



Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

April 27, 2020

10 CFR 50.4
10 CFR 50.46

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

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3**

- References:
1. TVA Letter to NRC, "10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated May 1, 2019 (ML19122A029)
 2. NRC Letter to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Issuance of Amendments Regarding Extended Power Uprate (CAC Nos. MF6741, MF6742, and MF6743)," dated August 14, 2017 (ML17032A120)
 3. NRC Letter to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Issuance of Amendment Nos. 310, 333, and 293 Regarding Maximum Extended Load Line Limit Analysis Plus (EPID L-2018-LLA-0048)," dated December 26, 2019 (ML19210C308)

The purpose of this letter is to provide the annual report, as required by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, of changes or errors discovered in the emergency core cooling system (ECCS) evaluation model for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3.

Since the previous submittal of an Annual Report, (Reference 1), all three BFN units have now implemented their approved extended power uprate operation (Reference 2). Implementation testing for Unit 1 for Maximum Extended Load Line Limit Analysis Plus (Reference 3) has been completed. Testing for Units 2 and 3 is scheduled for the second quarter of calendar year 2020.

This submittal satisfies the annual reporting requirement of 10 CFR 50.46(a)(3)(ii) for BFN Units 1, 2, and 3.

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As presented in this report, compliance with 10 CFR 50.46 requirements is demonstrated by the calculated peak cladding temperature for all three BFN units remaining below the 2200 degrees Fahrenheit limit. Therefore, TVA has concluded that no proposed schedule for providing a reanalysis or other action is required.

There are no regulatory commitments associated with this submittal. Should you have any questions, please contact J. L. Paul, Site Licensing Manager, at (256) 729-2636.

Respectfully,

APPROVED
By Steven M. Bono at 8:55 am, Apr 27, 2020

Steven M. Bono
Site Vice President
Browns Ferry Nuclear Plant

Enclosure: 10 CFR 50.46 All Unit Annual Report for BFN

cc:

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Browns Ferry Nuclear Plant
NRC Project Manager - Browns Ferry Nuclear Plant
State Health Officer, Alabama Department of Public Health

ENCLOSURE

10 CFR 50.46 ANNUAL REPORT FOR BROWNS FERRY NUCLEAR PLANT, UNIT 1

The Browns Ferry Nuclear Plant (BFN), Unit 1, core contains the ATRIUM™-10XM fuel designs, and a small number of legacy ATRIUM-10 assemblies. The previous 10 CFR 50.46 Report for BFN, was submitted per Reference 1. Since the issuance of Reference 1, a new baseline analysis supporting Maximum Extended Load Line Limit Analysis Plus (MELLLA+) conditions has been generated using the approved methodology; effective with the mid-cycle implementation during Cycle 13.

Fuel Evaluation

Tables 1 and 2 detail the accumulated peak cladding temperature (PCT) impact due to errors and changes in the loss of coolant accident analysis since the previously reported analysis of record (AOR) Reference 1.

Table 1: Cumulative Effect of PCT Changes - BFN, Unit 1 (Legacy ATRIUM™-10)	
Baseline PCT for MELLLA+ conditions (Reference 2)	2086°F
All thermal conductivity degradation effects (Reference 2, Section 5.1)	+ 0°F
RODEX4 Axial PCMI Onset (Reference 5)	+ 0°F
AUTOHUP inputs & options (Reference 5)	- 3°F
Accumulated changes since last baseline analysis	- 3°F
New licensing PCT	2083°F
Absolute value of accumulated changes since last baseline analysis	3°F

Table 2: Cumulative Effect of PCT Changes - BFN, Unit 1 (ATRIUM™-10XM)	
Baseline PCT (Reference 3)	2008°F
Cycle specific fuel design limiting lattice (Reference 4, same issue previously addressed for EPU only analysis basis)	+ 8°F
Rebase lined Heatup Analysis (Reference 4, prior to MELLLA+ implementation)	2016°F
All thermal conductivity degradation effects (References 3-4, Section 5.1)	+ 0°F
RODEX4 Axial PCMI Onset (Reference 5)	+ 0°F
AUTOHUP inputs & options (Reference 5)	+ 2°F
Accumulated changes since last baseline analysis	+ 2°F
New licensing PCT	2018°F
Absolute value of accumulated changes since last baseline analysis	2°F

References

1. Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated May 1, 2019. (ML19122A029)
2. AREVA NP Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limit for ATRIUM™-10 Fuel (EPU MELLLA+)," ANP-3548P Revision 0, March 2017.
3. AREVA NP Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU MELLLA+)," ANP-3547P Revision 0, March 2017.
4. Framatome Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU MELLLA+)," ANP-3547P Revision 1, June 2019.
5. Framatome Inc., "10 CFR 50.46 PCT Error Report for Browns Ferry Units 1 Cycle 13 MELLLA+ Conditions," FS1-0047797, Revision 1, January 2020.

**10 CFR 50.46 ANNUAL REPORT
FOR
BROWNS FERRY NUCLEAR PLANT, UNIT 2**

The Browns Ferry Nuclear Plant (BFN), Unit 2, core contains the ATRIUM™-10XM fuel designs, and a limited number of ATRIUM-11 lead fuel assemblies. The previous 10 CFR 50.46 Annual Report for BFN, was submitted per Reference 1. Since the issuance of Reference 1, no new baseline analysis supporting Extended Power Uprate (EPU) conditions have been generated.

Fuel Evaluation

Tables 3 & 4 detail the accumulated peak cladding temperature (PCT) impact due to errors and changes in the loss of coolant accident analysis since the previously reported analysis of record (AOR) Reference 1.

Table 3: Cumulative Effect of PCT Changes - BFN, Unit 2 (ATRIUM™-11 LFA's)	
Baseline PCT for EPU conditions (Reference 3)	1903°F
All thermal conductivity degradation effects (Reference 3) (Top Lattices Utilizing Top Peaked Power Shape)	+ 0°F
RODEX4 Axial PCMI Onset (Reference 3)	+ 0°F
AUTOHUP inputs & options (Reference 3)	+ 2°F
Accumulated changes since baseline analysis	+ 2°F
New licensing PCT	1905°F
Absolute value of accumulated changes	2°F

Table 4: Cumulative Effect of PCT Changes - BFN, Unit 2 (ATRIUM™-10XM)	
Baseline PCT for EPU conditions (Reference 2)	2016°F
All thermal conductivity degradation effects (References 2, Section 5.1) (Top Lattices Utilizing Top Peaked Power Shape)	+ 0°F
RODEX4 Axial PCMI Onset (Reference 3)	+ 0°F
AUTOHUP inputs & options (Reference 3)	+ 2°F
Accumulated changes since last baseline analysis	+ 2°F
New licensing PCT	2018°F
Absolute value of accumulated changes since last baseline analysis	2°F

References

1. Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated May 1, 2019. (ML19122A029)

2. AREVA NP Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU)," ANP-3378P Revision 4, December 2017.
3. Framatome Inc., "10 CFR 50.46 PCT Error Report for Browns Ferry Units 1, 2, and 3 with EPU conditions," FS1-0037856, Revision 2, January 2020.

**10 CFR 50.46 ANNUAL REPORT
FOR
BROWNS FERRY NUCLEAR PLANT, UNIT 3**

The Browns Ferry Nuclear Plant (BFN), Unit 3, core contains the ATRIUM™-10XM fuel designs, The previous 10 CFR 50.46 Annual Report for BFN, was submitted per Reference 1. Since the issuance of Reference 1, a new baseline analysis supporting Maximum Extended Load Line Limit Analysis Plus (MELLLA+) conditions has been generated using the approved methodology; effective with the startup of Cycle 20.

Fuel Evaluation

Table 5 details the accumulated peak cladding temperature (PCT) impact due to errors and changes in the loss of coolant accident analysis since the previously reported analysis of record (AOR) Reference 1.

Table 5: Cumulative Effect of PCT Changes - BFN, Unit 3 (ATRIUM™-10XM)	
Baseline PCT (Reference 2)	2008°F
Cycle specific fuel design limiting lattice (Reference 3, same issue previously addressed for EPU only analysis basis)	+ 8°F
Rebase lined Heatup Analysis (Reference 3, prior to MELLLA+ implementation)	2016°F
All thermal conductivity degradation effects (References 2-4, Section 5.1)	+ 0°F
Unit specific limiting lattice change (Reference 4) (<i>new lattice experienced pin failure, leading to additional metal-water reaction during heatup phase</i>)	+ 36°F
Accumulated changes since last baseline analysis	+ 36°F
New licensing PCT (Rebase lined Heatup Analysis of Record (Reference 4))	2052°F
Absolute value of accumulated changes since last baseline analysis	36°F

References

1. Letter from TVA to NRC, "10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Units 1, 2, and 3," dated May 1, 2019. (ML19122A029).
2. AREVA NP, Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU MELLLA+)," ANP-3547P Revision 0, March 2017.
3. AREVA NP, Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU MELLLA+)," ANP-3547P Revision 1, June 2019
4. Framatome, Inc., "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™ 10XM Fuel (EPU MELLLA+)," ANP-3547P Revision 2, January 2020.

5. Framatome, Inc., "10 CFR 50.46 PCT Error Report for Browns Ferry Units 1, 2, and 3 with EPU/MELLLA+ Conditions," FS1-0044279, Revision 1, January 2020.