "Final Small Break LOCA Summary Report for WBN Unit 2" (Reference 15), which has a baseline PCT of 1184°F. The SBLOCA AOR for Unit 2 was accepted by the NRC as documented in Reference 13.

Tables 1 and 2 detail the accumulated PCT effects resulting from the changes and errors in the LBLOCA and SBLOCA analyses since each of the respective AORs (References 5, 6, 13, 14, and 15) was established for WBN Units 1 and 2. Changes and errors that were not previously identified in either the most recent 10 CFR 50.46 annual report or 30-day report are detailed in the notes section following the tables.

As indicated in Table 1 for WBN Unit 1, the current updated (net) licensing basis PCT for the LBLOCA is 1880°F, and is unchanged from the most recent 10 CFR 50.46 30-day report for Unit 1 (Reference 2). This is a 12°F decrease relative to the BE LBLOCA AOR baseline PCT, and represents a 15°F increase in PCT from the last annual report (Reference 1). The Unit 1

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updated (net) licensing basis PCT value of 1132°F for the SBLOCA is unchanged from the SBLOCA AOR baseline PCT, as reflected in the previous reports.

As indicated in Table 2 for WBN Unit 2, the current updated (net) licensing basis PCT for the LBLOCA is 1727°F. The Unit 2 updated (net) licensing basis PCT for the SBLOCA is 1184°F. These PCT values are unchanged from their respective AOR baseline PCTs.

In accordance with 10 CFR 50.46(a)(3)(ii), future changes affecting WBN Unit 1 will be considered significant for reporting purposes because the absolute magnitude of the accumulated changes and errors to the calculated PCT since the last LBLOCA re-analysis was performed (Reference 5) exceeds 50°F.

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**TABLE 1
(Sheet 1 of 2)**

Summary of Changes to WBN Unit 1 PCT for LBLOCA and SBLOCA

Year	Description	LBLOCA ΔPCT (°F)	LBLOCA ΔPCT (°F)	SBLOCA ΔPCT (°F)	SBLOCA ΔPCT (°F)	Notes	References
1998	BE LBLOCA AOR Baseline PCT	1892	---	---	---	---	5
2006	SBLOCA AOR Baseline PCT	---	---	1132	---	---	6
1999	Vessel Channel DX Error	-4	4	---	---	---	7
2000	Increased Accumulator Room Temperature Evaluation	4	4	---	---	---	7
2000	1.4% Uprate Evaluation	12	12	---	---	---	7
2000	Accumulator Line/Pressurizer Surge Line Data Evaluation	-131	131	---	---	---	7
2000	MONTECF Decay Heat Uncertainty Error	4	4	---	---	---	8
2001	WBN Specific LBLOCA Vessel Geometry Input Errors	0	0	---	---	---	9
2003	Input Error Resulting in Incomplete Solution Matrix	0	0	---	---	---	10
2003	Tavg Bias Error	8	8	---	---	---	10
2004	Increased Stroke Time for ECCS Valves	0	0	---	---	---	11
2004	Revised Blowdown Heatup Uncertainty Distribution	5	5	---	---	---	11
2006	Replacement Steam Generators (D3 to 68AXP)	-10	10	0	0	---	12
2006	HOTSPOT™ Fuel Relocation Error	65	65	0	0	---	12

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**TABLE 1
(Sheet 2 of 2)**

Summary of Changes to WBN Unit 1 PCT for LBLOCA and SBLOCA

Year	Description	LBLOCA ΔPCT (°F)	LBLOCA ΔPCT (°F)	SBLOCA ΔPCT (°F)	SBLOCA ΔPCT (°F)	Notes	References
2012	PMID/PBOT Violation Evaluation	20	20	0	0	---	3, 4
2012	TCD and Peaking Factor Burndown	15	15	---	---	---	3, 4
2013	WCOBRA/TRAC™ History File Dimension Error	0	0	---	---	---	2
2013	General Code Maintenance	0	0	---	---	1	---
2013	HOTSPOT™ Burst Temperature Calculation for ZIRLO™ Cladding	0	0	---	---	2	---
2013	HOTSPOT™ Iteration Algorithm for Calculation Initial Fuel Pellet Average Temperature	0	0	---	---	3	---
2013	WCOBRA/TRAC™ Automated Restart Process Logic Error	0	0	---	---	4	---
2013	Rod Internal Pressure Calculation Error	0	0	---	---	5	---
2013	NOTRUMP-EM™ Evaluation of Fuel Pellet TCD	---	---	0	0	6	---
---	Updated (net) licensing basis PCT AOR PCT + $\sum \Delta$ PCT	1880	---	1132	---	---	---
---	Cumulative sum of PCT changes $\sum \Delta$ PCT	---	278	---	0	---	---

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TABLE 2

Summary of Changes to WBN Unit 2 PCT for LBLOCA and SBLOCA

Year	Description	LBLOCA Δ PCT (°F)	LBLOCA Δ PCT (°F)	SBLOCA Δ PCT (°F)	SBLOCA Δ PCT (°F)	Notes	References
2011	BE LBLOCA AOR Baseline PCT ^{1,2}	1727	---	---	---	---	13, 14
2011	SBLOCA AOR Baseline PCT ²	---	---	1184	---	---	13, 15
2013	Upper Core Plate Input Error	0	0	---	---	7	---
2013	Low Power Guide Tube Channel 37 Input Error	0	0	---	---	8	---
---	Updated (net) licensing basis PCT AOR PCT + $\sum \Delta$ PCT	1727	---	1184	---	---	---
---	Cumulative sum of PCT changes $\sum \Delta$ PCT	---	0	---	0	---	---

¹ BE LBLOCA AOR Baseline PCT value incorporates the analyzed effects from TCD and peaking factor burndown

² NRC acceptance documented in NUREG-0847, Supplement 24

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NOTES:

1) General Code Maintenance

Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include 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 are discretionary.

These changes have a 0°F effect on the WBN Unit 1 LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 1 LBLOCA analysis. No such optimization was performed on the SBLOCA AORs and WBN Unit 2 LBLOCA AOR, and they are unaffected by these changes.

2) HOTSPOT™ Burst Temperature Calculation for ZIRLO™ Cladding

A problem was identified in the calculation of the burst temperature for ZIRLO™ cladding in the HOTSPOT™ code when the cladding engineering hoop stress exceeds 15,622 pounds per square inch (psi). This problem results in either program failure or an invalid extrapolation of the burst temperature versus the calculated engineering hoop stress table.

The errors resulting from this problem have been estimated to have a 0°F effect on the WBN Unit 1 LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 1 LBLOCA analysis. The SBLOCA AORs and the WBN Unit 2 LBLOCA AOR are unaffected by this change.

3) HOTSPOT™ Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature

The HOTSPOT™ code has been updated to incorporate the following corrections to the iteration algorithm for calculating the initial fuel pellet average temperature: 1) bypass the iteration when the input value satisfies the acceptance criterion; 2) prevent low-end extrapolation of the gap heat transfer coefficient; 3) prevent premature termination of the iteration that occurred under certain conditions; and 4) prevent further adjustment of the gap heat transfer coefficient after reaching the iteration limit.

These changes have been estimated to have a 0°F effect on the WBN Unit 1 LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 1 LBLOCA analysis. The SBLOCA AORs and the WBN Unit 2 LBLOCA AOR are unaffected by this change.

4) WCOBRA/TRAC™ Automated Restart Process Logic Error

A minor error was identified in the WCOBRA/TRAC™ Automated Restart Process (WARP) logic defining the Double-Ended Guillotine (DEG) break tables. The error has been evaluated for effect on current licensing basis analysis results and will be incorporated into the plant-specific analyses on a forward fit basis.

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This error has been estimated to have a 0°F effect on the WBN Unit 1 LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 1 LBLOCA analysis. The SBLOCA AORs and the WBN Unit 2 LBLOCA AOR are unaffected by this error.

5) Rod Internal Pressure Calculation Error

Several issues which affect the calculation of rod internal pressure (RIP) have been identified for certain BE LBLOCA evaluation models. These issues include the sampling of rod internal pressure uncertainty, updating HOTSPOT™ to consider the effect of transient RIP variations in the application of uncertainty, and generating RIPs at a consistent rod power.

This error has been estimated to have a 0°F effect on the WBN Unit 1 LBLOCA AOR ECCS PCT. WEC has adequately incorporated the effect of this error into TCD evaluations. Potential effects are limited to the WBN Unit 1 LBLOCA analysis. The SBLOCA AORs and the WBN Unit 2 LBLOCA AOR are unaffected by this error.

6) NOTRUMP-EM Evaluation of Fuel Pellet TCD

An evaluation has been completed to estimate the effect of fuel pellet TCD on PCT for plants in the United States using the WEC SBLOCA Evaluation Model with NOTRUMP.

Fuel pellet TCD has been estimated to have a 0°F effect on the WBN Unit 1 SBLOCA AOR ECCS PCT based on the phenomena and physics of the SBLOCA transient. WEC has concluded that TCD has a negligible effect on the limiting cladding temperature transient. Potential effects are limited to the WBN Unit 1 SBLOCA analysis. The LBLOCA AORs and the WBN Unit 2 SBLOCA AOR are unaffected by this error.

7) Upper Core Plate Input Error (WBN Unit 2 only)

An input error was made in the modeling of the Upper Core Plate (UCP) in the WBN Unit 2 BE LBLOCA analysis. This error resulted in a slight under-prediction of the estimated metal mass in the WBN Unit 2 reactor vessel model.

This error has been estimated to have a 0°F effect on the WBN Unit 2 BE LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 2 BE LBLOCA AOR.

8) Low Power Guide Tube Channel 37 Input Error (WBN Unit 2 only)

An input error was made in the modeling of Low Power Guide Tube Channel 37 of the WBN Unit 2 ASTRUM analysis. This error resulted in a small under-prediction of the momentum area at the bottom of Channel 37 (at the UCP elevation).

This error has been estimated to have a 0°F effect on the WBN Unit 2 BE LBLOCA AOR ECCS PCT. Potential effects are limited to the WBN Unit 2 BE LBLOCA AOR.

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REFERENCES

1. Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Model Year 2011," dated April 25, 2012 [ML12117A261]
2. Letter from TVA to NRC, "10 CFR 50.46 - 30-Day Report for Watts Bar Unit 1," dated March 19, 2013 [ML13046A002]
3. Letter from TVA to NRC, "Supplement to 10 CFR 50.46 - 30-Day Special Report," dated February 13, 2013 [ML13046A002]
4. Letter from TVA to NRC, "10 CFR 50.46 - 30-Day Special Report," dated October 18, 2012 [ML12296A254]
5. WCAP-14839, Revision 1, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Watts Bar Nuclear Plant," September 1998
6. WTV-RSG-06-015, "LOCA & Non-LOCA Analysis Summary for Replacement Steam Generator," February 2006
7. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - 30-Day Report and Annual Notification and Reporting for 2000," dated October 26, 2000 [ML003764646]
8. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - 30-Day Report and Revised Annual Notification Report for 2000," dated September 7, 2001 [ML012570290]
9. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - Annual Notification and Reporting for 2001," dated April 3, 2002 [ML021070404]
10. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - 30-Day Report and Revised Annual Notification and Reporting for 2003," dated April 19, 2004 [ML041130196]
11. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - Annual Notification and Reporting for 2004," dated April 19, 2005 [ML051120164]
12. Letter from TVA to NRC, "Watts Bar Nuclear Plant (WBN) Unit 1 - Emergency Core Cooling System (ECCS) Evaluation Model Changes - 30-Day Report and Annual Notification and Reporting for 2006," dated July 3, 2007 [ML071860388]
13. NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplement 24, published September 2011 [ML11277A148]

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14. WCAP-17093-P, "Best-Estimate Analysis of the Large-Break Loss of Coolant Accident for Watts Bar Unit 2 Nuclear Plant Using the ASTRUM Methodology," December 2009
15. WBT-D-1460, "Final Small Break LOCA Summary Report for WBN Unit 2," January 2010