

Docket Nos. 50-259  
and 50-260

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. *62* and *57* to Facility Licenses Nos. DPR-33 and DPR-52 for the Browns Ferry Nuclear Plant, Units Nos. 1 and 2. These amendments are in response to your letter of August 13, 1980.

These amendments change the Technical Specifications to extend the exposure range of the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus average planar exposure from 30,000 MWd/T to 40,000 MWd/T.

Copies of the Safety Evaluation and Notice of Issuance are also enclosed.

Sincerely,

Thomas A. Ippolito, Chief  
Operating Reactors Branch #2  
Division of Licensing

- Enclosures:
1. Amendment No. *62* to DPR-33
  2. Amendment No. *57* to DPR-52
  3. Safety Evaluation
  4. Notice

8010240073

*No legal objection to  
issuance of notice of amendments.*

OFFICE	ORB #2	ORB #2	AD:OR	OELD	ORB #2
SURNAME	SNorris	RClark/mjf	Novak	GUTCHIN	Tippolito
DATE	8/19/80	8/15/80	8/21/80	8/24/80	8/19/80

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SURNAME	SNorris	RClark <i>mjf</i>	TNovak		Tippolito
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Mr. Hugh G. Parris

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October 6, 1980

cc:

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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 NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 62  
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 August 13, 1980, 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 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. 62, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

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3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Thomas A. Ippolito, Chief  
Operating Reactors Branch #2  
Division of Licensing

Attachment:  
Changes to the Technical  
Specifications

Date of Issuance: October 6, 1980

ATTACHMENT TO LICENSE AMENDMENT NO. 62

FACILITY OPERATING LICENSE NO. DPR-33

DOCKET NO. 50-259

Revise Appendix A as follows:

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

171/172

2. The underlined page is the page being changed; marginal lines on this page indicate the revised area. The overleaf page is provided for convenience.

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Table 3.5.I-1  
MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: Initial Core - Type 1 & 3

Average Planar Exposure (Mwd/t)	MAPLHGR (kW/ft)
200	15.0
1,000	15.1
5,000	16.0
10,000	16.3
15,000	16.1
20,000	15.4
25,000	14.2
30,000	13.1
35,000*	11.8
40,000*	10.5

Table 3.5.I-2  
MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: Initial Core - Type 2

Average Planar Exposure (Mwd/t)	MAPLHGR (kW/ft)
200	15.6
1,000	15.5
5,000	16.2
10,000	16.5
15,000	16.5
20,000	15.8
25,000	14.5
30,000	13.3
35,000*	11.9
40,000*	10.6

\*The average level of irradiation of the irradiated fuel from the reactor shall not exceed 33,000 MWD/MTU in accordance with Tables S-3 and S-4 of 10 CFR Part 51.

Table 3.5.I-3

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: 8D274L

Average Planar Exposure (Mwd/t)	MAPLHGR (kW/ft)
200	11.2
1,000	11.3
5,000	11.9
10,000	12.1
15,000	12.2
20,000	12.1
25,000	11.6
30,000	10.9

Table 3.5.I-4

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: 8D274H

Average Planar Exposure (Mwd/t)	MAPLHGR (kW/ft)
200	11.1
1,000	11.2
5,000	11.8
10,000	12.1
15,000	12.2
20,000	12.0
25,000	11.5
30,000	10.9





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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-260

BROWNS FERRY NUCLEAR PLANT, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 57  
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 13, 1980, 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 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. 57, 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 the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Thomas R. Ippolito, Chief  
Operating Reactors Branch #2  
Division of Licensing

Attachment:  
Changes to the Technical  
Specifications

Date of Issuance: October 6, 1980

ATTACHMENT TO LICENSE AMENDMENT NO. 57

FACILITY OPERATING LICENSE NO. DPR-52

DOCKET NO. 50-260

Review Appendix A as follows:

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

171/172

2. The underlined page is the page being changed; marginal lines on this page indicate the area being revised. The overleaf page is provided for convenience.

Table 3.5.I-1

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: Initial Core - Type 1 & 3

<u>Average Planar Exposure (Mwd/t)</u>	<u>MAPLHGR (kW/ft)</u>	<u>PCT (°F)</u>
200	15.0	1926
1,000	15.1	1902
5,000	16.0	1975
10,000	16.3	2047
15,000	16.1	2151
20,000	15.4	2136
25,000	14.2	2035
30,000	13.1	1922
35,000 *	11.8	1821
40,000 *	10.5	1640

Table 3.5.I-2

MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: Initial Core - Type 2

<u>Average Planar Exposure (Mwd/t)</u>	<u>MAPLHGR (kW/ft)</u>	<u>PCT (°F)</u>
200	15.6	1973
1,000	15.5	1956
5,000	16.2	1973
10,000	16.5	2063
15,000	16.5	2143
20,000	15.8	2119
25,000	14.5	2005
30,000	13.3	1886
35,000 *	11.9	1782
40,000 *	10.6	1615

\*The average level of irradiation of the irradiated fuel from the reactor shall not exceed 33,000 MWD/MTU in accordance with Tables S-3 and S-4 of 10 CFR Part 51.

Table 3.5.I-3

## MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: 8D274L

<u>Average Planar Exposure (Mwd/t)</u>	<u>MAPLHGR (kW/ft)</u>	<u>PCT (°F)</u>
200	11.2	1652
1,000	11.3	1645
5,000	11.9	1648
10,000	12.1	1626
15,000	12.2	1642
20,000	12.1	1642
25,000	11.6	1603
30,000	10.9	1537

Table 3.5.I-4

## MAPLHGR VERSUS AVERAGE PLANAR EXPOSURE

Fuel Type: 8D274E

<u>Average Planar Exposure (Mwd/t)</u>	<u>MAPLHGR (kW/ft)</u>	<u>PCT (°F)</u>
200	11.1	1646
1,000	11.2	1635
5,000	11.8	1640
10,000	12.1	1630
15,000	12.2	1647
20,000	12.0	1648
25,000	11.5	1608
30,000	10.9	1547



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
SUPPORTING AMENDMENT NO. 62 TO FACILITY OPERATING LICENSE NO. DPR-33  
AMENDMENT NO. 57 TO FACILITY OPERATING LICENSE NO. DPR-52

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT, UNITS NOS. 1 AND 2

DOCKET NOS. 50-259 AND 50-260

1.0 Introduction

By letter dated August 13, 1980 (TVA BFNP TS 145) the Tennessee Valley Authority (the licensee or TVA) requested changes to the Technical Specifications (Appendix A) appended to Facility Operating License Nos. DPR-33 and DPR-52 for the Browns Ferry Nuclear Plant, Unit Nos. 1 and 2.

The proposed amendments and revised Technical Specifications would extend the exposure range of the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus average planar exposure values for the type 7D250 fuel bundles loaded in the core. The proposed extension would provide MAPLHGR limits for the 7D250 bundles to an average planar exposure of 40,000 MWd/T, which is 10,000 MWd/T beyond the current exposure range of 30,000 MWd/T.

The Technical Specification change request resulted from the discovery by TVA on August 12, 1980 that the average planar exposure in nodes 4 and 5 (a node is a 6" length of a fuel bundle) of one 7x7 fuel bundle exceeded 30,000 MWd/T in Unit No. 2. At the time, Unit 2 was near the end of a fuel cycle, with the control rods essentially all the way out (Unit 2 shutdown for its third refueling as scheduled on September 5, 1980). At the time, the core for Unit 2 contained 364 7x7 fuel bundles, 168 8x8 fuel bundles and 232 8x8R fuel bundles. During the refueling outage, 240 more of the highest burnup 7x7 fuel bundles will be replaced with P8x8R fuel, including the fuel bundle in which the exposure exceeded 30,000 MWd/T. At the time, TVA had in hand analyses that had been performed by General Electric Company (GE) using NRC approved fuel codes that extended the MAPLHGR versus average planar exposure limits for the 7x7 fuel from 30,000 to 40,000 MWd/T. As the manufacturer of the fuel, GE had also concluded that the thermal-mechanical-hydraulic characteristics of the 7x7 fuel were adequate for average planar exposures of 40,000 MWd/T. Accordingly, the Office of Inspection and Enforcement and the Office of Nuclear Reactor Regulation permitted Unit No. 2 to continue operation until the end of the fuel cycle in compliance with the new

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limits developed by GE. The proposed change in the Technical Specifications is also being requested for Unit 1 since TVA projects that the planar average exposure in the 7x7 fuel in the present core will exceed 30,000 MWd/T prior to the end of the current cycle (April 15, 1981) specifically about October 18, 1980.

## 2.0 Discussion

It is required by 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors" that a power reactor be provided with an emergency core cooling system (ECCS) which shall be designed such that its calculated cooling performance following postulated loss of coolant accidents conforms to the criteria set forth in 10 CFR 50.46. Technical Specifications restrict plant operations to linear heat generation rates for which the required calculations are valid.

The reason for limits on the Maximum Average Planar Linear Heat Generation Rate is to assure that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the limit specified in 10 CFR 50, Appendix K.

The Technical Specifications (Tables 3.5.I-1 thru 3.5.I-7) for Browns Ferry Units 1 and 2 provide MAPLHGR limits for the various types of fuel assemblies in each core versus average planar exposure values from 200 up to 30,000 MWd/T. Continued exposure of these fuel types beyond 30,000 MWd/T requires a downward revision of the allowable MAPLHGR limits. A typical curve of these limits for the 7x7 fuel in Browns Ferry Unit 2 is shown in the attached figure (Fig. 1). Although the curves for most BWRs use to stop at 30,000 MWd/T, there is no reason from a fuels standpoint for stopping at 30,000 or even 40,000 MWd/T. Using approved fuel design models, the curves could be extended well beyond even 40,000 MWd/T. The fact that the curves stopped at 30,000 MWd/T is not an indication that there was a fuels problem at this limit and the MAPLHGR curves are not a reason for limiting burnup. In developing the curves, a conservative power history is assumed, which produces a gap conductance value used in the LOCA analysis. Approved models exist for ECCS analyses beyond 30,000 MWd/T exposure. In order to extend the MAPLHGR versus average planar exposure values beyond 30,000 MWd/T, it is necessary for the licensee to reevaluate the adequacy of ECCS performance for the subject fuel at the exposures of interest, using NRC approved models.

By letter dated September 26, 1977 and supplement dated October 28, 1977, TVA provided a revised Loss of Coolant Accident Analysis, NEDO-24056, for Browns Ferry Unit No. 1 in response to the Commission's Order of March 11, 1977. By amendment No. 35 dated January 10, 1978, we approved the revised LOCA analysis and MAPLHGR limits and concluded that Unit 1 was in compliance with the requirements of 10 CFR 50.46. The MAPLHGR limits were subsequently revised by Amendment No. 47 dated January 17, 1979 and Amendment No. 59 dated February 25, 1980 covering operation

during the third and fourth fuel cycles, respectively. Similarly for Browns Ferry Unit No. 2, TVA provided a revised LOCA Analysis, NEDO-24088-1, by letter dated March 22, 1978, in response to the Commission's Order of March 11, 1977. The revised analysis was found acceptable and in compliance with 10 CFR 50.46 and revised MAPLHGR limits were issued with Amendment 35 dated June 21, 1978 authorizing operation of Unit 2 in cycle 2. The MAPLHGR limits were subsequently revised by Amendment No. 46 dated May 25, 1979 for cycle 3 operation of Unit 2 (an 18 month fuel cycle). It is the limits authorized by Amendment No. 46 which were exceeded during the period of August 7-13, 1980.

All of the above MAPLHGR limits were limited to an average planar exposure of 30,000 MWd/T, since this was as far as the analysis submitted by the licensee extended.

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. Generally, MAPLHGR limits are about 10% lower than LHGR limits.

As can be noted from the attached curve (Fig. 1), the MAPLHGR limit drops off significantly beyond about 20,000 MWd/T exposure. The limits up to about 20,000 MWd/T are important because of the impact on the LOCA analyses. Beyond approximately 20,000 MWd/T exposure, the fuel does not have sufficient remaining fissionable material to have a significant effect on the LOCA calculations. The limits beyond 20,000 MWd/T are more related to fuel design (particularly cladding integrity) constraints developed by the manufacturer of the fuel. Due to depletion of fissionable material, the high exposure fuel has less nuclear capability and will operate at correspondingly lower powers, so that a wide margin is maintained between the operating LHGR and the LHGR calculated to cause 1 percent cladding dimetral strain. Basically, it is a matter for the fuel designer and manufacturer (in this case, GE) to determine - using NRC approved fuel design codes - whether the mechanical design of his fuel is adequate. Originally, GE has set 30,000 MWd/T as a limit from the standpoint of fuel warranty, not as a safety limit. In discussing the safety evaluation of the fuel mechanical design, the Browns Ferry Final Safety Analysis Report (FSAR) discusses and lists LHGR limits up to 40,000 MWd/T for both 7x7 and 8x8 fuel (Section 3.2.5, p. 3.2-6). Similarly, in discussing the thermal and hydraulic design of the fuel, the FSAR discusses the LHGR rates for both 7x7 and 8x8 fuel assemblies up to 40,000 MWd/T (Section 3.7.4, p. 3.7-2). Thus, it is evident that at least LHGR rates up to 40,000 MWd/T exposure were evaluated in the initial design of Browns Ferry.



A BWR typically replaces about 1/4 of the fuel assemblies at each refueling outage. Since spent fuel is not being reprocessed, it has to be stored. To reduce the generation of spent fuel, there has been a trend to redesign the fuel cycle - i.e., to load more U-235 and burnable poison in the fuel and to achieve higher burnups - to extend the time between refuelings from one year to 18 months and even two years. Increasing the cycle length does not necessarily increase burnup, since burnup and cycle length are not related. Nevertheless, there has been a tendency to higher exposure in most BWRs. Monticello was the first BWR in which the average planar exposure exceeded 30,000 MWd/T. On December 28, 1979, we issued Amendment No. 42 to License No. DPR-22 for the Monticello Nuclear Generating Plant to increase the average planar exposure range from 30,000 to 40,000 MWd/T, similar to that requested by TVA. Also, on December 28, 1979 we issued Amendment No. 45 to License No. DPR-19 for Dresden Unit 2 and Amendment No. 54 to License DPR-29 for Quad Cities Unit 1 to extend the range of average planar exposure from 30,000 to 40,000 MWd/T. As a result of the findings at Monticello and Quad Cities Unit 1, on February 4, 1980 we issued IE Information Notice No. 80-04 discussing the issue and alerted all BWR licensees that increased surveillance was indicated to periodically compare actual peak average planar exposure and peak pellet exposure values to approved exposure limits. Most recently, Vermont Yankee determined that they were approaching the 30,000 MWd/T limit in their Technical Specifications; on August 22, 1980, we issued Amendment No. 57 to DPR-28 to extend the MAPLHGR vs average planar exposure values from 30,000 to 40,000 MWd/T for this BWR.

### 3.0 Evaluation

As discussed above, we would not expect the extension of the MAPLHGR vs exposure limits to pose a safety problem with respect to LOCA analyses and ECCS performance. In order to extend the MAPLHGR versus average planar exposure values for the 7x7 fuel, GE, on behalf of the licensee, re-evaluated the adequacy of ECCS performance for the subject 7x7 fuel at exposures out to 40,000 MWd/T. The supplemental analysis was performed using analytical procedures previously approved by the staff. Additionally, these methods are considered applicable for an average planar exposure of 40,000 MWd/T. The analysis results show that with MAPLHGR limited to the values in tables 3.5.I-1 and 3.5.I-2 of the proposed Technical Specifications, the cladding temperature and local cladding oxidation are well below the 2200°F (peak cladding temperature) and 17% (local cladding oxidation) limits allowed by 10 CFR 50.46. As part of the reload license amendment for the upcoming fuel cycle for Unit 2 (TVA's submittal of July 14, 1980), GE had evaluated the peak pellet exposures expected during the recently concluded operating cycle and had concluded that the peak pellet exposure would not exceed 40,000 MWd/T. TVA has also stated that the peak exposure in Unit 1 will not exceed 40,000 MWd/T during the present fuel cycle. Accordingly, we find the proposed MAPLHGR vs average planar exposure values acceptable.

### Thermal-Mechanical Design Considerations

Previously reviewed fuel thermal-mechanical design and safety analyses are dependent on local exposure. Additionally, the maximum local (pellet) exposure in a fuel assembly is not independent of the maximum average planar exposure since the former is always greater than the latter. Accordingly, we have reviewed the adequacy of the previously approved use of this 7x7 fuel in Browns Ferry 1 and 2 in light of the proposed Technical Specification change. The licensee and GE have determined that the maximum local exposure of the 7x7 fuel would not exceed 40,000 MWd/T in the recently concluded cycle 3 for Unit 2 or in the current cycle 4 for Unit 1. Since the staff previously reviewed and accepted generic fuel thermal and mechanical performance analyses for 7x7 and 8x8 fuel planar average exposures up to 40,000 MWd/T, we find our generic conclusions and basis for acceptance of the 7x7 and 8x8 fuel thermal and mechanical design valid for planar average exposures up to 40,000 MWd/T. The plant-specific aspects of the fuel thermal and mechanical design were also previously addressed in the most recent reload amendments for Units 1 and 2 (Amendments No. 59 and 46, respectively). Thus, the conclusions stated in our plant and cycle-specific evaluation of thermal-mechanical performance also remain unaffected.

We find that the proposed extension of the MAPLHGR versus average planar exposure values do not invalidate the basis or conclusions of any of our previous approvals of the thermal-mechanical design of the 7x7 and 8x8 fuel for peak pellet exposures up to 40,000 MWd/T.

### Surveillance Frequencies

The Technical Specifications require that the MAPLHGR, LHGR and MCPR be checked daily to determine if fuel burnup or control rod movement has caused changes in power distribution. Since the preliminary investigation indicates that Browns Ferry Unit 2 was apparently operated for five days without realizing that the planar average exposure in two nodes of one fuel assembly exceeded 30,000 MWd/T, we reevaluated this requirement in the Technical Specifications. The process computer checks each fuel assembly in the core for every node and determines the maximum LHGR for each node.

Since each node has its own exposure, there is a range of exposures per bundle. The process computer also determines the axial distribution for each node in the core. The information can be used to predict what the maximum assembly and peak pellet exposures will be. Vermont Yankee, Dresden and Quad Cities, for example, predicted that the planar average exposures in these cores would exceed 30,000 MWd/T and requested appropriate changes to their Technical Specifications well in advance of the predicted

occurrence. Since changes due to burnup are slow, and only a few control rods are moved daily, we concluded that a daily check of power distribution is adequate and that the present requirement in the Technical Specifications for a daily check of MAPLHGR, LHGR and MCPR is likewise adequate. What appears to be needed is better controls by the licensee on the data developed by the process computer and the evaluation and use of this data. This matter is being pursued by the NRC's Office of Inspection and Enforcement.

#### 4.0 Environmental Considerations

We have determined that the amendments do not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendments involve an action which is insignificant from the standpoint of environmental impact and pursuant to 10 CFR 5.15(d)(4) that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of the amendments.

There is, however, an environmental constraint related to the proposed amendments. In 1974, the Commission published WASH-1248, "Environmental Survey of the Uranium Fuel Cycle," which assessed the environmental impacts associated with the nuclear fuel cycle in support of a typical 1000 MWe light water reactor. The environmental impacts associated with the nuclear fuel cycle were summarized in the Commission's regulations, in Table S-3 of 10 CFR Part 51. Following an extensive rulemaking, which began May 26, 1977, on July 27, 1979, the Commission promulgated a final rule which sets out a table of revised environmental impact values for the uranium fuel cycle ("Table S-3"). These values are to be included in environmental reports and impact statements for individual light water nuclear power reactors. (See 10 CFR Part 51 and 44 Fed. Reg. 45362 of August 2, 1979.) The revised Table S-3 replaces an interim Table S-3 promulgated for a limited period on March 14, 1977. The final rule became effective on September 4, 1979. Similarly, the environmental impact of transporting fuel and waste to and from a reactor are summarized in Table S-4 of 10 CFR Part 51.

In preparing WASH-1248, a "model LWR" was developed to relate the environmental considerations of the supporting fuel cycle to the annual operation of a nuclear power plant. In the development of this model, the requirements for each step of the fuel cycle were reviewed for the current generation of 1000 MWe BWRs and PWRs. A 30-year life was assumed in defining the "annual fuel requirement" for the model LWR. Specifically, the annual fuel requirement was defined as the sum of one initial core loading plus 29 annual reloads, averaged over the 30 year life of the plant. The resource use and effluent quantities for the various steps in the fuel cycle were related to this annual fuel requirement. The

characteristics of the Model LWR used in determining the fuel cycle requirements are listed in Table S-1 of WASH-1284. The assumed irradiation levels given in columns 2 and 3 of this Table S-1 are 33,000 MWD<sub>t</sub>/MTU (megawatt days per metric ton of uranium) for "annual reload" and "Lifetime Average Annual Fuel Requirement," respectively. PWR burnup limits are characteristically given in terms of megawatt days per metric ton (MTU). BWR limits are characteristically given in terms of megawatt days per short ton of uranium (MWD/t). The 33,000 MWD/MTU is equivalent to 29,900 MWD/T.

The 33,000 MWD/MTU exposure was also used in developing Table S-4, which summarizes the "environmental impact of transportation of fuel and waste to and from one light water-cooled nuclear power reactor." 10 CFR 51.20(g)(2) states that Table S-4 applies only if "the average level of irradiation of the irradiated fuel from the reactor does not exceed 33,000 megawatt days per metric ton..." In examining the background material used in developing Tables S-3 and S-4, it is evident that if these Tables are (or were) used in evaluating the environmental impact of plant operation, it is necessary when approving higher exposure limits on fuel to evaluate whether the higher exposures might invalidate use of the S-3 and S-4 Tables. Specifically, we evaluated whether the higher exposed fuel, when averaged with the lower exposed fuel from the initial fuel cycles, might approach 33,000 MWD/MTU or more specifically, in this case 29,900 MWD/T.

The MAPLHGR versus average planar exposure limit is a limit on the exposure in any 6" node of any fuel assembly. A BWR fuel assembly is approximately 6" square. Thus, the MAPLHGR limit is, in practice, a limit on the exposure in any 6" cube (of a fuel assembly) in the reactor. When the MAPLHGR limit was at 30,000 MWD/T, there was no way the average exposure of the fuel assemblies being removed during a refueling could exceed 30,000 MWD/T. In evaluating the effect of a 40,000 MWD/T MAPLHGR limit, it is important to realize that burnup in a fuel assembly is not uniform over its length and burnup is not uniform throughout the fuel assemblies in a core. Assuming an average batch discharge exposure of 30,000 MWD/T (i.e., assuming that the average exposure in all the fuel elements being removed during a refueling, averaged over the length of all the elements, is 30,000 MWD/T, the limit in the S-3 and S-4 Tables), the most highly exposed bundles are likely to have an average exposure in the range of 10% higher burnup - that is, about 33,000 MWD/T. The peak exposure in any node of these higher exposure bundles could typically be in the order of 20% greater than the average exposure - that is, about 40,000 MWD/T. Peak pellet exposures could reasonably be expected to be about 10% more than this, so the LHGR could be about 44,000 MWD/T. Looking at it backwards, with MAPLHGR limits at 40,000 MWD/T, it might be possible for the average batch discharge exposure to approach the 29,900 MWD/T limit in the S-3 and S-4 tables. As noted

in the introduction to this safety evaluation, the proposed change is to extend the MAPLHGR limits only for the 7x7 fuel elements in Units 1 and 2; the range on the MAPLHGR limits for the 8x8 fuel elements in each core remain at 30,000 MWD/T. There are only 210 (out of 764) 7x7 fuel elements remaining in Unit 1 and these are scheduled to be replaced with P8x8R fuel during the April-May 1981 refueling outage. When Unit 2 starts up from the current refueling outage, there will only be 124 7x7 fuel assemblies left in the core and even these are scheduled to be replaced by 8x8 fuel during the fall 1981 refueling outage. Thus, there is no way that this amendment could cause the average exposure of fuel discharged from the reactors over the lifetime of the facilities to exceed 33,000 MWD/MTU, particularly when averaged with the lower exposure fuel from the first three fuel cycles. We therefore conclude that approval of the proposed changes to the MAPLHGR versus average planar exposure values will not invalidate the use of the S-3 and S-4 tables in 10 CFR 51 in assessing the environmental impacts of operating the Browns Ferry Nuclear Plant.

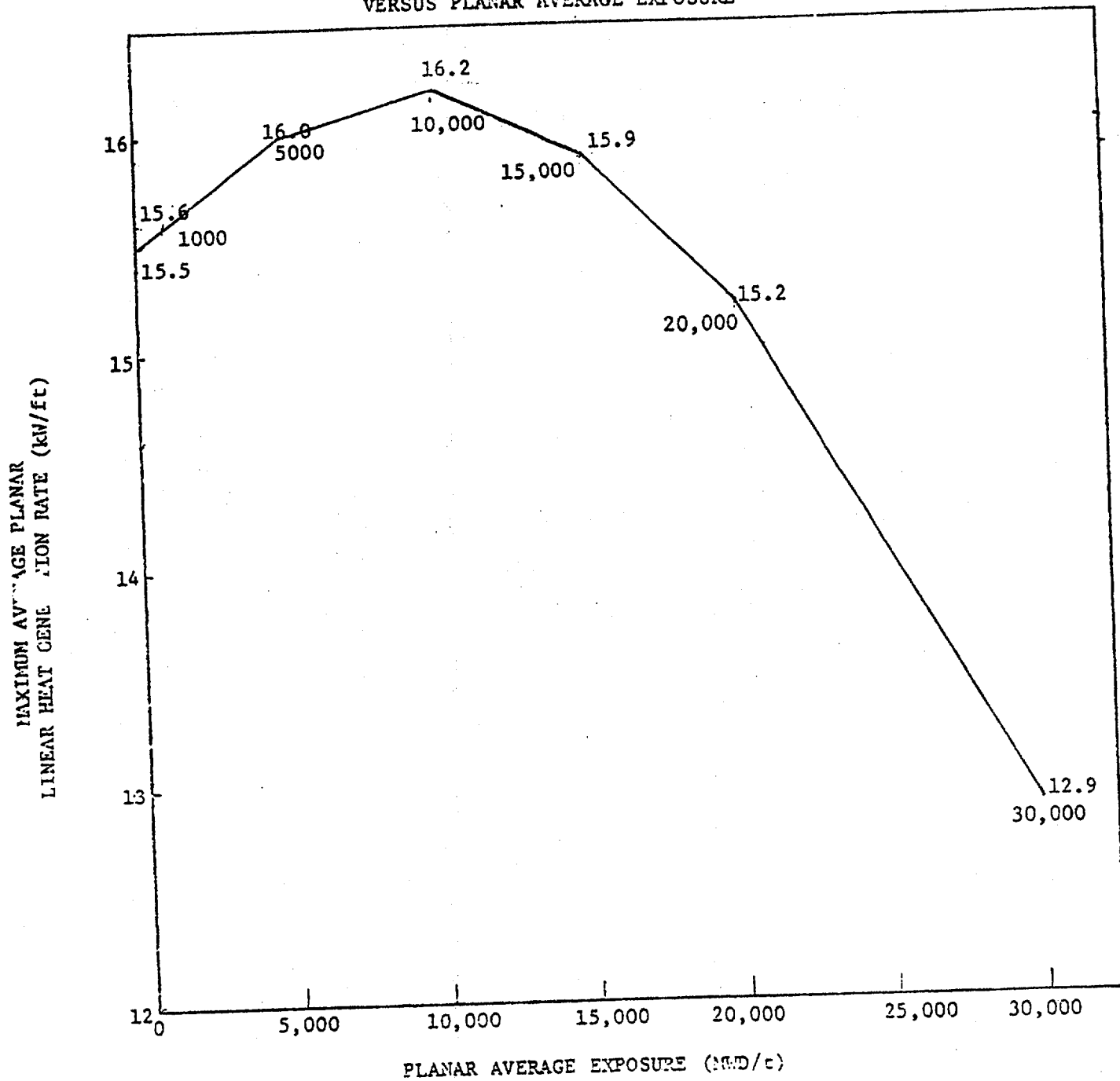
The NRC staff is currently evaluating a request by GE to approve peak pellet exposures for GE fuel up to 50,000 MWD/T to assist in extended cycle operation. (There is now a GE self-imposed limit of 44,000 MWD/T on peak pellet exposures.) It is likely that this or an equivalent limit will be approved by the staff in the near future. If this occurs, it could be a basis for licensees requesting extension of the MAPLHGR curves beyond 40,000 MWD/T on all GE fuel. To assure that the environmental considerations in 10 CFR 51 are evaluated if MAPLHGR limits are extended in the future, we have - with the licensee's concurrence - added a note to Tables 3.5.I-1 and 3.5.I-2 on MAPLHGR versus average planar exposure limits stating the requirement in 10 CFR Part 51.20.

## 5.0 Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendments do not involve a significant increase in the probability or consequences of accidents previously considered and do not involve a significant decrease in a safety margin, the amendments do not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) 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.

Dated: October 6, 1980

MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR)  
VERSUS PLANAR AVERAGE EXPOSURE



BROWNS FERRY NUCLEAR PLANT  
FINAL SAFETY ANALYSIS REPORT

MAPLHGR VS. EXPOSURE  
INITIAL CORE FUEL TYPE 2

UNITED STATES NUCLEAR REGULATORY COMMISSIONDOCKET NOS. 50-259 and 50-260TENNESSEE VALLEY AUTHORITYNOTICE OF ISSUANCE OF AMENDMENTS TO FACILITY  
OPERATING LICENSES

The U. S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 62 to Facility Operating License No. DPR-33 and Amendment No. 57 to Facility Operating License No. DPR-52 issued to Tennessee Valley Authority (the licensee), which revised Technical Specifications for operation of the Browns Ferry Nuclear Plant, Units Nos. 1 and 2, located in Limestone County, Alabama. The amendments are effective as of the date of issuance.

These amendments change the Technical Specifications to extend the exposure range of the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus average planar exposure from 30,000 MWd/T to 40,000 MWd/T. The extension of the fuel exposure range was requested by TVA after it discovered that fuel exposure presently exceeds approved limits in at least one fuel assembly in Unit 2. The extension would increase remaining core fuel lifetime and thus decrease the rate of spent fuel generation at the Browns Ferry Nuclear Plant. Although the extension would increase the inventory of fission products in the spent fuel generated it would decrease the demand on currently available spent fuel storage capacity at the Browns Ferry Nuclear Plant.

The application for the amendments complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate

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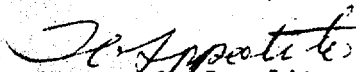
findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendments. Prior public notice of these amendments was not required since the amendments do not involve a significant hazards consideration.

The Commission has determined that the issuance of these amendments will not result in any significant environmental impact and that pursuant to 10 CFR Section 51.5(d)(4) an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with issuance of these amendments.

For further details with respect to this action, see (1) the application for amendments dated August 13, 1980, (2) Amendment No. 62 to License No. DPR-33 and Amendment No. 57 to License No. DPR-52 and (3) the Commission's related Safety Evaluation. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C. and at the Athens Public Library, South and Forrest, Athens, Alabama 35611. A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Licensing.

Dated at Bethesda, Maryland this 6th day of October, 1980.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Thomas K. Ippolito, Chief  
Operating Reactors Branch #2  
Division of Licensing