TVA

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

March 31, 1995

TVA-BFN-TS-349 10 CFR 50.90

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-259
Tennessee Valley Authority	)	50-260
		50-296

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 - TECHNICAL SPECIFICATION (TS) NO. 349 - REACTOR VESSEL PRESSURE-TEMPERATURE CURVES AND BOLTUP TEMPERATURES

In accordance with the provisions of 10 CFR 50.4 and 50.90, TVA is submitting a request for an amendment (TS-349) to licenses DPR-33, DPR-52 and DPR-68 to change the TS for Units 1, 2, and 3. The proposed change revises the Units 1, 2, and 3 reactor vessel pressure-temperature (P-T) curves, which lowers the temperature at which the reactor vessel head bolting studs may be fully tensioned (boltup temperature). This proposed change will decrease the length of the Unit 2 Cycle 8 and Unit 3 Cycle 6 outages.

TVA has determined that there are no significant hazards considerations associated with the proposed change and that the change is exempt from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). The BFN Plant Operations Review Committee and the BFN Nuclear Safety Review Board have reviewed this proposed change and determined that operation of BFN Units 1, 2, and 3 in accordance with the proposed change will not endanger the health and safety of the public. Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and enclosures to the Alabama State Department of Public Health.

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Enclosure 1 to this letter provides the description and evaluation of the proposed change. This includes TVA's determination that the proposed change does not involve a significant hazards consideration, and is exempt from environmental review. Enclosure 2 contains copies of the appropriate Units 1, 2, and 3 TS pages marked-up to show the proposed change. Enclosure 3 forwards the revised Units 1, 2, and 3 TS pages that incorporate the proposed change.

Approval of this proposed TS amendment is requested prior to the Unit 2 Cycle 8 refueling outage. However, its approval prior to the hydrostatic testing milestone for Unit 3 restart is highly desired. TVA requests that the revised TS be made effective within 30 days of NRC approval. If you have any questions about this change, please telephone me at (205) 729-2636.

Sincerely,

Pedro Salas
Manager of Site Licensing

Enclosures
cc: See page 3

Subscribed and sworn to before me
on this 31 day of March 1995.

Notary Public

My Commission Expires 4/15/95

cc (Enclosures):

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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

PROPOSED TECHNICAL SPECIFICATION (TS) CHANGE TS-349
DESCRIPTION AND EVALUATION OF THE PROPOSED CHANGE

I. DESCRIPTION OF THE PROPOSED CHANGE

In summary, the proposed change revises the Units 1, 2, and 3 reactor vessel pressure-temperature (P-T) curves, which lowers the temperature at which the reactor vessel head bolting studs may be fully tensioned (boltup temperature). The current boltup temperature is 100°F for all three units. The proposed boltup temperature is 80°F for Unit 1, 82°F for Unit 2, and 70°F for Unit 3. The specific changes are described below.

1. Unit 1, TS page 3.6/4.6-3, Limiting Condition for Operation (LCO) 3.6.A.5.

   Current LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 100°F, and must remain above 100°F while under full tension."

   Proposed LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 80°F, and must remain above 80°F while under full tension."

2. Unit 2, TS page 3.6/4.6-3, Limiting Condition for Operation (LCO) 3.6.A.5.

   Current LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 100°F, and must remain above 100°F while under full tension."

   Proposed LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 82°F, and must remain above 82°F while under full tension."

3. Unit 3, TS page 3.6/4.6-3, Limiting Condition for Operation (LCO) 3.6.A.5.

   Current LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 100°F, and must remain above 100°F while under full tension."

   Proposed LCO 3.6.A.5:

   > "The reactor vessel head bolting studs may be partially tensioned (four sequences of the seating pass) provided the studs and flange materials are above 70°F. Before loading the flanges any more, the vessel flange and head flange must be greater than 70°F, and must remain above 70°F while under full tension."

4. Replace the existing Units 1, 2, and 3 TS page 3.6/4.6-24, Figure 3.6-1, with a new figure for each unit that reflects the new boltup temperatures and revised P-T limits.

5. Unit 1 Bases Section 3.6.A/4.6.A, TS pages 3.6/4.6-27 and 3.6/4.6-28,

   Current Bases:

   > "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 40°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 40°F plus 60°F for a total of 100°F. The partial boltup is . . ."

   Revised Bases:

   > "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 20°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 20°F plus 60°F for a total of 80°F. The partial boltup is . . ."

6. Unit 2 Bases Section 3.6.A/4.6.A, TS page 3.6/4.6-27,

   Current Bases:

   > "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 40°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 40°F plus 60°F for a total of 100°F. The partial boltup is . . ."

   Revised Bases:

   > "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 22°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 22°F plus 60°F for a total of 82°F. The partial boltup is . . ."

7. Unit 3 Bases Section 3.6.A/4.6.A, TS page 3.6/4.6-27,

Current Bases:

> "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 40°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 40°F plus 60°F for a total of 100°F. The partial boltup is . . ."

Revised Bases:

> "The NDT temperature of the closure flanges, adjacent head, and shell material is a maximum of 10°F and a maximum of 10°F for the stud material. Therefore, the minimum temperature for full tension boltup is 10°F plus 60°F for a total of 70°F. The partial boltup is . . ."

II. <u>REASON FOR THE PROPOSED CHANGE</u>

The current P-T curves for BFN Units 1, 2, and 3 require a 100°F bolt-up temperature. Lowering the bolt-up temperature reduces the complexity of the Integrated Leak Rate Test and further ensures the reactor vessel and drywell heads (heavy loads) would only have to be lifted once at the end of each outage. In addition, there may not be sufficient decay heat available to heat the primary system to the boltup temperature in a timely fashion during an extended outage. Similarly, the use of alternate heat sources (i.e., running the residual heat removal pumps) also results in a delay of the outage. Thus, decreasing the required bolt-up temperature will decrease the overall Unit 2 Cycle 8 and Unit 3 Cycle 6 outage time by several hours.

III. <u>SAFETY ANALYSIS</u>

All components of the reactor coolant system are designed to withstand effects of cyclic loads due to system pressure and temperature changes. These loads are introduced by startup (heatup) and shutdown (cooldown) operations, power transients, and reactor trips. Therefore, P-T limits are established to ensure the reactor coolant system is operated at stresses that preclude brittle failure of the reactor coolant pressure boundary, which is an unanalyzed condition.

10 CFR 50, Appendix G, requires the establishment of these P-T limits for reactor coolant pressure boundary materials. Appendix G also requires an adequate margin to brittle failure during normal operation, anticipated operational

occurrences, and system hydrostatic tests. The P-T limits are acceptance limits, since they preclude operation in an unanalyzed condition. The P-T limits are not derived from Design Basis Accident analyses.

The proposed P-T limit curves are composite curves established by superimposing limits derived from stress analyses of those portions of the reactor vessel and head that are the most restrictive. At any specific pressure, temperature, and temperature rate of change, one location within the reactor vessel will dictate the most restrictive limit. Across the span of the P-T limit curves, different locations are more restrictive, and, thus, the curves are composites of the most restrictive regions.

For BFN Units 1, 2, and 3, the P-T limits are specified in TS Figure 3.6-1. This figure contains three separate P-T curves, which define the minimum pressure and temperature for the following reactor operating conditions:

Curve 1 specifies the P-T limits during primary system hydrostatic and leakage testing.

Curve 2 specifies the P-T limits during heatup and cooldown.

Curve 3 specifies the P-T limits during operations when the core is critical.

The boltup temperature is a part of Curve 1. Hydrostatic/leak testing of the reactor vessel is performed prior to startup after a refueling outage to verify that the vessel is leak tight. TSs require isolation of containment and increased system operability requirements once the reactor coolant temperature reaches 212°F. These requirements, plus the additional personnel hazards encountered at higher temperatures, establish 212°F as the maximum temperature for this test. The minimum temperature is established by the P-T curves. TSs require reactor coolant temperatures between the flange and bottom head to be greater than the P-T curves.

Curve 2, the heatup and cooldown curve, is also a composite curve since the directions of the thermal gradients through the vessel wall for heatup and cooldown are reversed. The thermal gradient reversal alters the location of the tensile stress between the outer and inner walls.

Curve 3, the operational P-T limit curve, provides operational boundaries during maneuvers at power. The primary system pressure and temperature are monitored and compared to the applicable curve to determine that operation is within the allowable region.

The P-T limits of these curves are mostly dependent upon the fracture toughness of the vessel ferritic materials. The key parameters which characterize a material's fracture toughness are the reference temperature of nil-ductility transition (RT_{NDT}) and the Upper Shelf Energy. These parameters are defined in 10 CFR 50, Appendix G, and in Appendix G of the ASME Boiler and Pressure Vessel Code, Section XI. These documents also contain the requirements used to establish the P-T operating limits that must be met to avoid brittle fracture.

Regulatory Guide 1.99, Revision 2, Radiation Embrittlement of Reactor Vessel Materials, provides an acceptable method for calculating P-T limits that satisfy the requirements of 10 CFR 50, Appendix G. TVA has recalculated the P-T curves for BFN Units 1, 2, and 3 based on General Electric (GE) methodologies that are in accordance with Regulatory Guide 1.99, Revision 2, using plant-specific material and fluence information. The basis for GE RT_{NDT} estimation is described in NEDC-32399, which was approved by the Staff on December 16, 1994 (Reference 1). The BFN Units 1, 2, and 3 specific RT_{NDT}, weld and plate material composition and fluence information was provided by TVA to NRC in response to Generic Letter 92-01, Revision 1, Reactor Vessel Structural Integrity (See References 2 - 7).

The reactor vessel bolt-up limits were established by using the highest value of RT_{NDT} + 60°F of the reactor vessel head or shell flanges and their connected plates and welds, or the Lowest Service Temperature of the head bolts. In this case, the highest value of RT_{NDT} + 60°F was always the controlling factor. The Certified Material Test Reports were used to provide the fracture toughness data for all plates and forgings in the Reactor Pressure Vessel (RPV) head and the shell flange region. This information was used to calculate the RT_{NDT} and the limiting bolt-up temperature for the flanges and plates for 12 effective full power years of operation (through Unit 2 Cycle 8).

IV. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

TVA has concluded that operation of Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 in accordance with the proposed change to the technical specifications does not involve a significant hazards consideration. TVA's

conclusion is based on its evaluation, in accordance with 10 CFR 50.91(a)(1), of the three standards set forth in 10 CFR 50.92(c).

A. **The proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.**

The proposed Units 1, 2, and 3 change deals exclusively with the reactor vessel P-T curves, which define the permissible regions for operation and testing. Failure of the reactor vessel is not a design basis accident. Through the design conservatisms used to calculate the P-T curves, reactor vessel failure has a low probability of occurrence and is not considered in the safety analyses. These changes do not alter or prevent the operation of equipment required to mitigate any accident analyzed in the BFN Final Safety Analysis Report. Therefore, this change does not increase the probability or consequences of any previously evaluated accident.

B. **The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.**

The proposed change to the Units 1, 2, and 3 reactor vessel P-T curves does not involve a modification to plant equipment. No new failure modes are introduced. There is no effect on the function of any plant system and no new system interactions are introduced by this change. The calculation of the proposed P-T curves was in accordance with Regulatory Guide 1.99, Revision 2, and the requirements of 10 CFR 50, Appendix G. Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

C. **The proposed amendment does not involve a significant reduction in a margin of safety.**

The ductile to brittle transition temperature is shifted approximately 10°F at higher temperatures and approximately 30°F at lower temperatures on the proposed P-T curves. While this represents a decreased margin against non-ductile fracture during heatup, cooldown and hydrotesting, the proposed curves conform to the guidance contained in Regulatory Guide 1.99, Revision 2, and maintain the safety margins specified in 10 CFR 50, Appendix G. Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

V. ENVIRONMENTAL IMPACT CONSIDERATION

The proposed change does not involve a significant hazards consideration, a significant change in the types of or significant increase in the amounts of any effluents that may be released offsite, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Accordingly, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

VI. REFERENCES

1. NRC letter to the BWR Owners' Group, dated December 16, 1994, Safety Assessment of Report NEDC-32399-P, "Basis for GE RT_{NDT} Estimation Method," September 1994

2. TVA letter to NRC, dated July 7, 1992, Browns Ferry Nuclear Plant (BFN), Sequoyah Nuclear Plant (SQN), and Watts Bar Nuclear Plant (WBN) - Response to Generic Letter 92-01 (Reactor Vessel Structural Integrity)

3. TVA letter to NRC, dated December 1, 1992, Completion of Commitment Made in Response to Generic Letter 92-01, "Reactor Vessel Structural Integrity"

4. TVA letter to NRC, dated August 2, 1993, Response to Request for Additional Information, Generic Letter 92-01, Revision 1

5. TVA letter to NRC, dated May 23, 1994, Supplemental Response to TVA letter dated April 14, 1994, Generic Letter 92-01, Revision 1, Reactor Vessel Structural Integrity

6. TVA letter to NRC, dated July 28, 1994, Supplemental Response to TVA letter dated May 23, 1994, Generic Letter 92-01, Revision 1, Reactor Vessel Structural Integrity

7. TVA letter to NRC dated March 27, 1995, Generic Letter (GL) 92-01, Reactor Vessel Structural Integrity Update for the Initial Reference Nil-Ductility Temperature (RT_{NDT}), Chemistry Composition and Fluence Values