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

January 4, 2013

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, Unit 1
Facility Operating License No DPR-33
NRC Docket No 50-259

Subject: **10 CFR 50.46 30-Day Report for Browns Ferry Nuclear Plant, Unit 1**

Reference:
1. TVA Letter to NRC, "10 CFR 50.46 Annual Report for Browns Ferry Nuclear Plant, Unit 1," dated April 30, 2012
2. NRC Letter, "Browns Ferry Nuclear Plant, Unit 1 - Issuance of Amendments Regarding the Transition to AREVA Fuel (TAC No. ME3775) (TS-473)," April 27, 2012

The purpose of this letter is to provide a 30-day report as required by Title 10 of the Code of Federal Regulations (10 CFR) 50.46 of significant changes in the Emergency Core Cooling System (ECCS) evaluation model for Browns Ferry Nuclear Plant (BFN), Unit 1. In accordance with 10 CFR 50.46, "Acceptance Criteria for ECCS for Light-Water Nuclear Power Reactors," paragraph (a)(3)(ii), the enclosure to this letter describes the nature and the estimated effect on the limiting ECCS analysis of changes or errors discovered since submittal of the 10 CFR 50.46 Annual Report for BFN, Unit 1 dated April 30, 2012 (Reference 1).

During the BFN, Unit 1, Fall 2012 refueling outage, modifications were completed that restored the automatic initiation capability of the BFN, Unit 1, Automatic Depressurization System. As a result, NEDC-32484P Revision 6, "Browns Ferry Nuclear Plant Units 1, 2, and 3: SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," GE Nuclear Energy, February 2005 was re-established as the Loss of Coolant Accident (LOCA) analysis of record for GE14 fuel, with a baseline peak cladding temperature (PCT) of 1760°F for GE14

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fuel. The previous baseline PCT reported in the Reference 1 letter was 1920°F for GE14 fuel.

AREVA ATRIUM-10 fuel was introduced into BFN, Unit 1 reactor core during the Fall 2012 refueling outage. Reference 2 documents the NRC approval of the LOCA analysis for ATRIUM-10 fuel for BFN, Unit 1 which includes the application of a modified EXEM BWR-2000 LOCA methodology. This analysis is established as the LOCA analysis of record for ATRIUM-10 fuel with a baseline PCT of 1926°F for ATRIUM-10 fuel.

In accordance with the BFN, Unit 1, Renewed Operating License and Technical Specifications, the new baseline PCT values described above became effective on December 5, 2012. The 160°F change in the baseline PCT for GE14 fuel meets the criteria of 10 CFR 50.46 (a)(3)(i) as a significant change. As such, in accordance with 10 CFR 50.46 (a)(3)(ii), this 30-day report is required to be submitted by January 4, 2013.

There are no new regulatory commitments in this letter. Please direct questions concerning this issue to Tom Hess at (423) 751-3487.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure:

10 CFR 50.46 30-Day Report for Browns Ferry Nuclear Plant, Unit 1

cc (w/Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Browns Ferry Nuclear Plant

ENCLOSURE

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FOR
BROWNS FERRY NUCLEAR PLANT, UNIT 1

The Browns Ferry Nuclear Plant (BFN), Unit 1, reactor core contains both the ATRIUM-10 and GE14 fuel designs. This report establishes new baseline peak cladding temperature (PCT) values for both fuel types, as described below.

ATRIUM-10 Fuel Evaluation

AREVA ATRIUM-10 fuel was introduced into the BFN, Unit 1 reactor core during the Fall 2012 refueling outage. References 1 and 2 constitute the Loss of Coolant Accident (LOCA) analysis of record for ATRIUM-10 fuel in the BFN, Unit 1, reactor core. These analyses were reviewed by the NRC and approved for application to BFN, Unit 1, in Reference 3. The baseline PCT for ATRIUM-10 fuel is 1926 °F.

On June 28, 2012, AREVA notified the Tennessee Valley Authority (TVA) of a change to their evaluation of thermal conductivity degradation over the approved burnup range. When older generation codes, like AREVA's RODEX2 were approved, experimental data was not available to support explicit modeling of thermal conductivity degradation with fuel burnup. However, in recent evaluations of this phenomenon, it appears that the use of the RODEX2 code (which provides inputs to RELAX and HUXY in the LOCA analysis methodology) results in conservatively high temperatures at low burnup (less than 15 Giga-Watt Day per Metric Ton Uranium), but underpredicts pellet temperatures at higher exposures.

For BFN, Unit 1, the current analysis (Reference 2) shows that the limiting PCT occurs at beginning of life (BOL). As discussed in Reference 4, the effects of thermal conductivity degradation at higher burnups result in a zero degree change in the limiting PCT, which occurs at BOL. Therefore, there is no change in the reported PCT due to thermal conductivity degradation for BFN, Unit 1.

Table 1 details the accumulated PCT impact due to errors and changes in the ATRIUM-10 LOCA analyses since the References 1 and 2 analyses of record.

Table 1: Cumulative Effect of PCT Changes - BFN, Unit 1 (ATRIUM-10)	
Baseline PCT	1926 °F
Thermal Conductivity Degradation (Reference 4)	+ 0 °F
Accumulated changes since baseline analysis	0 °F
New licensing PCT	**1926 °F**
Absolute value of accumulated changes	0 °F

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GE14 Fuel Evaluation

During the BFN, Unit 1, Fall 2012 refueling outage, modifications were completed that restored the automatic initiation capability of the BFN, Unit 1, Automatic Depressurization System. As a result, Reference 5 was re-established as the LOCA analysis of record for GE14 fuel, with a baseline PCT of 1760 °F. The applicability of this analysis to the as-modified plant configuration was confirmed by GE-Hitachi in Reference 6. Reference 5 provides PCT results for both Extended Power Uprate (EPU) and Current Licensed Thermal Power (CLTP) conditions. The TVA has elected to use the CLTP results for 10 CFR 50.46 reporting, since EPU has not been approved for BFN, Unit 1, and all GE14 fuel is scheduled to be discharged from the reactor core prior to the planned EPU implementation date.

In addition, GE-Hitachi has provided three 10 CFR 50.46 error reports that are applicable to the limiting BFN LOCA analysis for GE14 fuel.

On July 20, 2011, GE-Hitachi issued 10 CFR 50.46 Notification Letter 2011-02 (Reference 7), which notified TVA of a database error that affected input coefficients used to direct the deposition of gamma radiation energy produced by fuel when determining whether this energy would heat the fuel rod, cladding, channel, or control rod structure materials. The input caused the heat deposited in the fuel channel (post scram) to be over predicted and the corresponding heat to the fuel to be under predicted. This effect was determined to be non-conservative. The error only applies to 10x10 fuel and increased the PCT by 25 °F. As discussed in Reference 6, this error is applicable to the current BFN LOCA analysis for GE14 fuel.

On July 20, 2011, GE-Hitachi also issued 10 CFR 50.46 Notification Letter 2011-03 (Reference 8), which notified TVA of an updated formulation for gamma heat deposition in the channel wall for 9x9 and 10x10 fuel assemblies. An examination of the existing formulation revealed that the contribution of heat from gamma ray absorption by the channel was found to have been minimized. The method had been simplified such that initially all the energy was assumed to be deposited in the fuel rods prior to the LOCA and then adjusted such that the correct heat deposition was applied after the scram. This modeling was concluded to be potentially non-conservative, as not accounting for this small fraction of total power generation outside the fuel rod would tend to suppress the hot bundle power required to meet the initial operating Average Planar Linear Heat Generation Rate limit. Further, there is a small effect on the initial conditions for the balance of the core, as these are set in relation to the hot bundle condition. The energy distribution during the pre-scram phase was updated with the appropriate energy distribution. Since the integral heat deposition is dominated by post-scram energy, the change has only a small impact on the results, increasing PCT by 15 °F. As discussed in Reference 6, this error is applicable to the current BFN LOCA analysis for GE14 fuel.

On November 29, 2012, GE Hitachi issued 10 CFR 50.46 Notification Letter 2012-01 (Reference 9), which notified TVA of a change to the Emergency Core Cooling System (ECCS) evaluation model in response to NRC Information Notice 2011-21, "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting from Nuclear Fuel Thermal Conductivity Degradation," and addressed inaccuracies in fuel pellet thermal conductivity as a function of exposure. The PRIME fuel rod thermal-mechanical code addresses these thermal conductivity concerns. Reference 9 estimates the magnitude of the change in PCT due to the change in fuel

properties in PRIME relative to the existing GESTR model used in Reference 5. The most dominant effect of the PRIME fuel properties is in thermal conductivity, which results in a higher fuel stored energy. The impact of PRIME is drawn from stored energy sensitivity results. For BFN, Unit 1, GE14 fuel, the PCT impact of modeling fuel rod mechanical properties with PRIME was determined to be zero degrees.

Table 2 details the accumulated PCT impact due to errors and changes in the GE14 LOCA analyses since the Reference 5 analysis of record.

Table 2: Cumulative Effect of PCT Changes - BFN, Unit 1 (GE14)	
Baseline PCT	1760 °F
Input coefficient database error	25 °F
Revised gamma heat deposition formulation	15 °F
Pellet thermal conductivity degradation	0 °F
Accumulated changes since baseline analysis	40 °F
New licensing PCT	**1800 °F**
Absolute value of accumulated changes	40 °F

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BROWNS FERRY NUCLEAR PLANT, UNIT 1

References

1. ANP-3015(P) Revision 0, "Browns Ferry Units 1, 2, and 3 LOCA Break Spectrum Analysis," AREVA NP Inc., September 2011.

2. ANP-3016(P) Revision 0, "Browns Ferry Units 1, 2, and 3 LOCA-ECCS Analysis MAPLHGR Limit for ATRIUM™-10 Fuel," AREVA NP Inc., December 2011.

3. NRC Letter, "Browns Ferry Nuclear Plan, Unit 1 – Issuance of Amendments Regarding the Transition to AREVA Fuel (TAC No. ME3775) (TS-473)," April 27, 2012.

4. FAB12-2249, "Transmittal of 10 CFR 50.46 PCT Error Reporting for Browns Ferry Units 1, 2, and 3," AREVA NP Inc., June 28, 2012.

5. NEDC-32484P Revision 6, "Browns Ferry Nuclear Plant Units 1, 2, and 3: SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," GE Nuclear Energy, February 2005.

6. NEDC-32484P Revision 6, Supplement 2 Revision 0, "Browns Ferry Nuclear Plant Unit 1: Supplementary Report Regarding ECCS-LOCA Evaluation Additional Single Failure Evaluation at Current Licensed Thermal Power," GE-Hitachi Nuclear Energy, September 2012.

7. GE-Hitachi 10 CFR 50.46 Notification Letter 2011-02, July 20, 2011.

8. GE-Hitachi 10 CFR 50.46 Notification Letter 2011-03, July 20, 2011.

9. GE-Hitachi 10 CFR 50.46 Notification Letter 2012-01, November 29, 2012.