September 16, 1985

Posted
Amdt. 116
to DPR-52

Docket Nos. 50-259/260/296

Mr. Hugh G. Parris
Manager of Power
Tennessee Valley Authority
500A Chestnut Street, Tower II
Chattanooga, Tennessee 37401

Dear Mr. Parris:

The Commission has issued the enclosed Amendment Nos. 121 , 116 and 92 to Facility Operating License Nos. DPR-33, DPR-52 and DPR-68 for the Browns Ferry Nuclear Plant, Units 1, 2 and 3. These amendments are in response to your application dated September 22, 1983 (TVA BFNP TS 191), as supplemented March 20, 1985.

These amendments revise the present pressure-temperature limit curves (Figure 3.6-1) in the Technical Specifications to provide more conservative limiting temperatures for pressure test, heatup, cooldown and core operations which are valid for 12 equivalent full power years of plant operation. On April 12, 1985, we had issued Amendment No. 87 for Browns Ferry Unit 3 which, as an interim measure, had approved the same identical curves for the duration of the present Cycle 6 operations.

A copy of the Safety Evaluation is also enclosed.

Sincerely,

Richard J. Clark

Richard J. Clark, Project Manager
Operating Reactors Branch #2
Division of Licensing

Enclosures:
1. Amendment No. 121 to License No. DPR-33
2. Amendment No. 116 to License No. DPR-52
3. Amendment No. 92 to License No. DPR-68
4. Safety Evaluation

cc w/enclosures:
See next page

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-259

BROWNS FERRY NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 121
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 September 22, 1983, as supplemented March 20, 1985, 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 Facility Operating License No. DPR-33 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 121, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective 90 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 16, 1985

ATTACHMENT TO LICENSE AMENDMENT NO. 121

FACILITY OPERATING LICENSE NO. DPR-33

DOCKET NO. 50-259

Revise Appendix A as follows:

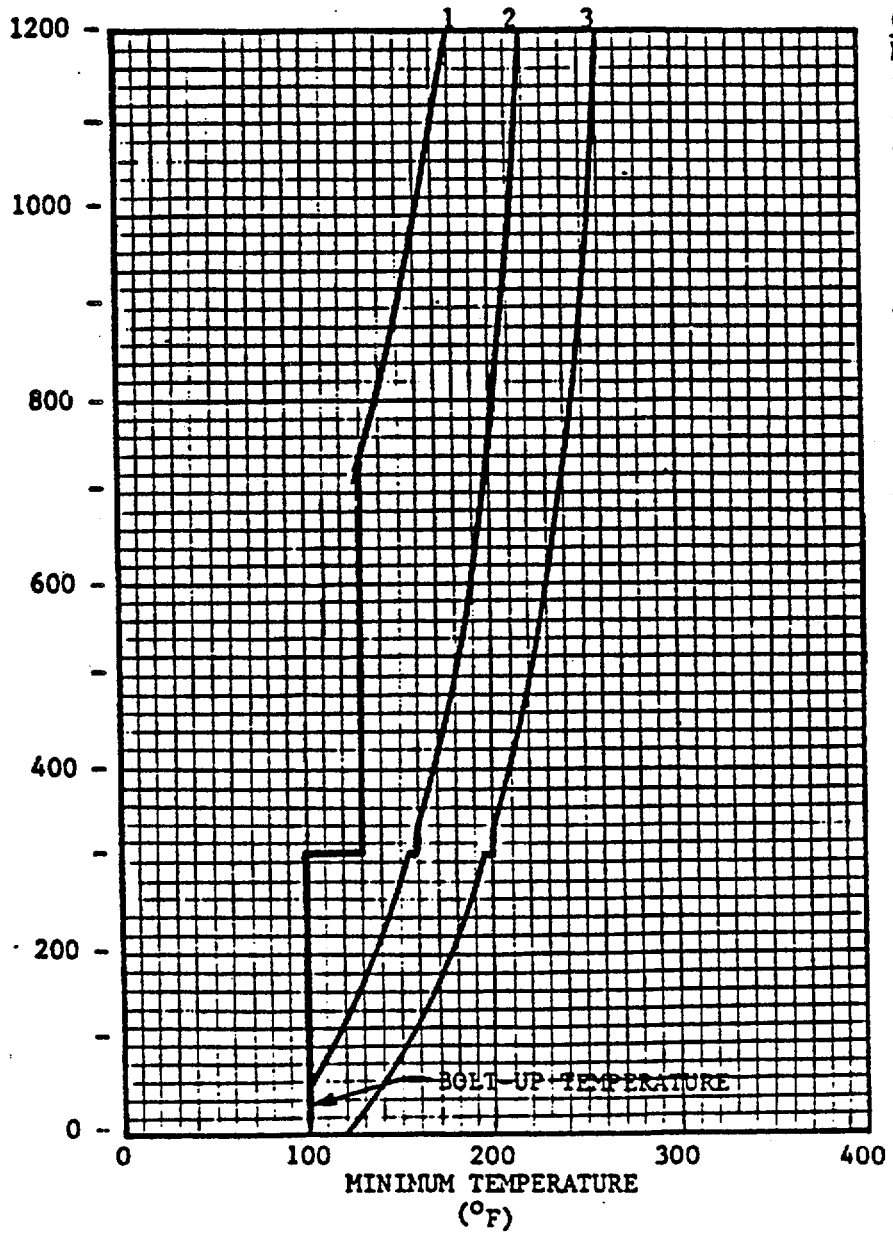
1. Remove the following page and replace with identically numbered page.

194

2. The marginal lines on this page denote the area being changed.

9/20/84

Figure 3.6-1



Curve #1
Minimum temperature for pressure tests such as required by Section XI. Minimum temperature of 170°F is required for test pressure of 1,100 psig.

Curve #2
Minimum temperature for mechanical heatup or cooldown following nuclear shutdown.

Curve #3
Minimum temperature for core operation (criticality) includes additional margin required by 10CFR50, Appendix G, Par. IV.A.3 which became effective July 26, 1983.

Notes
These curves include sufficient margin to provide protection against feedwater nozzle degradation. The curves allow for shifts in RT_{NDT} of the reactor vessel beltline materials to compensate for radiation embrittlement for 12 EFPY.

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 116
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 September 22, 1983, as supplemented March 20, 1985, 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 Facility Operating License No. DPR-52 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 116, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective 90 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 16, 1985

ATTACHMENT TO LICENSE AMENDMENT NO. 116

FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Revise Appendix A as follows:

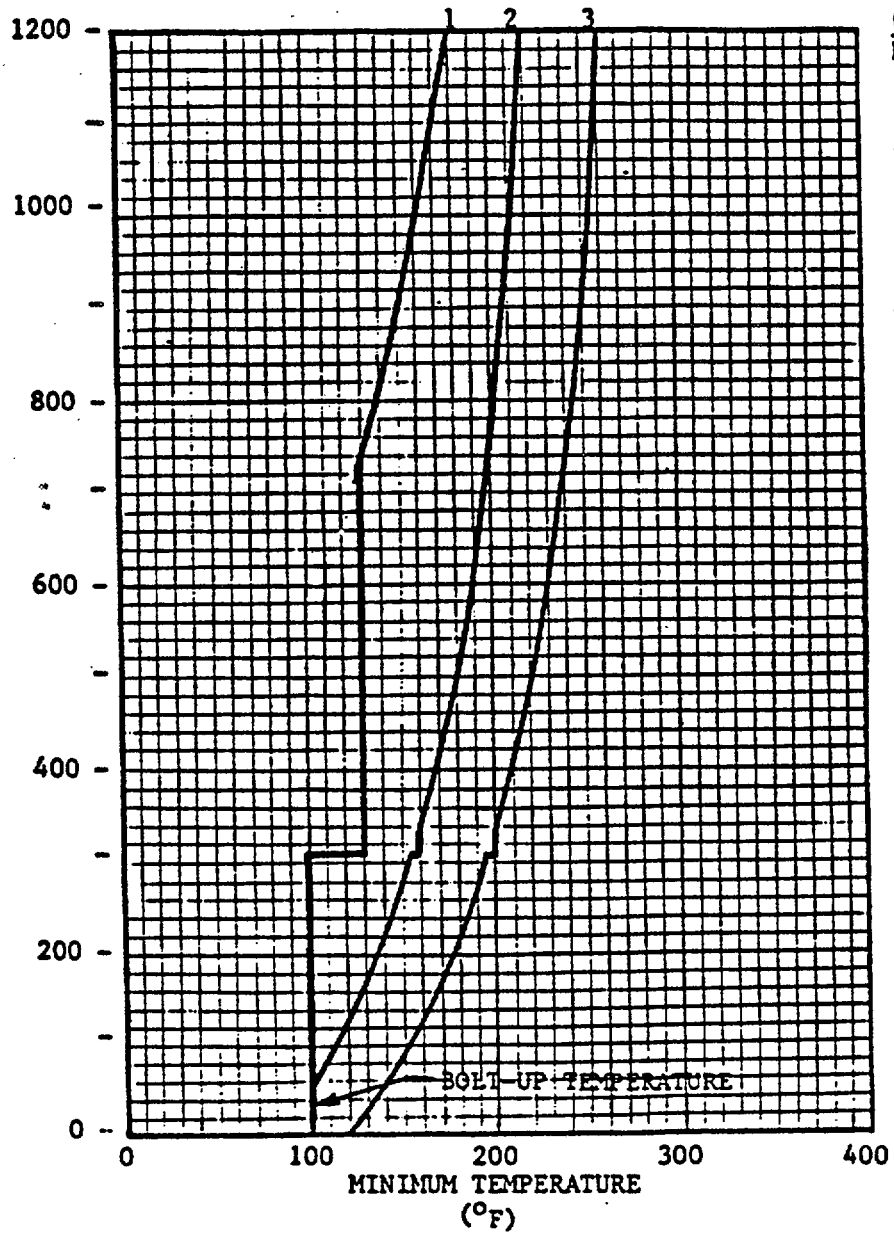
1. Remove the following page and replace with identically numbered page.

194

2. The marginal lines on this page denote the area being changed.

9/20/84

Figure 3.6-1



Curve #1
Minimum temperature for pressure tests such as required by Section XI. Minimum temperature of 170°F is required for test pressure of 1,100 psig.

Curve #2
Minimum temperature for mechanical heatup or cooldown following nuclear shutdown.

Curve #3
Minimum temperature for core operation (criticality) includes additional margin required by 10CFR50, Appendix G, Par. IV.A.3 which became effective July 26, 1983.

Notes
These curves include sufficient margin to provide protection against feedwater nozzle degradation. The curves allow for shifts in RT_{NDT} of the reactor vessel beltline materials to compensate for radiation embrittlement for 12 EFPY.

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-296

BROWNS FERRY NUCLEAR PLANT, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 92
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 September 22, 1983, as supplemented March 20, 1985, 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 Facility Operating License No. DPR-68 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 92, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective 90 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Domenic B. Vassallo, Chief
Operating Reactors Branch #2
Division of Licensing

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 16, 1985

ATTACHMENT TO LICENSE AMENDMENT NO. 92

FACILITY OPERATING LICENSE NO. DPR-68

DOCKET NO. 50-296

Revise Appendix A as follows:

1. Remove the following pages and replace with identically numbered pages.

185

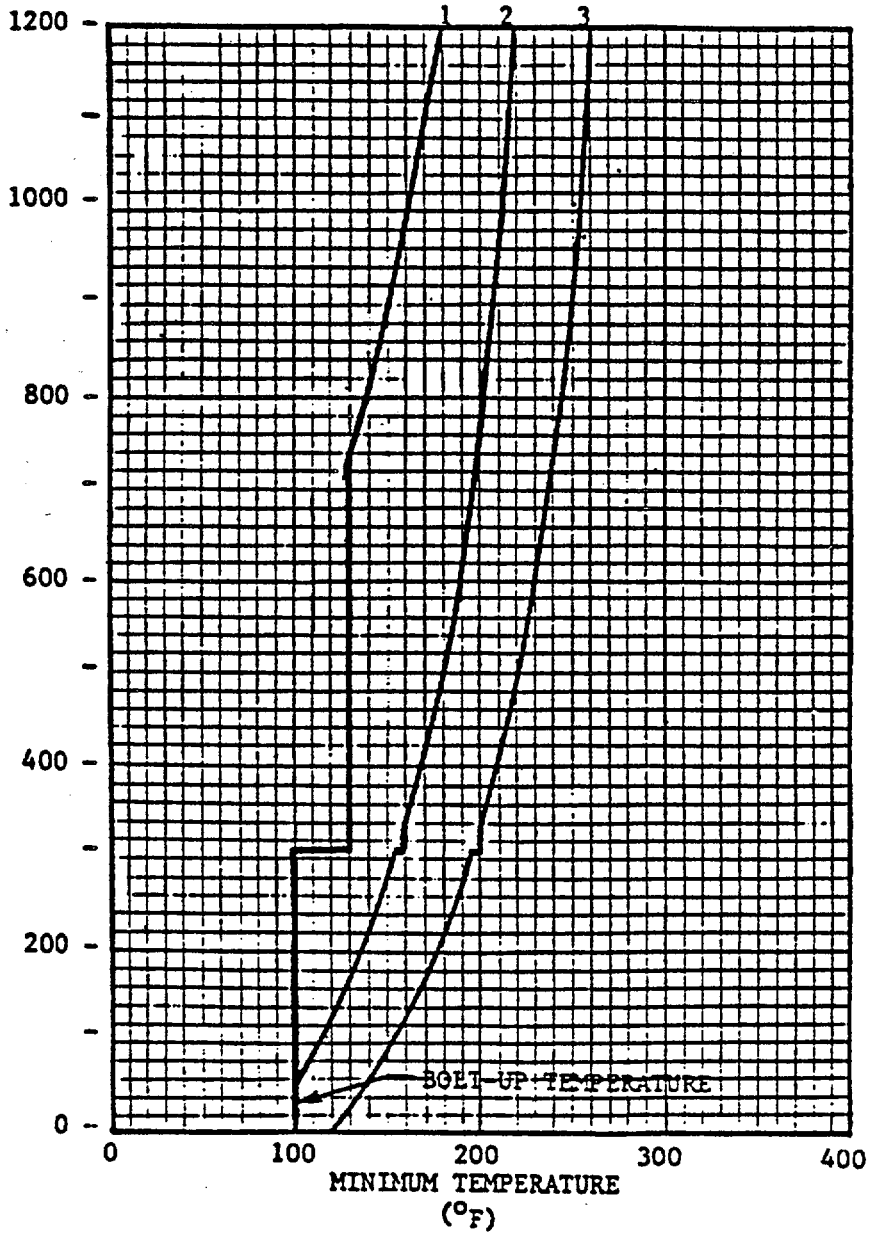
207

2. The marginal lines on the above pages denotes the area being changed.

LIMITING CONDITIONS FOR OPERATION	SURVEILLANCE REQUIREMENTS
3.6 PRIMARY SYSTEM BOUNDARY	4.6 PRIMARY SYSTEM BOUNDARY
	d. Reactor vessel bottom head temperature e. Reactor vessel shell adjacent to shell flange
2. During all operations with a critical core, other than for low level physics tests, except when the vessel is vented, the reactor vessel shell and fluid temperatures shall be at or above the temperature of curve #3 of figure 3.6-1.	2. Reactor vessel metal temperature at the outside surface of the bottom head in the vicinity of the control rod drive housing and reactor vessel shell adjacent to shell flange, shall be recorded at least every 15 minutes during inservice hydrostatic or leak testing when the vessl pressure is > 312 psig.
3. During heatup by non-nuclear means, except when the vessel is vented or as indicated in 3.6.A.4, during cooldown following nuclear shutdown, or during low-level physics tests, the reactor vessel temperature shall be at or above the temperatures of curve #2 of Figure 3.6.1 until removing tension on the head stud bolts as specified in 3.6.A.5.	3. Test specimens representing the reactor vessel, base weld, and weld heat affected zone metal shall be installed in the reactor vessel adjacent to the vessel wall at the core midplane level. The number and type of specimens will be in accordance with GE report NEDO-10115. The specimens shall meet the intent of ASTM E 185-70. Samples shall be withdrawn at one-fourth and three-fourths service life.

9/20/84

Figure 3.6-1



Curve #1
Minimum temperature for pressure tests such as required by Section XI. Minimum temperature of 170°F is required for test pressure of 1,100 psig.

Curve #2
Minimum temperature for mechanical heatup or cooldown following nuclear shutdown.

Curve #3
Minimum temperature for core operation (criticality) includes additional margin required by 10CFR50, Appendix G, Par. IV.A.3 which became effective July 26, 1983.

Notes
These curves include sufficient margin to provide protection against feedwater nozzle degradation. The curves allow for shifts in RT_{NDT} of the reactor vessel beltline materials to compensate for radiation embrittlement for 12 EFPY.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 121 TO FACILITY OPERATING LICENSE NO. DPR-33

AMENDMENT NO. 116 TO FACILITY OPERATING LICENSE NO. DPR-52

AMENDMENT NO. 92 TO 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 letter dated September 22, 1983 (TVA BFNP TS 191), as supplemented March 20, 1985, the Tennessee Valley Authority (licensee/TVA) requested amendments to Facility Operating License Nos. DPR-33, DPR-52 and DPR-68 for the Browns Ferry Nuclear Plant, Units 1, 2 and 3. The licensee requested amendments to the Technical Specifications (TS) to revise the present pressure-temperature limit curves (Figure 3.6-1). Periodic revision of these curves is required to account for the loss of reactor vessel material toughness resulting from the accumulated radiation exposure to the vessel with time. The licensee indicates that the proposed pressure-temperature limits are applicable for a period corresponding to 12 effective full power years (EFPY). Submitted in the September 22, 1983 letter were three Southwest Research Institute Reports: No. 02-4884-001, titled, "Analysis of the Vessel Wall Neutron Dosimeter From Browns Ferry Unit 1 Pressure Vessel; No. 01-4884-002 titled, "Analysis of the Vessel Wall Neutron Dosimeter From Browns Ferry Unit 2 Pressure Vessel; and No. 02-4884-003 titled, "Analysis of the Vessel Wall Neutron Dosimeter From Browns Ferry Unit 3 Pressure Vessel. Submitted in the March 20, 1985 letter was Babcock & Wilcox Report BAW-1845, titled, "Browns Ferry Core Region Materials Information (Units 1, 2 and 3)."

2.0 EVALUATION

Appendix G, "Fracture Toughness Requirements," and Appendix H, "Reactor Vessel Material Surveillance Program Requirements," 10 CFR Part 50, describe the conditions that require pressure-temperature limits for the reactor coolant pressure boundary and provide the general bases for these limits. These appendices specifically require that pressure-temperature limits must provide safety margins for the reactor coolant pressure boundary at least as great as the safety margins recommended in the ASME Boiler and Pressure Vessel Code, Section III, Appendix G, "Protection Against Nonductile Failure." Appendix G, 10 CFR Part 50, requires additional safety margins whenever the reactor core is critical, except for low-level physics tests.

The fracture toughness of all ferritic steels gradually decreases with exposure to fast neutrons above a threshold value. To adjust for this, the minimum operating temperature vs. pressure curves need to be revised. The present curves in Figure 3.6-1, which were based on a shift in RT_{NDT} of 30 F, were approved for use through 4.0 EFPY. The Browns Ferry reactor vessels have exceeded this exposure. By application dated September 23, 1983, the licensee proposed revised curves. Our review of this submittal determined that additional information (as described in our letter of January 23, 1984) was needed on the chemical composition and test results on the weld and plate material used to fabricate the reactor vessels. The information requested was provided by TVA'S letter of March 20, 1985. The March 20, 1985 submittal provided clarifying information to support the licensee's materials evaluation and did not significantly change the initial application. Based on the irradiation data, TVA concludes that a 45°F shift in RT_{NDT} will not occur for at least 12 EFPY of operation. This would cover about the next decade of operation for each Browns Ferry unit.

Prressure-temperature limits must be calculated in accordance with the requirements of Appendix G, 10 CFR 50, which became effective on July 26, 1983. Pressure-temperature limits that are calculated in accordance with the requirements of Appendix G, 10 CFR 50 are dependent upon the initial RT_{NDT} for the limiting materials in the beltline and closure flange regions of the reactor vessel and the increase in RT_{NDT} resulting from neutron irradiation damage to the limiting beltline material.

The Browns Ferry FSAR Section 4.2 indicates that all materials in the closure flange region will have a nil-ductility transition (NDT) temperature, as determined by ASTM E 208, of a maximum of 10°F. The FSAR indicates that material used to fabricate the closure flange forging met the requirements of ASME Code Specification SA 508 C1.2, Code Case 1332. According to Table 4.4 of NUREG 0577, "Potential for Low Fracture Toughness and Lamaller Tearing on PWR Steam Generator and Reactor Coolant Pump Supports," an upper bound estimate of the RT_{NDT} for this material is 40°F.

The amount of time that pressure-temperature limits are effective depends upon the initial RT_{NDT} and the amount of neutron irradiation damage to the limiting beltline material. The amount of neutron irradiation damage calculated in accordance with Regulatory Guide 1.99, Rev. 1, "Effects of Residual Elements on the Predicted Radiation Damage to Reactor Vessel Materials" is dependent upon the amount of neutron fluence (E less than 1MeV) and the percentage of phosphorus (P) and copper (Cu) in the limiting beltline material.

BAW-1845 indicates that the beltline of each Browns Ferry reactor vessel consists of six plates, six longitudinal weld seams and one circumferential weld seam. This report includes test data from base material removed from actual beltline plates and weld metal representative of that used for fabrication of the beltline welds. As a result of our review of this data, we conclude that the limiting beltline material for Unit 1 is the circumferential weld seam and the limiting beltline materials for Units 2 and 3 are the longitudinal weld seams.

The circumferential weld seam in Unit 1 was fabricated by Babcock & Wilcox using the automatic submerged arc process with Linde 80 flux and is identified as WF 154. The upper bound unirradiated RT_{NDT} for this material is reported in BAW-10046 as +20°F. Its chemical composition is reported in BAW 1799 as .31% Cu. and 0.013% P.

The longitudinal weld seams in Units 2 and 3 were fabricated by Babcock & Wilcox using the electroslag process with Linde 124 Flux. Samples from actual prolongation material used in fabricating these welds were not tested. However, the licensee provided test results from four electroslag weld procedure qualifications, which Babcock & Wilcox indicates are the only ones that would have been applicable for the three Browns Ferry Units. In addition, eight weld wire chemistries were also available. Based on these test results, the licensee estimated the electroslag chemical composition as .25% Cu, and .016% P and the unirradiated RT_{NDT} as 0°F. We have reviewed the test data submitted by the licensee and additional test data from prolongation material removed from Peach Bottom Units 1 and 2 electroslag welds, which was also fabricated by Babcock & Wilcox using Linde 124 flux. This data is contained in FSAR Appendix F of Dresden Units 2 and 3. As a result of this evaluation, we have concluded that the estimated chemical composition is acceptable, but the unirradiated RT_{NDT} should be 10°F. This value of RT_{NDT} corresponds to the highest NDT reported from the tests on the material from the weld procedure qualification. Since there were only four weld qualification tests performed, a generic upper bound value should be used in estimating the unirradiated RT_{NDT} for the electroslag welds.

The Unit 1 peak end-of-life neutron fluence at the 1/4 thickness location was calculated from the Unit 1 surveillance capsule dosimetry as 1.0 X 10^{18} n/cm^2 (E less than 1MeV). The dosimetry data and method used to calculate the peak end-of-life neutron fluence is documented in the Southwest Research Report No. 02-4884-001. The circumferential weld is reported to be 28 inches below the core midplane, which corresponds to the peak neutron flux location. Based on the vertical distribution of flux reported in the Southwest Research surveillance capsule report, the licensee indicates that the peak neutron fluence for this circumferential weld at the 1/4 thickness location is 1.887 X 10^{16} n/cm^2 per EFPY.

The Units 2 and 3 peak end-of-life neutron fluence at the 1/4 thickness location was calculated from their surveillance capsule dosimetry as 9.0 X 10^{17} n/cm^2 and 8.8 X 10^{17} n/cm^2 (E less then 1MeV), respectively. The dosimetry data and method used to calculate the peak end-of-life neutron fluence is documented for Units 2 and 3 in Southwest Research Reports No. 02-4884-002 and No. 02-4884-003, respectively. Since the longitudinal welds cross the core midplane, these peak neutron fluence values will conservatively represent the peak end-of-life values for the longitudinal weld seams for Units 2 and 3.

The conditions under which these pressure-temperature limits must be applied - including operation with the curves in Figure 3.6-1 - are specified in Section 3.6.A of the TS (Thermal and Pressurization Limitations). We noted during review of these amendment applications that there was a phrase

missing from Section 3.6.A.2 of the Unit 3 TS compared to Units 1 and 2. Specifically, this section in the Units 1 and 2 TS reads: "During all operations with a critical core, other than for low level physics tests, except when the vessel is vented, the reactor vessel shell and fluid temperatures shall be at or above the temperature of curve #3 of figure 3.6-1". The phrase that is missing in Section 3.6.A.2 of the Unit 3 TS is: "except when the vessel is vented". The phrase is properly included in Section 3.6.A.3 of the Unit 3 TS. The NRC resident inspectors had also noted this in a recent inspection report. This phrase was in the original Unit 3 TS. Our review indicates the phrase was inadvertently dropped when page 185 was retyped to modify Section 3.6.A.3 in Amendment 56 issued July 22, 1982, and was not part of the changes intended to be authorized by that Amendment. The licensee agreed that this error in omission should be corrected to clarify a possible violation and to have the TS for all there units the same (and correct). By agreement with the licensee, we are adding the phrase "except when the vessel is vented" back to Section 3.6.A.2 of the Unit 3 TSs to correct this error.

Utilizing the method recommended in Regulatory Guide 1.99 Rev. 1 to predict neutron irradiation damage, the neutron fluence estimates calculated by Southwest Research from surveillance capsule dosimetry, the unirradiated RT_{NDT} and chemical composition for the limiting beltline welds previously discussed, and RT_{NDT} for the closure flange region of 40 F; we have determined that the proposed pressure-temperature limits meet the safety margins of Appendix G, 10 CFR 50 for 12 EFPY, and may be incorporated into the plants' Technical Specifications.

3.0 ENVIRONMENTAL CONSIDERATIONS

The amendments involve a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The 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 amendments involve no significant hazards consideration and there has been no public comment on such finding. 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 amendments.

4.0 CONCLUSION

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

Principal Contributors: B. Elliot and R. Clark

Dated: September 16, 1985