



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

CNL-16-057

March 18, 2016

10 CFR 50.4
10 CFR 50.46

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

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

Watts Bar Nuclear Plant, Unit 2
Facility Operating License No. NPF-96
NRC Docket No. 50-391

Subject: **10 CFR 50.46 - Annual Report for Watts Bar Nuclear Plant Units 1 and 2**

Reference: 1. TVA Letter to NRC, CNL-15-053, "10 CFR 50.46 - 30-Day and Annual Report for Watts Bar, Units 1 and 2," dated March 30, 2015 [ML15098A124]

The purpose of this letter is to provide the annual report of changes and errors to the calculated peak cladding temperature (PCT) for the Watts Bar Nuclear Plant (WBN) Units 1 and 2, Emergency Core Cooling System (ECCS) evaluation model. 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 Tennessee Valley Authority (TVA) submitted the last 10 CFR 50.46 annual report for WBN Units 1 and 2 to the Nuclear Regulatory Commission (NRC) in the referenced letter. As indicated in the enclosure, there are no changes to the current updated (net) licensing basis PCT for the WBN Unit 1 large break loss of coolant accident (LBLOCA) and the updated (net) licensing basis PCT for the WBN Unit 1 small break loss of coolant accident (SBLOCA). Similarly, there are no changes to the current updated (net) licensing basis PCT for the WBN Unit 2 LBLOCA and the updated (net) licensing basis PCT for the WBN Unit 2 SBLOCA.

There are no new regulatory commitments in this letter. Please address any questions regarding this response to Mr. Gordon Arent at 423-365-2004.

U.S. Nuclear Regulatory Commission
CNL-16-057
Page 2
March 18, 2016

Respectfully,



K. T. Walsh
Site Vice President
Watts Bar Nuclear Plant

Enclosure:

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

cc (Enclosures):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Watts Bar Nuclear Plant, Unit 1
NRC Senior Resident Inspector - Watts Bar Nuclear Plant, Unit 2
Division of Radiological Health - State of Tennessee

U.S. Nuclear Regulatory Commission
CNL-16-057
Page 3
March 18, 2016

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TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

In accordance with the reporting requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46(a)(3)(ii), the Tennessee Valley Authority (TVA) is providing the following 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 evaluation models for WBN Units 1 and 2. This report describes the changes and errors affecting the calculated peak cladding temperatures (PCTs) since the last analysis of record was submitted to the Nuclear Regulatory Commission (NRC).

TVA submitted the last 10 CFR 50.46 annual report for WBN Units 1 and 2 to the NRC on March 30, 2015 (Reference 1).

Table 1 lists the changes and errors in the large break LOCA (LBLOCA) analysis for WBN Unit 1 since the last analysis of record (AOR) and the associated effect on PCT. For 2015, there were no new changes or errors to report for the LBLOCA analysis. Table 2 lists the changes and errors in the small break LOCA (SBLOCA) analyses for WBN Unit 1 since the last AOR and the associated effect on PCT. The changes that were not previously identified in Reference 1 are described in the notes to Tables 1 and 2.

Table 3 lists the changes and errors in the LBLOCA analysis for WBN Unit 2 since the last AOR and the associated effect on PCT. For 2015, there were no new changes or errors to report for the LBLOCA analysis. Table 4 lists the changes and errors in the SBLOCA analyses for WBN Unit 2 since the last AOR and the associated effect on PCT. The changes that were not previously identified in Reference 1 are described in the notes to Tables 3 and 4.

The updated (net) licensing basis PCT for the LBLOCA and SBLOCA remain unchanged for WBN Units 1 and 2 from the last annual report.

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

Table 1
Watts Bar Unit 1 LBLOCA

Year	Description	Reflood 1		Reflood 2		Note	Reference
		Δ PCT (°F)	Δ PCT (°F)	Δ PCT (°F)	Δ PCT (°F)		
1998	BE LBLOCA AOR PCT	1656	---	1892	---	---	3
1999	Vessel Channel DX Error	56	56	-4	4	---	4
2000	Increased Accumulator Room Temperature Evaluation	4	4	4	4	---	4
2000	1.4% Uprate Evaluation	12	12	12	12	---	4
2000	Accumulator Line/Pressurizer Surge Line Data Evaluation	-37	37	-131	131	---	4
2000	MONTECF Decay Heat Uncertainty Error	4	4	4	4	---	5
2001	WBN Specific LBLOCA Vessel Geometry Input Errors	0	0	0	0	---	6
2003	Input Error Resulting in Incomplete Solution Matrix	60	60	0	0	---	7
2003	Tavg Bias Error	8	8	8	8	---	7
2004	Increased Stroke Time for ECCS Valves	0	0	0	0	---	8
2004	Revised Blowdown Heatup Uncertainty Distribution	5	5	5	5	---	8
2006	Replacement Steam Generators (D3 to 68AXP)	-50	50	-10	10	---	9
2006	HOTSPOT™ Fuel Relocation Error	0	0	65	65	---	9

**ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391**

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

**Table 1
Watts Bar Unit 1 LBLOCA**

Year	Description	Reflood 1		Reflood 2		Note	Reference
		Δ PCT (°F)	Δ PCT (°F)	Δ PCT (°F)	Δ PCT (°F)		
2012	PMID/PBOT Violation Evaluation	20	20	20	20	---	10, 11
2012	TCD and Peaking Factor Burndown	114	114	15	15	---	10, 11
2013	WCOBRA/TRAC™ History File Dimension Error	0	0	0	0	---	12
2013	General Code Maintenance	0	0	0	0	---	13
2013	HOTSPOT™ Burst Temperature Calculation for ZIRLO™ Cladding	0	0	0	0	---	13
2013	HOTSPOT™ Iteration Algorithm for Calculation Initial Fuel Pellet Average Temperature	0	0	0	0	---	13
2013	WCOBRA/TRAC™ Automated Restart Process Logic Error	0	0	0	0	---	13
2013	Rod Internal Pressure Calculation Error	0	0	0	0	---	13
2013	Elevations for Heat Slab Temperature Initialization	0	0	0	0	---	14
2013	Heat Transfer Model Error Corrections	0	0	0	0	---	14
2013	Correction to Heat Transfer Node Initialization	0	0	0	0	---	14
2013	Mass Conservation Error Fix	0	0	0	0	---	14
2013	Correction to Split Channel Momentum Equation	0	0	0	0	---	14

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

Table 1
Watts Bar Unit 1 LBLOCA

Year	Description	Reflood 1		Reflood 2		Note	Reference
		ΔPCT (°F)	$ \Delta PCT $ (°F)	ΔPCT (°F)	$ \Delta PCT $ (°F)		
2013	Heat Transfer Logic Correction for Rod Burst Calculation	0	0	0	0	---	14
2013	Changes to Vessel Superheated Steam Properties	0	0	0	0	---	14
2013	Update to Metal Density Reference Temperatures	0	0	0	0	---	14
2013	Decay Heat Model Error Corrections	0	0	0	0	---	14
2013	Correction to the Pipe Exit Pressure Drop Error	0	0	0	0	---	14
2013	WCOBRA/TRAC File Dimension Error Correction	0	0	0	0	---	14
2013	Revised Heat Transfer Multiplier Distributions	-40	40	-85	85	---	14
2013	HOTSPOT Burst Strain Error	20	20	70	70	---	15
2014	General Computer Code Maintenance	0	0	0	0	---	1
2014	Revised Uncertainty in LBLOCA Monte Carl Simulations	0	0	0	0	---	1
---	Updated (net) licensing basis PCT AOR PCT + $\sum \Delta PCT$	1832	---	1865	---		
---	Cumulative sum of PCT changes $\sum \Delta PCT $	---	430	---	433		

**ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391**

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

**Table 2
Watts Bar Unit 1 SBLOCA**

Year	Description	SBLOCA ΔPCT (°F)	SBLOCA ΔPCT (°F)	Note	Reference
2006	SBLOCA AOR PCT	1132	---	---	16
2013	NOTRUMP-EM™ Evaluation of Fuel Pellet TCD	0	0	---	13
2014	General Computer Code Maintenance	0	0	---	1
2014	Fuel Rod Gap Conductance Error	0	0	---	1
2014	Radiation Heat Transfer Model Error	0	0	---	1
2014	SBLOCTA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation	0	0	---	1
2014	Evaluation of 8-inch Axial Blankets	0	0	---	1
2015	General Computer Code Maintenance	0	0	1	---
2015	Auxiliary Feedwater (AFW) Temperature Increase During Cold Leg Recirculation	0	0	2	---
---	Updated (net) licensing basis PCT AOR PCT + $\sum \Delta$ PCT	1132	---	---	---
---	Cumulative sum of PCT changes $\sum \Delta$ PCT	---	0	---	---

**ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391**

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

Notes:

1. 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.
2. The WBN Unit 1 and WBN Unit 2 AFW temperature during cold leg recirculation may reach a temperature of 130°F. This temperature is an increase in the AFW temperature modeled in the SBLOCA analyses of record. However, there is no effect on the SBLOCA analysis results.

**ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391**

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

**Table 3
Watts Bar Unit 2 LBLOCA**

Year	Description	LBLOCA Δ PCT (°F)	LBLOCA $ \Delta$ PCT (°F)	Note	Reference
2013	LBLOCA AOR PCT	1766	---	---	17
2013	Elevations for Heat Slab Temperature Initialization	0	0	---	19
2013	Heat Transfer Model Error Corrections	0	0	---	19
2013	Correction to Heat Transfer Node Initialization	0	0	---	19
2013	Mass Conservation Error Fix	0	0	---	19
2013	Correction to Split Channel Momentum Equation	0	0	---	19
2013	Heat Transfer Logic Correction for Rod Burst Calculation	0	0	---	19
2013	Changes to Vessel Superheated Steam Properties	0	0	---	19
2013	Update to Metal Density Reference Temperatures	0	0	---	19
2013	Decay Heat Model Error Corrections	0	0	---	19
2013	Correction to the Pipe Exit Pressure Drop Error	0	0	---	19
2013	WCOBRA/TRAC File Dimension Error Correction	0	0	---	19
2013	Revised Heat Transfer Multiplier Distributions	-55	55	---	19
2013	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0	0	---	19
2013	HOTSPOT Burst Strain Error	0	0	---	15

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

Year	Description	LBLOCA ΔPCT (°F)	LBLOCA ΔPCT (°F)	Note	Reference
2014	Cold Leg Accumulator Injection Lines Hydraulic Resistance Changes	0	0	---	2
2014	General Computer Code Maintenance	0	0	---	1
2014	Errors in Decay Group Uncertainty Factors	0	0	---	1
2014	Treatment of Burnup Effects on Thermal Conductivity Degradation	0	0	---	1
---	Updated (net) licensing basis PCT (AOR PCT + $\sum \Delta$ PCT)	1711	---	---	---
---	Cumulative sum of PCT changes $\sum \Delta$ PCT	---	55	---	---

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

Table 4
Watts Bar Unit 2 SBLOCA

Year	Description	SBLOCA Δ PCT (°F)	SBLOCA $ \Delta$ PCT (°F)	Note	Reference
2010	SBLOCA AOR PCT	1184	---	---	18
2014	Cold Leg Accumulator Injection Lines Hydraulic Resistance Changes	0	0	---	2
2014	General Computer Code Maintenance	0	0	---	1
2014	Fuel Rod Gap Conductance Error	0	0	---	1
2014	Radiation Heat Transfer Model Error	0	0	---	1
2014	SBLOCA Pre-DNB Cladding Surface Heat Transfer Coefficient Calculation	0	0	---	1
2015	General Computer Code Maintenance	0	0	1	---
2015	AFW Temperature Increase During Cold Leg Recirculation	0	0	2	---
---	Updated (net) licensing basis PCT (AOR PCT + $\sum \Delta$ PCT)	1184	---	---	---
---	Cumulative sum of PCT changes $\sum \Delta$ PCT	0	0	---	---

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

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ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

References:

1. Letter from TVA to NRC, CNL-15-053, "10 CFR 50.46 - 30-Day and Annual Report for Watts Bar, Units 1 and 2," dated March 30, 2015 [ML15098A124]
2. Letter from TVA to NRC, CNL-15-034, "10 CFR 50.46 - 30-Day Report for Watts Bar, Unit 2" dated February 6, 2015 [ML15037A725]
3. WCAP-14839, Revision 1, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Watts Bar Nuclear Plant," September 1998
4. 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]
5. 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]
6. 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]
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 Revised Annual Notification and Reporting for 2003," dated April 19, 2004 [ML041130196]
8. 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]
9. 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]
10. Letter from TVA to NRC, "Supplement to 10 CFR 50.46 - 30-Day Special Report," dated February 13, 2013 [ML13046A002]
11. Letter from TVA to NRC, "10 CFR 50.46 - 30-Day Special Report," dated October 18, 2012 [ML12296A254]
12. Letter from TVA to NRC, "10 CFR 50.46 - 30-Day Report for Watts Bar Unit 1," dated March 19, 2013 [ML13080A405]
13. Letter from TVA to NRC, "10 CFR 50.46 - 30-Day and Annual Report for 2012," dated April 25, 2013 [ML13120A005]

**ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT UNITS 1 and 2
DOCKET Nos . 50-390 and 50-391**

Watts Bar Nuclear Plant, 10 CFR 50.46 Annual Report for 2015

14. Letter from TVA to NRC, "10 CFR 50.46 - 30 day Report for Watts Bar, Unit 1," dated August 28, 2013 [ML13267A034]
15. Letter from TVA to NRC, CNL-14-035, "10 CFR 50.46 - 30 day Report for Watts Bar, Units 1 and 2," dated February 28, 2014. [ML14064A431]
16. WTV-RSG-06-015, "LOCA & Non-LOCA Analysis Summary for Replacement Steam Generator," February 2006
17. WCAP-17093-P, Revision 1, "Best Estimate Analysis of the Large Break Loss of Coolant Accident for the Watts Bar Unit 2 Nuclear Plant Using the ASTRUM Methodology," June 2013
18. WBT-D-1460, "Final Small Break LOCA Summary Report for WBN Unit 2," January 2010
19. Letter from TVA to NRC, "Watts Bar Nuclear Plant, Unit 2 - Emergency Core Cooling System Evaluation Model Changes - 30 Day Report - 10 CFR 50.46 Notification," dated August 28, 2013. [ML13246A076]