UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 24, 2011

Mr. R. M. Krich
Vice President, Nuclear Licensing
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNIT 1 — REQUEST FOR ADDITIONAL INFORMATION REGARDING AMENDMENT REQUEST TO TRANSITION TO AREVA FUEL (TAC NO. ME3775)

Dear Mr. Krich:

By letter dated April 16, 2010 (Agencywide Document Access and Management System Accession No. ML101160156), Tennessee Valley Authority (TVA) submitted a request to amend the technical specifications (TSs) for Browns Ferry Nuclear Plant (BFN), Unit 1. The amendment would revise the Operating License to allow the use of AREVA fuel and analytical methodologies for BFN, Unit 1. This information request supports the transition to AREVA fuel for non-Extended Power Uprate power conditions (i.e., 105 percent of Original Licensed Thermal Power level).

Based on our review of your submittal, the U. S. Nuclear Regulatory Commission (NRC) staff finds that a response to the enclosed request for additional information is needed before we can complete the review. The NRC staff forwarded a draft of the enclosure to this request to TVA on January 10, 2011.

The NRC staff held a call with members of your staff on January 14, 2011, to clarify, as necessary, any questions on the draft information request, and it was agreed that a response would be provided by TVA within 30 days of this letter. As a result of the call, the NRC staff agreed that the information requested in Question 8(a) is not needed at this time, therefore the question has been removed.

If you have any questions, please contact me at (301) 415-1055.

Sincerely,

Christopher Gratton, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-259

Enclosure: Request for Additional Information

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REQUEST FOR ADDITIONAL INFORMATION

PROPOSED LICENSE AMENDMENT REQUEST FOR

TECHNICAL SPECIFICATION CHANGE TS-473 – AREVA FUEL TRANSITION

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-259

By letter dated April 16, 2010, Tennessee Valley Authority (TVA) submitted a request for amendment to the Technical Specifications (TS) for Browns Ferry Nuclear Plant (BFN), Unit 1. The amendment request proposed to add the AREVA NP analysis methodologies to the list of approved methods to be used in determining the core operating limits in the Core Operating Limits Report (COLR). The scope of this application focuses on BFN Unit 1 transition to AREVA fuel, addition of AREVA NP analyses methodologies to the list of approved methods to be used in determining the core operating limits in the COLR, and additional TS changes to reflect the AREVA NP specific methods for monitoring and enforcing the thermal limits. TVA is also requesting approval for transition to AREVA fuel for BFN Unit 1 for non-extended power uprate conditions (105 percent Original Licensed Thermal Power Level).

The Nuclear Regulatory Commission (NRC) staff has reviewed the license amendment request, and has determined that additional information is needed in order to complete our evaluation.

1. ANP-2877P, Section 1.0

Explain what "chamfered pellet design" is and describe how this design reduces the occurrence of pellet chipping during manufacturing, and then reducing the pellet-clad-interaction failure due to missing pellet surface.

2. ANP-2877P, Section 2.1.4

Explain the "Harmonized Advanced Load Chain" modifications that improved the upper tie plate (UTP) connection by making it simpler and more robust,

3. ANP-2877P, Section 2.1.5, ANP-2859(P) Appendix B

(a) Provide details of the distribution of Gadolinia (UO_2+Gd_2O_3) rods in the BFN Unit 1 core for the upcoming cycle, with respect to the number of Gadolinia rods and respective Gadolium (Gd) enrichment.

(b) With degraded thermal conductivity, and lower melting point of the UO_2+Gd_2O_3 mixture, describe what adjustments are made in the Gadolinia rods to prevent failure of the Gadolinia rod melting. Is there any restriction on linear heat

Enclosure

generation rate (LHGR) limit for the Gadolinia rods during normal operation and anticipated operational occurrences (AOOs)?

(c) Section 3.2.4 of ANP-2877 indicates that "for AOOs, the fuel temperatures are calculated using the same power history (as for normal operating temperatures), except that additional calculations are performed at elevated power levels as a function of exposure corresponding with the Protection Against Power Transients (PAPT) LHGR limit." Describe this process with example calculations.

(d) Describe the adjustments, and how the adjustments are applied to the fuel melt temperature, for exposure and Gadolinia content, as stated in Section 3.2.4 of ANP-2877. Show a typical calculation.

4. ANP-2877P, Section 3.2

Section 3.2, under bullet "Cladding Collapse," states that "The pellet/clad gap is evaluated [*up to a proprietary rod exposure*] to ensure the cladding does not [*proprietary end state*].

Section 3.2.2 "Cladding Collapse" states that gap conditions are evaluated after the first [*proprietary rod exposure stating a different end state than Section 3.2 above*].

After reviewing the proprietary information contained in ANP-2877, Section 3.2, please explain why there is discrepancy between the above two statements and correct the error, if needed.

5. ANP-2877P, Section 3.2.6

Section 3.2.6 of ANP-2877 states that "the evaluation (for cladding rupture) is covered separate from this report." Identify the location of this report if it is part of the license amendment request or is contained in other docketed material. Otherwise, please provide a copy of this report.

6. ANP-2877P, Sections 3.2.8, and 3.3.7

Discuss the impact of Gd content in Gadolinia rods (UO_2+Gd_2O_3) on fuel densification, swelling and fission gas release in fuel rods.

7. ANP-2877P, Section 3.3.8

Section 3.3.8 states that "Mixed core conditions for liftoff are considered on a specific basis as determined by the plant and other fuel types. Analyses to date indicate a large margin to liftoff under normal operating conditions." Justify this claim by providing a summary of the analysis and calculations.

8. ANP-2877P, Sections 3.4.1 through 3.4.3, Table 3.3 Item 3.4.2

(a) [deleted]

(b) Item 3.4.2 of Table 3.3 indicates that violent expulsion of fuel criteria for fuel is less than 280 calories per gram (cal/g) for coolability, and is less than 170 cal/g for rod failure. Standard Review Plan (SRP, NUREG-0800) Section 4.2, Appendix B, Section C (Core coolability criteria) stipulates that for fuel rod thermal-mechanical calculations, employed to demonstrate compliance with Criteria 1 (peak radial average fuel enthalpy must remain below 230 cal/g) and Criteria 2 (peal fuel temperature must remain below incipient fuel melting conditions), must be based upon design-specific information accounting for manufacturing tolerances and modeling using the NRC-approved methods, including burnup-enhanced effects on pellet power distribution, fuel thermal conductivity, and fuel melting temperature. Provide justification for the items in 3.4.2 of Table 3.3 in support of the Standard Review Plan acceptance criteria, specifically, the difference between the SRP value for coolability (less than 230 cal/g) and the value in Table 3.3, item 3.4.2.

9. ANP-2821(P) Thermal – Hydraulic (T-H) Design Report, Section 3.1

Provide a summary of detailed calculations for thermal-hydraulic characterization for the ATRIUM 10 reload fuel for BFN Unit 1. These calculations should show how the licensee obtained the loss coefficients and friction factors listed in Table 3.3 of ANP-2821; for example, the upper tie plate (UTP) loss coefficient, spacer loss coefficients, lower tie plate (LTP) grid loss coefficients, orifice, and LTP loss coefficients.

10. ANP-2821(P), Section 3.2

Provide detailed calculations that demonstrate thermal-hydraulic compatibility of ATRIUM 10 with the co-resident GE14 fuel in BFN Unit 1. These calculations should show the following:

(a) Calculations should demonstrate that during the entire transition from a full core GE14 to a full core ATRIUM 10 fuel, there will be no major impacts on thermal-hydraulic operation of BFN Unit 1 and should demonstrate compliance over the entire licensing range of the power/flow map.

(b) Justify your selection of bottom-peaked axial power distribution as a basis for the hydraulic compatibility results, compared to the results for top- and middle-peaked axial power distributions.

11. Thermal margin performance

(a) Discuss the impact of part length rods and Gadolinia (UO_2+Gd_2O_3) on the application of SPCB critical power correlation.

(b) Will any of these part length rods undergo boiling transition/dryout during normal operating conditions or during transients and accident conditions?

12. Mixed core and Critical Power Ratio (CPR) calculations

The proposed BFN Unit 1 core with AREVA Atrium 10 and GE14 fuel designs will constitute a "mixed core."

Provide details of the impact of the mixed core on the CPR calculations, accounting for the differences in mechanical, thermal and hydraulic characteristics of the two fuel designs in the transition core at BFN Unit 1.

13. ANP-2821P, Section 3.6 Stability

General Design Criterion 12 of Title 10 of the *Code of Federal Regulations*, Part 50 Appendix A requires suppression of reactor power oscillations so that the Specified Acceptable Fuel Design Limits are not exceeded. Demonstrate, with supporting analyses and calculations, how thermal-hydraulic and neutronic stability of the mixed core will be maintained at the BFN Unit 1 throughout the upcoming and following cycles of operation.

14. ANP-2859P Section 2.0

Provide a reference or summarize the methodology by which BFN Unit 1 is designed to achieve 71 Gigawatt-days of additional energy via final feedwater temperature reduction operation, beyond the full power capability.

15. Shutdown Margin

Describe the analysis procedure used to ensure that the shutdown margin is within the TS limit throughout the transition cycles. Specifically, address how the eigenvalue biases and uncertainties are determined and accounted for during the transition cycles.

16. EMF-2158

Licensee has used EMF-2158 methodology to perform fuel cycle design and fuel management calculations for the Cycle 10 operation of BFN Unit 1 to generate nuclear data including cross sections, local power peaking factors, and associated uncertainties.

Section 5 of XN-NF-80-19(P)(A), Volume 1, Supplement 3, and Section 9 of EMF-2158(P)(A) together provide very detailed description of the analyses and calculations to determine the traversing in-core probe detector (TIP) uncertainty components for boiling-water reactors. Sections 9.4 and 9.5 provide combined uncertainties for TIP distribution calculations, TIP distribution measurement, net calculated TIP distribution and synthesized TIP distribution uncertainty. Provide details of the calculations and uncertainties listed in Chapter 9 of EMF-2158 applicable to the D-lattice BFN Unit 1 plant. Show that the BFN Unit 1 uncertainties documented in EMF-2158 for D-lattice plants remain conservative.

If you have any questions, please contact me at (301) 415-1055.

Sincerely,

/RA/
Christopher Gratton, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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