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

December 16, 2015

Mr. Joseph W. Shea
Vice President, Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga, TN 37402-2801

SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 - ISSUANCE OF AMENDMENTS REGARDING TECHNICAL SPECIFICATION CHANGES TO REACTOR CORE SAFETY LIMITS (CAC NOS. MF5412, MF5413, AND MF5414)

Dear Mr. Shea:

The U.S. Nuclear Regulatory Commission (NRC, Commission) has issued the enclosed Amendment Nos. 293, 318, and 276, to Renewed Facility Operating Licenses Nos. DPR-33, DPR-52, and DPR-68, for the Browns Ferry Nuclear Plant, Units 1, 2, and 3, respectively. These amendments are in response to the Tennessee Valley Authority's (TVA's) application dated December 11, 2014, as supplemented by letters dated June 3, 2015, and July 30, 2015.

These amendments revise Section 2.1.1, "Reactor Core SLs [Safety Limits]," of the Technical Specifications for all three units, to lower the value of the reactor steam dome pressure safety limit from the current 785 pounds per square inch gauge (psig) to 585 psig. The revised value of 585 psig is consistent with the lower range of the critical power correlations currently in use at the units. The revised value will also adequately bound a pressure regulator failure open transient event. This change resolves an issue identified in a notification pursuant to Title 10 of the *Code of Federal Regulation* (10 CFR) Part 21, concerning a potential to momentarily violate Reactor Core Safety Limit 2.1.1.1 during a Pressure Regulator Failure Maximum Demand (Open) transient.

The NRC staff has completed its review of the information provided by the licensee. The NRC staff's safety evaluation (SE) is enclosed. The NRC staff has determined that its documented SE (Enclosure 4) does not contain proprietary or other sensitive information pursuant to 10 CFR Section 2.390, "Public inspections, exemptions, requests for withholding." However, the NRC will delay placing the enclosed SE in the public document room for a period of 10 working days from the date of this letter to provide TVA with the opportunity to comment on any sensitive aspects of the SE. If you believe that any information in Enclosure 4 contains sensitive information, please identify such information line-by-line and define the basis for withholding pursuant to the criteria of 10 CFR 2.390. After 10 working days, the enclosed SE will be made publicly available.

Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

If you have any questions regarding this letter, please contact me at (301) 415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

(for)

Farideh E. Saba, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, and 50-296

Enclosures:
1. Amendment No. 293 to DPR-33
2. Amendment No. 318 to DPR-52
3. Amendment No. 276 to DPR-68
4. Safety Evaluation

cc w/enclosures: Addressee
cc w/enclosures 10 working days after issuance: Distribution via Listserv

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-259

BROWNS FERRY NUCLEAR PLANT UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 293
Renewed License No. DPR-33

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated December 11, 2014, as supplemented by letters dated June 3, 2015, and July 30, 2015, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-33 is hereby amended as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 293, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Benjamin G. Beasley

Benjamin G. Beasley, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: December 16, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 293

RENEWED FACILITY OPERATING LICENSE NO. DPR-33

DOCKET NO. 50-259

Replace page 3 of Renewed Operating License DPR-33 with the attached page 3.

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

REMOVE	INSERT
2.0-1	2.0-1

(3) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form for sample analysis or equipment and instrument calibration or associated with radioactive apparatus or components;

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) <u>Maximum Power Level</u>

The licensee is authorized to operate the facility at steady state reactor core power levels not in excess of 3458 megawatts thermal.

(2) <u>Technical Specifications</u>

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 293, are hereby incorporated in the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

For Surveillance Requirements (SRs) that are new in Amendment 234 to Facility Operating License DPR-33, the first performance is due at the end of the first surveillance interval that begins at implementation of the Amendment 234. For SRs that existed prior to Amendment 234, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the surveillance was last performed prior to implementation of Amendment 234.

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 585 psig or core flow < 10% rated core flow:

THERMAL POWER shall be ≤ 25% RTP.

2.1.1.2 With the reactor steam dome pressure ≥ 585 psig and core flow ≥ 10% rated core flow:

MCPR shall be ≥ 1.09 for two recirculation loop operation or ≥ 1.11 for single loop operation.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be ≤ 1325 psig.

2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 318
Renewed License No. DPR-52

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated December 11, 2014, as supplemented by letters dated June 3, 2015, and July 30, 2015, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-52 is hereby amended as follows:

    (2) Technical Specifications

    The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318, are hereby incorporated in the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Benjamin G. Beasley

Benjamin G. Beasley, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: December 16, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 318

RENEWED FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Replace page 3 of Renewed Operating License DPR-52 with the attached page 3.

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal line indicating the area of change.

REMOVE	INSERT
2.0-1	2.0-1

sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form for sample analysis or equipment and instrument calibration or associated with radioactive apparatus or components;

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady state reactor core power levels not in excess of 3458 megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 318, are hereby incorporated in the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

For Surveillance Requirements (SRs) that are new in Amendment 253 to Facility Operating License DPR-52, the first performance is due at the end of the first surveillance interval that begins at implementation of the Amendment 253. For SRs that existed prior to Amendment 253, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the surveillance was last performed prior to implementation of Amendment 253.

3) The licensee is authorized to relocate certain requirements included in Appendix A and the former Appendix B to licensee-controlled documents. Implementation of this amendment shall include the relocation of these requirements to the appropriate documents, as described in the licensee's

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 585 psig or core flow < 10% rated core flow:

THERMAL POWER shall be ≤ 25% RTP.

2.1.1.2 With the reactor steam dome pressure ≥ 585 psig and core flow ≥ 10% rated core flow:

MCPR shall be ≥ 1.06 for two recirculation loop operation or ≥ 1.08 for single loop operation.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be ≤ 1325 psig.

2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-296

BROWNS FERRY NUCLEAR PLANT, UNIT 3

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 276
Renewed License No. DPR-68

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated December 11, 2014, as supplemented by letters dated June 3, 2015, and July 30, 2015, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Renewed Facility Operating License No. DPR-68 is hereby amended as follows:

   (2) <u>Technical Specifications</u>

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 276, are hereby incorporated in the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Benjamin G. Beasley

Benjamin G. Beasley, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Operating License
and Technical Specifications

Date of Issuance: December 16, 2015

ATTACHMENT TO LICENSE AMENDMENT NO. 276

RENEWED FACILITY OPERATING LICENSE NO. DPR-68

DOCKET NO. 50-296

Replace page 3 of Renewed Operating License DPR-68 with the attached page 3.

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal line indicating the area of change.

REMOVE	INSERT
2.0-1	2.0-1

(3) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form for sample analysis or equipment and instrument calibration or associated with radioactive apparatus or components;

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed operating license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady state reactor core power levels not in excess of 3458 megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 276, are hereby incorporated in the renewed operating license. The licensee shall operate the facility in accordance with the Technical Specifications.

For Surveillance Requirements (SRs) that are new in Amendment 212 to Facility Operating License DPR-68, the first performance is due at the end of the first surveillance interval that begins at implementation of the Amendment 212. For SRs that existed prior to Amendment 212, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the surveillance was last performed prior to implementation of Amendment 212.

2.0 SAFETY LIMITS (SLs)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 With the reactor steam dome pressure < 585 psig or core flow < 10% rated core flow:

THERMAL POWER shall be ≤ 25% RTP.

2.1.1.2 With the reactor steam dome pressure ≥ 585 psig and core flow ≥ 10% rated core flow:

MCPR shall be ≥ 1.09 for two recirculation loop operation or ≥ 1.11 for single loop operation.

2.1.1.3 Reactor vessel water level shall be greater than the top of active irradiated fuel.

2.1.2 Reactor Coolant System Pressure SL

Reactor steam dome pressure shall be ≤ 1325 psig.

2.2 SL Violations

With any SL violation, the following actions shall be completed within 2 hours:

2.2.1 Restore compliance with all SLs; and

2.2.2 Insert all insertable control rods.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 293 TO RENEWED FACILITY OPERATING

LICENSE NO. DPR-33, AMENDMENT NO. 318 TO RENEWED FACILITY OPERATING

LICENSE NO. DPR-52, AND AMENDMENT NO. 276 TO RENEWED

FACILITY OPERATING LICENSE NO. DPR-68

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

DOCKET NOS. 50-259, 50-260, AND 50-296

1.0 INTRODUCTION

By application dated December 11, 2014 (Reference 1), as supplemented by letters dated June 3, 2015 (Reference 2), and July 30, 2015 (Reference 3), Tennessee Valley Authority (TVA, the licensee) submitted a license amendment request (LAR) to change the Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, Technical Specification (TS) 2.1.1, "Reactor Core SLs [Safety Limits]." The proposed change, which reduces the reactor steam dome pressure specified in TS 2.1.1, resolves an issue identified in a notification pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21 concerning a potential to momentarily violate Reactor Core SL 2.1.1.1 during a Pressure Regulator Failure Maximum Demand (Open) (PRFO) transient.

In 2005, General Electric (GE) submitted a 10 CFR Part 21 notification, SC05-03, "Potential to Exceed Low Pressure Technical Specification Safety Limit" (Reference 4), to the U.S. Nuclear Regulatory Commission (NRC). This Part 21 notification identified, through the use of new and approved models, that a PRFO transient could potentially result in a momentary decrease in reactor steam dome pressure to below 785 pounds per square inch gauge (psig) while Rated Thermal Power (RTP) was above the plant-specific thermal power limit specified in TS 2.1.1.1 (25 percent RTP). Thus, a PRFO transient could potentially cause a violation of Reactor Core SL 2.1.1.1. Initially, the Boiling Water Reactor Owners Group (BWROG) attempted to resolve the issue. On July 18, 2006, the Technical Specifications Task Force (TSTF) and the BWROG submitted TSTF-495, Revision 0 (Reference 5), "Bases Change to Address GE Part 21 SC05-03," proposing a modification to the "Applicable Safety Analysis" portion of the Reactor Core SL TS Bases (B 2.1.1). This change proposed to clarify that the SL was considered not to apply to momentary depressurization transients. In the NRC Safety Evaluation (SE) input for

TSTF-495, dated August 14, 2007 (Reference 6), the staff stated that although the technical arguments presented in TSTF-495 had some merit, the staff found the proposed change unacceptable because it would set a precedent that could lead to erosion of safety margins protected by SLs. The staff further stated in the SE that, from a regulatory standpoint, the proposed change to the TS Bases was also not acceptable.

Consequently in April 2012, the BWROG discontinued the effort to resolve the issue generically and recommended that plants request to lower their Low Pressure SL to meet the lower range of their critical power correlation on plant-specific basis. As such, TVA has submitted its LAR dated December 11, 2014, to lower its lower-bound pressure for BFN.

The licensee's LAR requests to lower the reactor steam dome pressure SLs at BFN from the current value of 785 psig to 585 psig. The current value of 785 psig corresponds to the lower end of the pressure range over which the GE GEXL critical power correlation was originally tested. Some advanced fuel designs have an NRC approved critical power correlation with a lower-bound pressure significantly below the 785 psig reactor steam dome pressure specified in TS Reactor Core SLs 2.1.1.1 and 2.1.1.2. The licensee proposes to utilize this fact and reduce the reactor steam dome pressure to 585 psig consistent with the NRC approved lower-bound pressure for the critical power correlation for the ATRIUM-10 fuel design, which currently comprises all three BFN cores. Only BFN Unit 1 contains legacy Global Nuclear Fuel (GNF) GE14 fuel in addition to ATRIUM-10. Revising the reactor steam dome pressure specified in Reactor Core SLs 2.1.1.1 and 2.1.1.2 to 585 psig resolves the issue originally identified in GE's 10 CFR Part 21 notification concerning the potential to violate a SL during a PRFO transient.

The supplements dated June 3, 2015, and July 30, 2015, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the *Federal Register* (FR) on May 5, 2015 (80 FR 25721).

2.0 REGULATORY EVALUATION

Section 182a of the Atomic Energy Act (the Act) requires applicants for nuclear power plant operating licenses to include TSs as part of the license. The TSs ensure the operational capability of structures, systems, and components that are required to protect the health and safety of the public. The regulatory requirements related to the content of the TSs are contained in 10 CFR Section 50.36. Safety limits are described in 10 CFR 50.36(c)(1)(i)(A) as follows:

> Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity. If any safety limit is exceeded, the reactor must be shut down. The licensee shall notify the Commission, review the matter, and record the results of the review, including the cause of the condition and the basis for corrective action taken to preclude recurrence. Operation must not be resumed until authorized by the Commission.

Compliance with the fuel licensing criteria of 10 CFR Part 50 Appendix A, General Design Criteria (GDC) 10, "Reactor design," is achieved by preventing the violation of fuel design limits. GDC 10 states:

> The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

The licensee stated in its submittal dated December 11, 2014, that "the proposed decrease in the reactor dome pressure safety limit in TS 2.1.1 complies with the requirements of GDC 10 and will continue to ensure that fuel clad integrity is maintained."

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," provides guidance on the acceptability of the reactivity control systems, the reactor core and fuel system design. Specifically, Section 4.2, "Fuel System Design," specifies all fuel damage criteria for evaluation of whether fuel designs meet the Specified Acceptable Fuel Design Limits (SAFDLs). Section 4.4, "Thermal and Hydraulic Design," provides guidance on the review of thermal-hydraulic design in meeting the requirement of GDC 10 and the fuel design criteria established in Section 4.2. It states that the Critical Power Ratio (CPR) is to be established such that at least 99.9 percent of fuel rods in the core would not be expected to experience departure from nucleate boiling or Onset of Transition Boiling (OTB) during normal operation or Anticipated Operational Occurrences (AOOs).

3.0 TECHNICAL EVALUATION

Each fuel vendor has developed correlations valid over specified pressure and flow ranges (mass flow rates) that are approved by the NRC. These critical power correlations have become increasingly fuel design dependent as advanced fuel designs evolved. This has resulted in an extension of the NRC approved pressure range to lower pressures as additional test data became available to demonstrate the validity of revised or new correlations for performance of critical power calculations. The critical power correlations for some advanced fuel designs have received NRC approval down to a lower pressure than those approved previously. The lower-bound of the extended pressure ranges for these advanced fuel designs can be used to establish a reactor steam dome pressure lower than the 785 psig value currently specified in Reactor Core SLs 2.1.1.1 and 2.1.1.2. As a result, a wider pressure range is available for transients to demonstrate compliance with Maximum Critical Power Ratio (MCPR) limits. Thus, the proposed change offers a greater pressure margin for a PRFO transient than what is currently available.

In the 10 CFR Part 21 notification (Reference 4), GE concluded that since during the PRFO, the CPR increases during depressurization, so that the initial CPR is the limiting CPR condition during the entire transient, and that the conditions that exceed the low pressure TS SL exist for only a few seconds, fuel cladding integrity is not threatened. Nevertheless, GE considered the PRFO to be a known AOO that could contribute to the exceeding of an SL. While this condition had been determined not to involve an actual safety hazard, the potential for violation of a Reactor Core SL had been identified, and restoration to comply with the safety limit is required for the PRFO event. As a result, the licensee requests to revise the reactor steam dome pressure TS SL consistent with the NRC approved pressure range of critical power correlations for the current BFN fuel design. Lowering the reactor steam dome pressure specification in this fashion provides margin to ensure Reactor Core SL 2.1.1.1 is not violated and resolves the issue involving a potential to violate the low pressure TS SL during a PRFO transient.

In its December 11, 2014 submittal (Reference 1), the licensee stated that the current core composition of BFN Units 2 and 3 is 100 percent ATRIUM-10 fuel, and that BFN Unit 1 contains a mixed core of ATRIUM-10 and legacy GNF GE14 fuel. TVA is transitioning BFN to the ATRIUM-10 XM fuel design (XM). The scheduled implementation of the transition to XM fuel is spring 2015 (Unit 2), spring 2016 (Unit 3), and fall 2016 (Unit 1). The proposed 585 psig SL is greater than the lower bound pressure limit of the NRC approved ACE/ATRIUM-10XM critical power correlation for XM fuel (Reference 7), and is acceptable. The proposed 585 psig SL is also greater than the lower bound pressure limit of the NRC approved Siemens Power Correlation for Boiling Water Reactors (SPCB) critical power correlation for ATRIUM-10 fuel (Reference 8) and is acceptable.

The GE14 fuel in BFN Unit 1 is monitored using NRC approved modified version of SPCB, and the indirect method described in Reference 9. The indirect method uses critical power data generated using the legacy vendor critical power correlation (Reference 10) to determine additive constants for application of the SPCB correlation to the legacy GE14 fuel. This modified correlation is termed SPCB/GE14. While the SPCB correlation itself has a tested pressure range below the proposed 585 psig SL, the GEXL correlation (Reference 10) was only tested down to a pressure of 685 psig. Therefore, a technical justification for applying the SPCB/GE14 correlation to GE14 fuel for pressures below 685 psig was required to be provided by the licensee.

The justification for applying the SPCB/GE14 correlation to GE14 fuel at pressures below the tested range of the GEXL correlation relies on the behavior of critical power at pressures in the range of interest. The licensee implemented an analytical adjustment to the AREVA critical power (CP) correlation when it is applied to legacy GE14 fuel for pressures below 685 psig. This adjustment under-estimates the actual CP for the co-resident GE14 fuel since the test data used in the development of the SPCB correlation shows an increasing trend in CP with decreasing pressure. Furthermore, the critical power calculated by the SPCB/GE14 correlation is lower than that which would be achieved if the actual measurements were available to derive the CP correlation, and thus, it is conservative. In addition, all the remaining GE14 fuel in the BFN Unit 1 core is third cycle fuel, with large MCPR margins due to the depleted state of the fuel and the lower power locations of those bundles. As a result, GE14 fuel is not the limiting fuel bundle for the MCPR. The staff, therefore, determined that extending the SPCB/GE14 correlation to low pressures is acceptable because GE14 fuel will be adequately protected down to pressures as low as the proposed TS value of 585 psig SL. The proposed reduction of the low pressure SL will not adversely affect any Updated Final Safety Analysis Report (UFSAR) accident analyses.

The licensee performed a plant-specific sensitivity analysis that identified the impact of various plant parameters that affect the minimum steam dome pressure during a PRFO transient. By using the most limiting parameters, an analysis was performed by the licensee to determine the lowest minimum steam dome pressure during a PRFO transient for several state points on the operational power/flow map. The lowest minimum steam dome pressure for the PRFO transient when the RTP decreased below 25 percent was 636 psig. Thus, the proposed 585 psig SL is below the lowest minimum dome pressure determined from limiting conditions for the PRFO transient analysed for the BFN units, and is within the range of applicability of the CP correlations in use at the BFN units.

The proposed change is similar to changes that have previously been approved by the staff for Monticello Nuclear Generating Plant - Issuance of Amendment to Transition to AREVA ATRIUM 10XM fuel and AREVA safety analysis methods, dated June 5, 2015 (Reference 11). Issuance of this license amendment provides a precedent for the NRC review and acceptance of the approach used by AREVA to extend the low pressure boundary of the SPCB/GE14 CP correlation and its application to co-resident GE14 fuels.

The NRC staff reviewed the licensee's submittal (Reference 1), supplemental information provided in response to the staff's questions (References 2 and 3), and related documentation (e.g., TSs, UFSAR, GE's Part 21 notification, TSTF-495 and related staff SEs). The staff concluded that reactor depressurization transients, such as PRFO, are non-limiting for fuel cladding integrity and that the proposed change in TS 2.1.1.2 will have no negative impact on the MCPR core operating limits. Although this condition does not involve a substantial safety hazard, potential for violation of a TS Reactor Core SL was identified and restoration to comply with the SL was required. Hence, the licensee proposed the amendment in order to address this issue.

The staff determined that revising the Reactor Core SLs 2.1.1.1 and 2.1.1.2 reactor steam dome pressure from 785 to 585 psig resolves the reported condition concerning the potential to violate Reactor Core SL 2.1.1.1 during a PRFO transient. TS SLs are specified to ensure that SAFDLS are not exceeded during steady state operation, normal operational transients, and anticipated operational occurrences. The Reactor Core SLs are set such that fuel cladding integrity is maintained and no significant fuel damage is calculated to occur due to OTB if the SLs are not exceeded.

The staff concluded that the proposed change to the Reactor Core SLs continues to ensure that a valid CPR calculation is performed for the AOOs described in the UFSAR, including the PRFO transient, and that with the value of 585 psig proposed for the reactor steam dome pressure a violation of Reactor Core SL 2.1.1.1 during a PRFO transient would not occur. Furthermore, the proposed change will continue to provide protection during startup conditions to ensure that operation at less than 585 psig or less than 10 million pound-mass per hour core flow while greater than 25 percent RTP would not occur. Since this approach follows, and is consistent with, the way the reactor steam dome pressure has been established, and valid CPR calculations will continue to be performed, the proposed change is a safe and appropriate method to address the issue described in Reference 4, and therefore, is acceptable. If the licensee transitions to different fuel design(s) in the future where the lower bound of the fuel's CPR correlation has not been approved for use down to the reactor steam dome pressure specified in the TS Reactor Core SLs, NRC approval would be required prior to transitioning to that fuel design.

The staff evaluated the proposed changes against the applicable regulatory requirements and acceptance criteria. The staff concluded that as long as the core pressure and flow are within the range of validity of the approved CPR correlation, the proposed reactor steam dome pressure change to Reactor Core SLs 2.1.1.1 and 2.1.1.2 will continue to ensure that 99.9 percent of the fuel rods in the core are not expected to experience OTB. This satisfies the regulatory requirements regarding acceptable fuel design limits and continues to assure that the underlying criteria of the SL are met consistent with GDC 10 and 10 CFR 50.36(c)(1)(i)(A); and therefore, the proposed amendment is acceptable. The staff further concludes that there is reasonable assurance that the health and safety of the public, following approval of this TS change, will be protected.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the NRC staff notified the State of Alabama official (Mr. David Walter, Director Alabama Office of Radiation Control) on November 18, 2015,[1] of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts and no significant change in the types of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration (NSHC), and there was one public comment on such finding (see Section 6). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 PUBLIC COMMENTS

On May 5, 2015, the NRC staff published in the FR a "Notice of Consideration of Issuance of Amendments to Facility Operating Licenses, Proposed No Significant Hazards Consideration Determination, and Opportunity for a Hearing," associated with the proposed amendment request (80 FR 25721). In accordance with the requirements in 10 CFR 50.91, "Notice for public comment; State consultation," the notice provided a 30-day period for public comment on the proposed NSHC determination. A public comment was received regarding the proposed amendment (Reference 1). The issues discussed in the public comment do not specifically pertain to the proposed NSHC determination. Nevertheless, the NRC staff addressed aspects of the comment below.

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[1] The NRC staff notified the State official by an e-mail. The e-mail is in ADAMS under Accession No. ML15323A006.

The public comments state, in part:

> Thank you for reducing the pressure at these reactors. This is testimony to the fact that there is a problem with these old brittle reactor pressure vessels, however. What is this reduction based on? Probably pretense that these are brand-new? The Belgian reactors are testimony to how little is known about the impacts of radiation, pressure and time on the reactor pressure vessels. Experts who have worked for the nuclear industry, including Dr. Digby MacDonald, have said that the computer models do not work. And, you are not even using enough data points and the scatter is all over the place[.]

NRC Response:

The NRC staff acknowledges the commenter's concerns regarding the operation of the Browns Ferry plant reactors. However, the change proposed by the licensee and approved by the NRC does not reduce the actual pressure at the Browns Ferry reactors; rather, it reduces the reactor pressure SLs. As discussed in this SE, the change reduces the reactor steam dome pressure SL specified in TS 2.1.1 from 785 psig to 585 psig. This change resolves a concern regarding a potential to momentarily violate the current Reactor Core SL 2.1.1.1 during a PRFO transient. After reviewing the licensee's submittal, supplemental information, and related documentation, the staff concluded that there is reasonable assurance that the health and safety of the public will continue to be protected following approval of this TS change.

With respect to the commenter's reference to Belgian reactors, the NRC has reviewed the issue of embedded quasi-laminar indications (anomalies below the surface and oriented primarily parallel to the inner and outer surfaces of the reactor pressure vessel) at two Belgian reactors. The NRC issued Information Notice 2013-19 (Reference 12) to provide a technical background for this issue, and to discuss its relevance to reactors in the United States.

7.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, there is reasonable assurance that: (1) the health and safety of the public will not be endangered by operation in the proposed manner, (2) that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

8.0 REFERENCES

1.0 Letter from J. W. Shea (TVA) to NRC, "Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3 - Application to Modify Technical Specification 2.1.1, Reactor Core Safety Limits (BFN-TS-492)," December 11, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14363A158).

2.0 Letter from TVA to NRC, "Response to NRC Request for Additional Information Regarding Proposed Technical Specification Change to Modify Technical Specification 2.1.1, Reactor Core Safety Limits (BFN TS-492)," dated June 3, 2015 (ADAMS Accession No. ML15156A563).

3.0 Letter from TVA to NRC, "Response to Follow-up NRC Request for Additional Information Regarding Proposed Technical Specification Change to Modify Technical Specification 2.1.1, Reactor Core Safety Limits (BFN TS-492) (TAC Nos. MF5412, MF5413, MF5414)," dated July 30, 2015 (ADAMS Accession No. ML15212A283).

4.0 Letter from Jason Post (GE Energy Nuclear) to NRC, "10CFR21 Reportable Condition Notification: Potential to Exceed Low Pressure Technical Specification Safety Limit," dated March 29, 2005 (ADAMS Accession No. ML050950428).

5.0 Technical Specifications Task Force letter (TSTF-06-20) transmitting TSTF-495, Revision 0, "Bases Change to Address GE Part 21 SC05-03," dated July 18, 2006 (ADAMS Accession No. ML061990227).

6.0 Denial of TSTF-495, Revision 0, "Bases Change To Address Ge Part 21 SC05-03." Docket No: PROJ0753 (TAC MD2672), dated August 27, 2007 (ADAMS Accession No. ML072340113).

7.0 AREVA NP Inc., "ACE/ATRIUM 10XM Critical Power Correlation," ANP-10298PA, Revision 0, March 31, 2010 (ADAMS Accession No. ML101190044).

8.0 Final Safety Evaluation For AREVA NP, INC. (AREVA) Topical Reports (TR) EMF-2209(P), Revision 2, Addendum 1, "SPCB Additive Constants for ATRIUM 10 Fuel" AND ANP-10249 (P), Revision 0, Supplement 1, "ACE Additive Constants for ATRIUM-10 Fuel," September 23, 2009 (ADAMS Package Accession No. ML092570657).

9.0 EMF-2245(NP)(A), Revision 0, "Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel," August 31, 2000 (ADAMS Accession No. ML003753200).

10.0 Acceptance Version of Global Nuclear Fuel (GNF) Topical Report (TR) NEDC-32851P, Revision 2, "GEXL14 Correlation for GE14 Fuel" (TAC No. MD5486), dated September 14, 2007 (ADAMS Accession No. ML072620193).

11.0 Monticello Nuclear Generating Plant - Issuance of Amendment to Transition to AREVA ATRIUM 10XM fuel and AREVA safety analysis methods (TAC No. MF2479), dated June 5, 2015 (ADAMS Accession No. ML15072A141).

12.0 Information Notice 2013-19, "Quasi-laminar Indications in Reactor Pressure Vessel Forgings," dated September 22, 2013 (ADAMS Accession No. ML13242A263).

Principal Contributor: Muhammad M. Razzaque

Date: December 16, 2015

Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

If you have any questions regarding this letter, please contact me at (301) 415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

/RA CPfefferkorn for/

Farideh E. Saba, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, and 50-296

Enclosures:
1. Amendment No. 293 to DPR-33
2. Amendment No. 318 to DPR-52
3. Amendment No. 276 to DPR-68
4. Safety Evaluation

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ADAMS Accession No: ML15287A213 *by memorandum **by e-mail

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