September 13, 1989

Docket No. 50-260

Mr. Oliver D. Kingsley, Jr.
Senior Vice President, Nuclear Power
Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

Dear Mr. Kingsley:

SUBJECT: REVISED RELOAD TECHNICAL SPECIFICATIONS (TAC 00450) (TS 254)
BROWNS FERRY NUCLEAR PLANT, UNIT 2

The Commission has issued the enclosed Amendment No. 172, to Facility Operating License No. DPR-52 for the Browns Ferry Nuclear Plant, Unit 2. This amendment is in response to your application dated August 26, 1988. This amendment updates the Unit 2 Technical Specifications to reflect revised reactor core operating limits for Cycle 6 operation.

A copy of the Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's Bi-Weekly Federal Register Notice.

Sincerely,

Original signed by

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Nuclear Reactor Regulation

Enclosures:
1. Amendment No. 172 to License No. DPR-52
2. Safety Evaluation

OFo1

cc w/enclosures:
See next page

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TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 172
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 August 26, 1988, 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. 172, 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 90 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Suzanne Black

Suzanne Black, Assistant Director
for Projects
TVA Projects Division
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 13, 1989

ATTACHMENT TO LICENSE AMENDMENT NO. 172

FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Revise the Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change. Overleaf pages* are provided to maintain document completeness.

REMOVE	INSERT
3.5/4.5-18	3.5/4.5-18
3.5/4.5-19	3.5/4.5-19*
3.5/4.5-20	3.5/4.5-20*
3.5/4.5-21	3.5/4.5-21
-	3.5/4.5-21a
-	3.5/4.5-21b
3.5/4.5-22	3.5/4.5-22
3.5/4.5-22a	3.5/4.5-22a
3.5/4.5-30	3.5/4.5-30*
3.5/4.5-31	3.5/4.5-31

LIMITING CONDITIONS R OPERATION

3.5.I Average Planar Linear Heat Generation Rate

During steady-state power operation, the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for each type of fuel as a function of average planar exposure shall not exceed the limiting value shown in Tables 3.5.I-1, 2, 3, and 4. If at any time during operation it is determined by normal surveillance that the limiting value for MAPLHGR is being exceeded, action shall be initiated within 15 minutes to restore operation to within the prescribed limits. If the MAPLHGR is not returned to within the prescribed limits within two (2) hours, the reactor shall be brought to the Cold Shutdown condition within 36 hours. Surveillance and corresponding action shall continue until reactor operation is within the prescribed limits.

J. Linear Heat Generation Rate (LHGR)

During steady-state power operation, the linear heat generation rate (LHGR) of any rod in any fuel assembly at any axial location shall not exceed 13.4 kW/ft. If at any time during operation it is determined by normal surveillance that the limiting value for LHGR is being exceeded, action shall be initiated within 15 minutes to restore operation to within the prescribed limits. If the LHGR is not returned to within the prescribed limits within two (2) hours, the reactor shall be brought to the Cold Shutdown condition within 36 hours. Surveillance and corresponding action shall continue until reactor operation is within the prescribed limits.

SURV LANCE REQUIREMENTS

4.5.I Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)

The MAPLHGR for each type of fuel as a function of average planar exposure shall be determined daily during reactor operation at $\geq$ 25% rated thermal power.

J. Linear Heat Generation Rate (LHGR)

The LHGR shall be checked daily during reactor fuel operation at $\geq$ 25% rated thermal power.

LIMITING CONDITIONS FOR OPERATION

3.5.K Minimum Critical Power Ratio (MCPR)

The minimum critical power ratio (MCPR) as a function of scram time and core flow, shall be equal to or greater than shown in Figure 3.5.K-1 multiplied by the K_f shown in Figure 3.5.2, where:

$$\tau = 0 \text{ or } \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}, \text{ whichever is greater}$$

τ_A = 0.90 sec (Specification 3.3.C.1 scram time limit to 20% insertion from fully withdrawn)

$$\tau_B = 0.710 + 1.65 \left[\frac{N}{n}\right]^{\frac{1}{2}} (0.053) \text{ [Ref.2]}$$

$$\tau_{ave} = \frac{\sum_{i=1}^{n} \tau_i}{n}$$

n = number of surveillance rod tests performed to date in cycle (including BOC test).

τ_i = Scram time to 20% insertion from fully withdrawn of the i^{th} rod.

N = total number of active rods measured in Specification 4.3.C.1 at BOC.

If at any time during steady-state operation it is determined by normal surveillance that the limiting value for MCPR is being exceeded, action shall be initiated within 15 minutes to restore operation to within the prescribed limits. If the steady-state MCPR is not returned to within the prescribed limits within two (2) hours, the reactor shall be brought to the Cold Shutdown condition within 36 hours, surveillance and corresponding action shall continue until reactor operation is within the prescribed limits.

SURVEILLANCE REQUIREMENTS

4.5.K. Minimum Critical Power Ratio (MCPR)

1. MCPR shall be determined daily during reactor power operation at ≥ 25% rated thermal power and following any change in power level or distribution that would cause operation with a limiting control rod pattern as described in the bases for Specification 3.3.

2. The MCPR limit shall be determined for each fuel type 8X8, 8X8R, P8X8R, from Figure 3.5.K-1, respectively, using:

   a. τ = 0.0 prior to initial scram time measurements for the cycle, performed in accordance with Specification 4.3.C.1.

   b. τ as defined in Specification 3.5.K following the conclusion of each scram-time surveillance test required by Specifications 4.3.C.1 and 4.3.C.2.

   The determination of the limit must be completed within 72 hours of each scram-time surveillance required by Specification 4.3.C.

LIMITING CONDITIONS FOR OPERATION

3.5 Core and Containment Cooling Systems

L. APRM Setpoints

1. Whenever the core thermal power is $\geq$ 25% of rated, the ration of FRP/CMFLPD shall be $\geq$ 1.0, or the APRM scram and rod block setpoint equations listed in Sections 2.1.A and 2.1.B shall be multiplied by FRP/CMFLPD as follows:

$$S \leq (0.66W + 54\%) \frac{FRP}{CMFLPD}$$

$$S_{RB} \leq (0.66W + 42\%) \left(\frac{FRP}{CMFLPD}\right)$$

2. When it is determined that 3.5.L.1 is not being met, 6 hours is allowed to correct the condition.

3. If 3.5.L.1 and 3.5.L.2 cannot be met, the reactor power shall be reduced to $\leq$ 25% of rated thermal power within 4 hours.

SURVEILLANCE REQUIREMENTS

4.5 Core and Containment Cooling Systems

L. APRM Setpoints

FRP/CMFLPD shall be determined daily when the reactor is $\geq$ 25% of rated thermal power.

Table 3.5.I-1

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: P8DRB284L QUAD+

Average Planar Exposure (MWd/t)	MAPLHGR (kW/ft)
200	11.2
1,000	11.3
5,000	11.8
10,000	12.0
15,000	12.0
20,000	11.8
25,000	11.2
30,000	10.8
35,000	10.2
40,000	9.5
45,000	8.8

Table 3.5.I-2

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: P8DRB265H

Average Planar Exposure (MWd/t)	MAPLHGR (kW/ft)
200	11.5
1,000	11.6
5,000	11.9
10,000	12.1
15,000	12.1
20,000	11.9
25,000	11.3
30,000	10.7
35,000	10.2
40,000	9.6

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Table 3.5.I-3

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: P8DRB284Z

Average Planar Exposure (MWd/t)	MAPLHGR (kW/ft)
200	11.2
1,000	11.2
5,000	11.7
10,000	12.0
15,000	12.0
20,000	11.8
25,000	11.1
30,000	10.4
35,000	9.8
40,000	9.1
45,000	8.5

Table 3.5.I-4

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: 8DRB284L

Average Planar Exposure (MWd/t)	MAPLHGR (kW/ft)
200	11.2
1,000	11.3
5,000	11.8
10,000	12.0
15,000	12.0
20,000	11.8
25,000	11.2
30,000	10.8
35,000	10.2
40,000	9.5

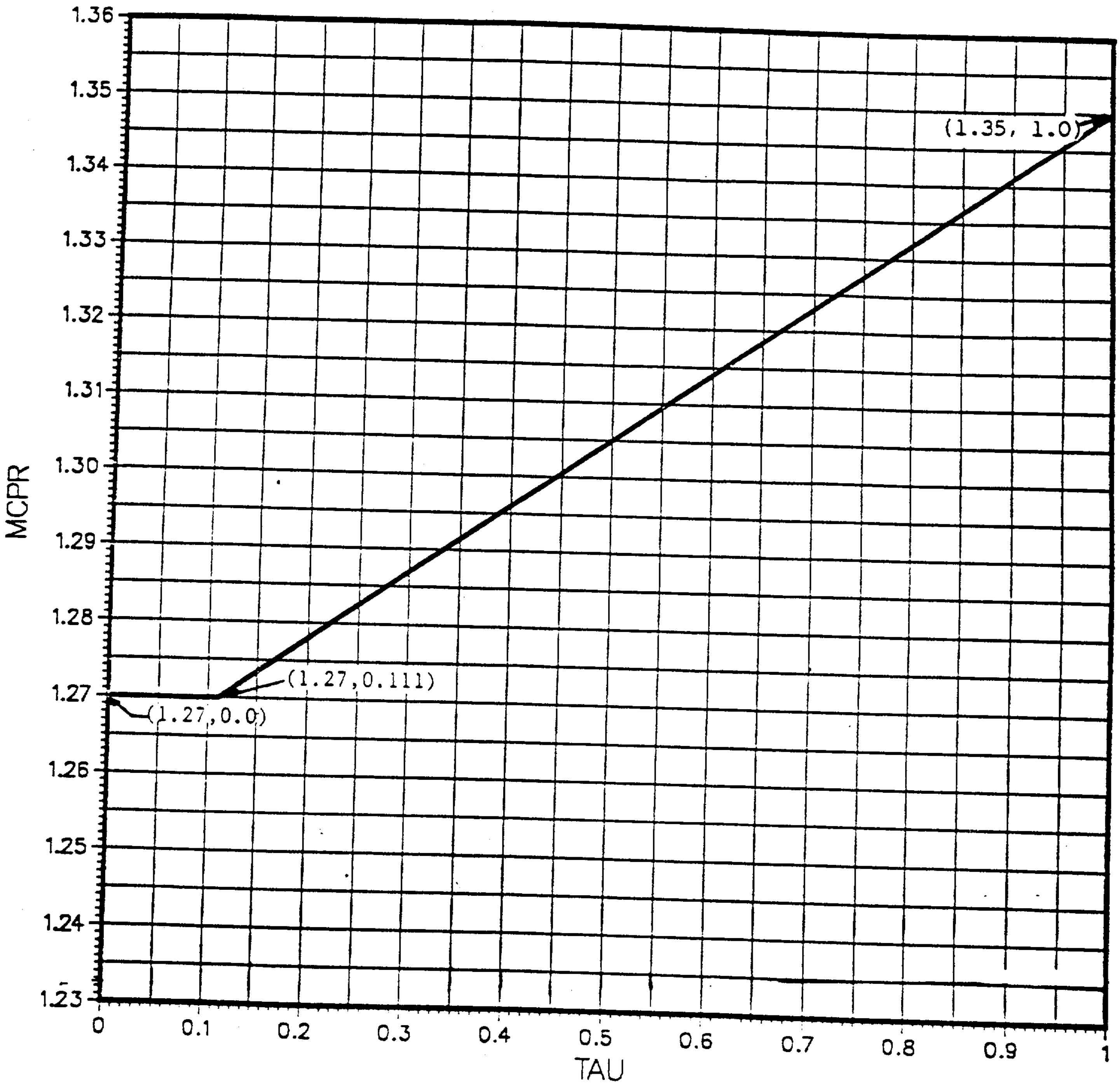

Figure 3.5.K-1
MCPR Limits for P8 X 8R/8 X 8R/ QUAD+

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The peak cladding temperature following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is only dependent secondarily on the rod-to-rod power distribution within an assembly. Since expected local variations in power distribution within a fuel assembly affect the calculated peak clad temperature by less than ± 20°F relative to the peak temperature for a typical fuel design, the limit on the average linear heat generation rate is sufficient to assure that calculated temperatures are within the 10 CFR 50 Appendix K limit. The limiting value for MAPLHGR is shown in Tables 3.5.I-1, 2, 3, and 4. The analyses supporting these limiting values are presented in Reference 1.

3.5.J. Linear Heat Generation Rate (LHGR)

This specification assures that the linear heat generation rate in any rod is less than the design linear heat generation if fuel pellet densification is postulated.

The LHGR shall be checked daily during reactor operation at ≥ 25 percent power to determine if fuel burnup, or control rod movement has caused changes in power distribution. For LHGR to be a limiting value below 25 percent rated thermal power, the R factor would have to be less than 0.241 which is precluded by a considerable margin when employing any permissible control rod pattern.

3.5.K. Minimum Critical Power Ratio (MCPR)

At core thermal power levels less than or equal to 25 percent, the reactor will be operating at minimum recirculation pump speed and the moderator void content will be very small. For all designated control rod patterns which may be employed at this point, operating plant experience and thermal hydraulic analysis indicated that the resulting MCPR value is in excess of requirements by a considerable margin. With this low void content, any inadvertent core flow increase would only place operation in a more conservative mode relative to MCPR. The daily requirement for calculating MCPR above 25 percent rated thermal power is sufficient since power distribution shifts are very slow when there have not been significant power or control rod changes. The requirement for calculating MCPR when a limiting control rod pattern is approached ensures that MCPR will be known following a change in power or power shape (regardless of magnitude) that could place operation at a thermal limit.

3.5.L. APRM Setpoints

Operation is constrained to a maximum LHGR of 13.4 kW/ft for 8x8 fuel. This limit is reached when core maximum fraction of limiting power density (CMFLPD) equals 1.0. For the case where CMFLPD exceeds the fraction of rated thermal power, operation is permitted only at less than 100-percent rated power and only with APRM scram settings as required by Specification 3.5.L.1. The scram trip setting and rod block trip setting are adjusted to ensure that no combination

Because the automatic depressurization system does not provide makeup to the reactor primary vessel, no credit is taken for the steam cooling of the core caused by the system actuation to provide further conservatism to the CSCS.

With two ADS valves known to be incapable of automatic operation, four valves remain OPERABLE to perform their ADS function. The ECCS loss-of-coolant accident analyses for small line breaks assumed that four of the six ADS valves were OPERABLE. Reactor operation with three ADS valves inoperable is allowed to continue for seven days provided that the HPCI system is OPERABLE. Operation with more than three of the six ADS valves inoperable is not acceptable.

3.5.H. Maintenance of Filled Discharge Pipe

If the discharge piping of the core spray, LPCI, HPCIS, and RCICS are not filled, a water hammer can develop in this piping when the pump and/or pumps are started. To minimize damage to the discharge piping and to ensure added margin in the operation of these systems, this Technical Specification requires the discharge lines to be filled whenever the system is in an OPERABLE condition. If a discharge pipe is not filled, the pumps that supply that line must be assumed to be inoperable for Technical Specification purposes.

The core spray and RHR system discharge piping high point vent is visually checked for water flow once a month and prior to testing to ensure that the lines are filled. The visual checking will avoid starting the core spray or RHR system with a discharge line not filled. In addition to the visual observation and to ensure a filled discharge line other than prior to testing, a pressure suppression chamber head tank is located approximately 20 feet above the discharge line high point to supply makeup water for these systems. The condensate head tank located approximately 100 feet above the discharge high point serves as a backup charging system when the pressure suppression chamber head tank is not in service. System discharge pressure indicators are used to determine the water level above the discharge line high point. The indicators will reflect approximately 30 psig for a water level at the high point and 45 psig for a water level in the pressure suppression chamber head tank and are monitored daily to ensure that the discharge lines are filled.

When in their normal standby condition, the suction for the HPCI and RCIC pumps are aligned to the condensate storage tank, which is physically at a higher elevation than the HPCIS and RCICS piping. This assures that the HPCI and RCIC discharge piping remains filled. Further assurance is provided by observing water flow from these systems' high points monthly.

3.5.I. Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)

This specification assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the limit specified in the 10 CFR 50, Appendix K.

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

ENCLOSURE 2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO.172 TO FACILITY OPERATING LICENSE NO. DPR-52

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNIT 2

DOCKET NO. 50-260

1.0 INTRODUCTION

By letter dated August 26, 1988 (Reference 1), the Tennessee Valley Authority (the licensee or TVA) requested an amendment to Facility Operating License No. DPR-52 for the Browns Ferry Nuclear Plant Unit 2 (BFN2). The proposed amendment would change the Technical Specifications (TS) of the operating license to modify the operating thermal limits to be consistent with the reanalysis associated with Cycle 6 operation. The staff review included those aspects of the reload related to the BFN Fuel Inspection and Reconstitution Program. A summary report on this program was submitted by the licensee by Reference 2.

2.0 EVALUATION

The original application for Technical Specification changes for operation of BFN Unit 2 in Cycle 6 was submitted by Reference 3 and was reviewed by the NRC in connection with Amendment 125 to Facility Operating License No. DPR-52 in 1986 (Reference 4). The present proposal reflects Cycle 6 fuel loading changes made as a result of the fuel inspection and reconstitution program which was completed in July 1988. In support of the application, TVA submitted Revision 2 to TVA-RLR-002 (dated July 1988) which is an update of the current licensed design reviewed by the staff for Amendment 125. The revision was prepared with consideration of the reconstituted fuel and reanalysis by TVA with input from General Electric Company and reported in Reference 2.

Reference 2 was reviewed by the staff to the extent necessary to confirm that the modeling assumptions used in the reload analyses are valid for the reconstituted core. The inspection and reconstitution process was necessary because of fuel reliability problems as a result of a corrosion mechanism which can cause fuel rod cladding degradation. The objective of the program was to provide a sufficient number of reload fuel assemblies to ensure reliable operation of the BFN2 core within its licensing basis. Those considerations relative to the proposed Amendment included core nuclear design characteristics, the transient and accident safety analysis results, and the proposed operating thermal limits.

The reconstitution process for assemblies designated for Cycle 6 reload involved exchanging fuel rods found unacceptable by visual observation with rods meeting acceptance criteria as established in the inspection plan. The designated fuel assemblies were twice- and thrice-burned bundles from prior operation of BFN Plant Unit 2. A total of 212 reconstituted assemblies will be used in Cycle 6. Those aspects of the fuel reconstitution relative to the Amendment request review are addressed in the following Safety Evaluation (SE) sections.

2.1 Reload Description

For Cycle 6, 304 irradiated fuel assemblies will be removed from the reactor core and replaced by 300 new General Electric pressurized P8x8R assemblies and four Westinghouse QUAD+ Demonstration assemblies. These new assemblies were previously reviewed and found acceptable in License Amendment 125 (Reference 4). The safety analyses for Cycle 6 were redone with the 212 reconstitiuted assemblies modeled as original assemblies. This modeling assumption was verified in support of the fuel reconstitution project using a methodology previously reviewed and approved by the NRC (Reference 5).

The fuel (P8x8R) to be inserted into the core for Cycle 6 is similar to that customarily used for BWR reloads. This fuel and the four QUAD+ Demonstration assemblies were previously found acceptable in License Amendment 125. The fuel reconstitution effort does not affect this conclusion.

2.2 Nuclear Design

The nuclear design and analysis for the Cycle 6 reload was performed with methods and techniques previously reviewed and approved by the staff for use in such analyses. The reanalyses with consideration of the fuel reconstitution effort were reported in TVA-RLR-002, Revision 2 (enclosed with Reference 1). The shutdown margin is calculated to be 1.0 percent (delta K)/K at the point in the cycle at which it is a minimum. This value exceeds the Technical Specifi cation requirement of 0.38 percent and is acceptable. The Standby Liquid Control System provides a shutdown margin of 2.9 percent (delta K)/K with a boron concentration of 600 ppm boron. This is greater than the design criterion of 1.8 percent and is acceptable. The modeling of the reconstituted fuel in the reanalysis had a minimal effect on the margin. The conclusion of the staff in Amendment 125 is unchanged by the reanalyses.

2.3 Thermal-Hydraulic Design

The thermal-hydraulic reanalysis of the BFN Plant Unit 2 Cycle 6 reload did not result in significant differences in results previously reported in Amendment 125. The staff conclusions are therefore unchanged.

The analyses of core-wide pressurization transient, non-pressurization events and the loss-of-coolant accident did not require any changes in the transient models since the thermal, mechanical, and hydraulic characteristics of the reconstituted assemblies are equivalent to those used in the previous analyses.

The Operating Limit Minimum Critical Power Ratio (MCPR) and Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) analyses previously accepted in Amendment 125 remain acceptable.

2.4 Thermal-Hydraulic Stability

The licensee's submittal included the results of analyses using a methodology which predicted core and channel stability by way of a calculated decay ratio. Based on recent staff consideration of power oscillations in boiling water reactors (NRC Bulletin 88-07, Reference 6), the staff has taken the position, in part, that past licensing calculations are not a reliable indicator that a core will be stable under all operating conditions during a fuel cycle and instrumentation for detection and suppression of neutron flux oscillations and recording instrumentation for evaluation of limit cycle flux oscillations may not be adequate. This raises a question of compliance of Browns Ferry Plants with General Design Criterion 12, "Suppression of Reactor Power Oscillations," 10 CFR Part 50, Appendix A.

The licensee has responded to NRC Bulletin 88-07 in Reference 7. The staff evaluation of the licensee's response will be provided in a separate report prior to restart.

2.5 Technical Specification Changes

The Technical Specification (TS) changes proposed by the licensee reflect the new fuel to be loaded in the BFN Plant Unit 2 for Cycle 6 operation. These changes include core related changes for Linear Heat Generation Rate (LHGR) Limit, MCPR operating limits and MAPLHGR curves for the new fuel. Specifically, Tables 3.5.I.1 and 3.5.I.2 contained revised MAPLHGR limits based upon the licensee's acceptable reanalyses as discussed above. Tables 3.5.I-3 and 3.5.I-4 added new MAPLHGR limits for the two new fuel types resulting from the fuel reconstitution effort. Figure 3.5.K-1 provides a revised curve for calculating MCPR limits again based upon the licensee's revised analysis.

2.6 Summary

The licensee has proposed the above described TS changes which reflect the reanalyses required by the Inspection and Reconstitution Program for the Cycle 6 reload. The changes are acceptable since they are based on analyses using approved methodology and use fuel modeling assumptions for fuel verified to be acceptably reconstituted.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change to a requirement with respect to 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 amendment involves 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 this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, the amendment meets 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.

4.0 CONCLUSION

The Commission made a proposed determination that the amendment involves no significant hazards consideration which was published in the Federal Register (53 FR 48336) on November 30, 1988 and consulted with the State of Alabama. No public comments were received and the State of Alabama did not have any comments.

The staff has 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 the amendments will not be inimical to the common defense and security nor to the health and safety of the public.

5.0 REFERENCES

1. Letter, M. J. Ray (TVA) to Document Control Desk (USNRC) dated August 26, 1988 (TVA BFN TS-254).

2. Letter, R. Gridley (TVA) to Document Control Desk (USNRC) dated October 26, 1988, "Summary Report for BFN Plant Unit 2 Cycle 6 Inspection and Reconstitution Program."

3. Browns Ferry Nuclear Plant Reload Licensing Report, Unit 2, Cycle 6, TVA-RLR-002, July 1984, as supplemented.

4. Amendment No. 125 to Facility Operating License No. DPR-52 for Browns Ferry Nuclear Plant, Unit 2, August 19, 1986.

5. TVA-EG-047, "TVA Reload Core Design and Analysis Methodology for the Browns Ferry Nuclear Plant," January 1982.

6. NRC Bulletin 88-07, "Power Oscillations in Boiling Water Reactors," June 15, 1988 and Supplement 1, dated December 30, 1988.

7. Letters, R. Gridley (TVA) to Document Control Desk (USNRC) dated November 4, 1988 and March 6, 1989.

Principal Contributors: Michael McCoy

Dated: September 13, 1989