February 17, 1993

Docket No. 50-289

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Mr. T. Gary Broughton, Vice President
and Director - TMI-1
GPU Nuclear Corporation
Post Office Box 480
Middletown, Pennsylvania 17057

Dear Mr. Broughton:

SUBJECT: ISSUANCE OF AMENDMENT (TAC NO. M84596)

The Commission has issued the enclosed Amendment No. 170 to Facility Operating License No. DPR-50 for the Three Mile Island Nuclear Station, Unit No. 1 (TMI-1), in response to your letter dated August 25, 1992.

The amendment revises Technical Specification Sections 5.3.1.6, 5.4.1, and 5.4.2 and associated surveillance requirements to allow receipt, storage, and transfer of new fuel assemblies containing as high as 5.0 weight percent (w/o) U-235 enrichment. The previous limit was 4.3 w/o. The amendment also modifies Figure 5.4 and adds a new Figure 5.5 to demonstrate the acceptable regions relative to fuel enrichment vs. discharge fuel burnup in fuel pools A and B, respectively.

A copy of the related Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

Original signed by

Ronald W. Hernan, Senior Project Manager
Project Directorate I-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Amendment No. 170 to DPR-50
2. Safety Evaluation

cc w/enclosures:
See next page

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Mr. T. Gary Broughton
GPU Nuclear Corporation

Three Mile Island Nuclear Station,
Unit No. 1

cc:

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

METROPOLITAN EDISON COMPANY

JERSEY CENTRAL POWER & LIGHT COMPANY

PENNSYLVANIA ELECTRIC COMPANY

GPU NUCLEAR CORPORATION

DOCKET NO. 50-289

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 170
License No. DPR-50

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

   A. The application for amendment by GPU Nuclear Corporation, et al. (the licensee) dated August 25, 1992, 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.

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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-50 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 170, are hereby incorporated in the license. GPU Nuclear Corporation shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance, to be implemented within 60 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John F. Stolz, Director
Project Directorate I-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: February 17, 1993

ATTACHMENT TO LICENSE AMENDMENT NO. 170

FACILITY OPERATING LICENSE NO. DPR-50

DOCKET NO. 50-289

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

Remove	Insert
5-4	5-4
5-6	5-6
5-7	5-7
5-7a	5-7a
--	5-7b

5.3 REACTOR

Applicability

Applies to the design features of the reactor core and reactor coolant system.

Objective

To define the significant design features of the reactor core and reactor coolant system.

Specification

5.3.1 REACTOR CORE

5.3.1.1 The reactor core is composed of slightly enriched uranium dioxide pellets contained in fuel rods. A fuel assembly normally contains 208 fuel rods arranged in a 15 by 15 lattice. The details of the fuel assembly design are described in TMI-1 UFSAR Chapter 3.

5.3.1.2 The reactor core shall approximate a right circular cylinder with an equivalent diameter of 128.9 inches. The active fuel height is defined in TMI-1 UFSAR Chapter 3.

5.3.1.3 The core average and individual batch enrichments for the present cycle are described in TMI-1 UFSAR Chapter 3.

5.3.1.4 The control rod assemblies (CRA) and axial power shaping rod assemblies (APSRA) are distributed in the reactor core as shown in TMI-1 FSAR Chapter 3. The CRA and APSRA design data are also described in the UFSAR.

5.3.1.5 The TMI-1 core may contain burnable poison rod assemblies (BPRA) as described in TMI-1 UFSAR Chapter 3.

5.3.1.6 Reload fuel assemblies and rods shall conform to design and evaluation data described in the UFSAR. Enrichment shall not exceed a nominal 5.0 weight percent of U^{235}.

5.3.2 REACTOR COOLANT SYSTEM

5.3.2.1 The reactor coolant system shall be designed and constructed in accordance with code requirements. (Refer to UFSAR Chapter 4 for details of design and operation.)

5.3.2.2 The reactor coolant system and any connected auxiliary systems exposed to the reactor coolant conditions of temperature and pressure, shall be designed for a pressure of 2,500 psig and a temperature of 650°F. The pressurizer and pressurizer surge line shall be designed for a temperature of 670°F.

5.4 NEW AND SPENT [ ] STORAGE FACILITIES

Applicability

Applies to storage facilities for new and spent fuel assemblies.

Objective

To assure that both new and spent fuel assemblies will be stored in such a manner that an inadvertent criticality could not occur.

Specification

5.4.1 NEW FUEL STORAGE

a. New fuel will normally be stored in the new fuel storage vault or spent fuel pools.

   For the new fuel storage vault, the fuel assemblies are stored in racks in parallel rows, having a nominal center to center distance of 21-1/8 inches in both directions. The spacing in the new fuel storage vault is sufficient to maintain K_{eff} less than 0.95 based on storage of fuel assemblies in clean unborated water or less than 0.98 based on storage in an optimum hypothetical low density moderator (fog or foam) for fuel assemblies with a nominal enrichment of 5.0 weight percent U^{235}. When fuel is being stored in the new fuel storage vault, twelve (12) storage locations (aligned in two rows of six locations each; transverse row numbers four and eight) must be left vacant of fissile or moderating material to provide sufficient neutron leakage to satisfy the NRC maximum allowable reactivity value under the optimum low moderator density condition.

   For Spent Fuel Pool "A", the fuel assemblies are stored in racks in parallel rows, having a nominal center to center distance of 11.1 inches in both directions for the Region I racks and 9.2 inches in both directions for the Region II racks. The spacing in the Spent Fuel Pool "A" storage locations for both Region I and II is adequate to maintain K_{eff} less than 0.95. Region I will store fuel with a maximum 5.0 percent initial enrichment. Region II will store new fuel with low enrichment. When fuel is being moved in or over the Spent Fuel Storage Pool "A" and fuel is being stored in the pool, a boron concentration of at least 600 ppmb must be maintained to meet the NRC maximum allowable reactivity value under the postulated accident condition.

   For Spent Fuel Pool "B", the fuel assemblies are stored in racks in parallel rows, having nominal center to center distance of 13-5/8 inches in both directions. This spacing is sufficient to maintain a K_{eff} less than 0.95 based on fuel assemblies with a maximum enrichment of 4.37 weight percent U^{235}. When fuel is being moved in or over the Spent Fuel Storage Pool "B" and fuel is being stored in the pool, a boron concentration of at least 600 ppmb must be maintained to meet the NRC maximum allowable reactivity value under the postulated accident condition.

b. Deleted.

c. New fuel may also be stored in shipping containers.

5.4.2 SPENT FUEL STORAGE (Reference 1)

a. Irradiated fuel assemblies will be stored, prior to offsite shipment, in the stainless steel lined spent fuel pools, which are located in the fuel handling building.

b. Whenever there is fuel in the pool except for initial fuel loading, the spent fuel pool is filled with water borated to the concentration used in the reactor cavity and fuel transfer canal.

c. Deleted.

d. The fuel assembly storage racks provided and the number of fuel elements each will store are listed by location below:

	Spent Fuel Pool A North End of Fuel Handling Building	Spent Fuel Pool B South End of Fuel Handling Building	Dry New Fuel Storage Area Fuel Handling Building
Fuel Assys.	846 *	496	54
Cores	4.78	2.8	0.37

NOTE: * Includes three spaces for accommodating failed fuel containers. An additional 648 storage locations can be installed to provide a total of 1494 locations or 8.44 cores.

e. All of the fuel assembly storage racks provided are designed to Seismic Class 1 criteria to the accelerations indicated below:

	Fuel Handling Building Dry New Fuel Storage Area And Spent Fuel Pool A	Fuel Handling Building Spent Fuel Pool B
Horiz.	0.38 g	**
Vertical	0.25 g	**

NOTE: ** The "B" pool fuel storage racks are designed using the floor response spectra of the Fuel Handling Building.

f. Fuel in the storage pool shall have a U^{235} loading equal to or less than 66.2 grams of U^{235} per axial centimeter of fuel assembly.

g. When spent fuel assemblies are stored in the Spent Fuel Pool "A", Region II storage locations, the combination of initial enrichment and cumulative burnup for spent fuel assemblies shall be within the acceptable area of Figure 5-4.

h. When spent fuel assemblies are stored in the Spent Fuel Pool "B", storage locations, the combination of initial enrichment and cumulative burnup for spent fuel assemblies shall be within the acceptable area of Figure 5-5.

REFERENCES

(1) UFSAR, Section 9.7 - "Fuel Handling System"

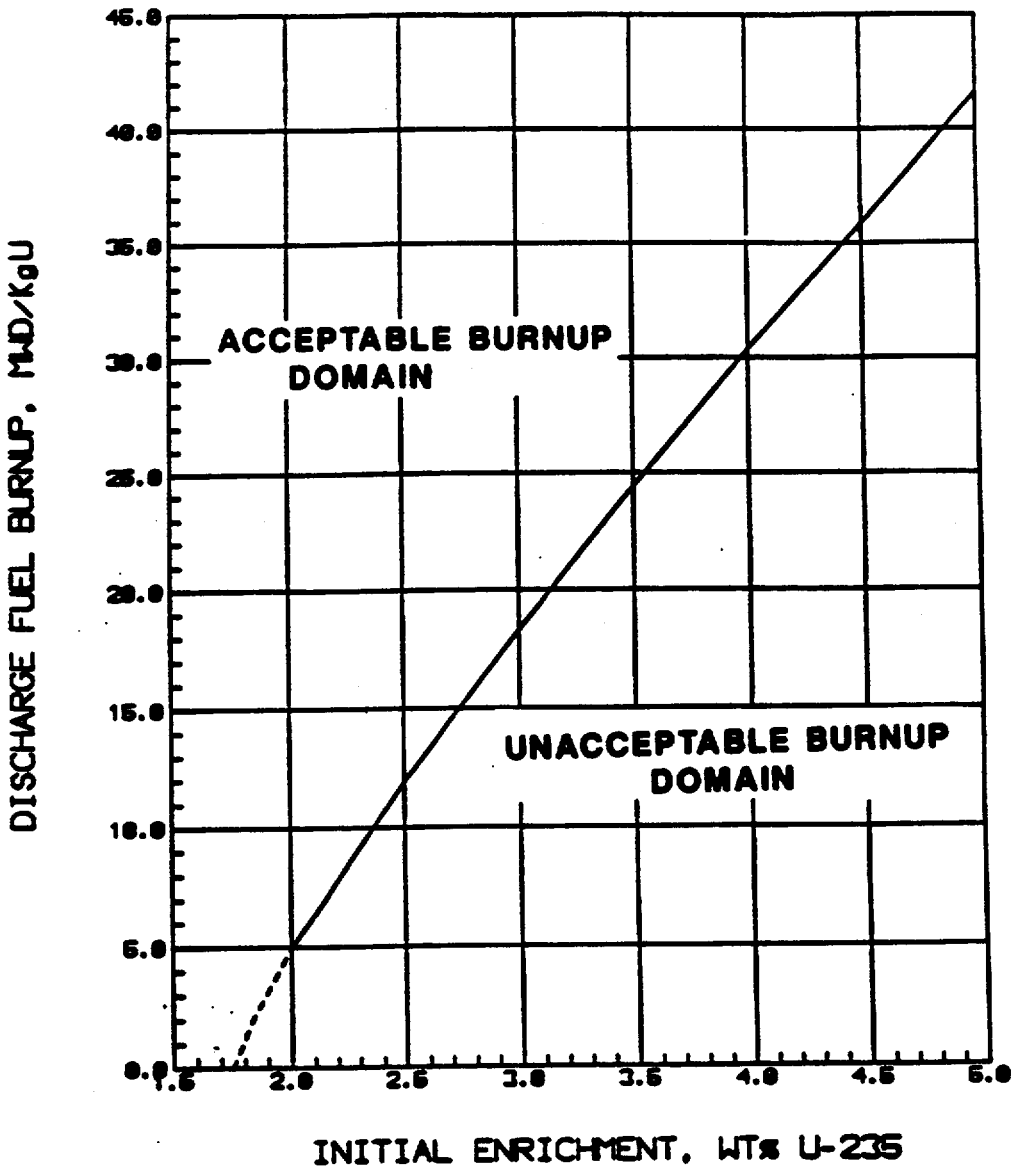

Figure 5-4 MINIMUM BURNUP REQUIREMENTS FOR FUEL IN REGION II OF THE POOL A STORAGE RACKS

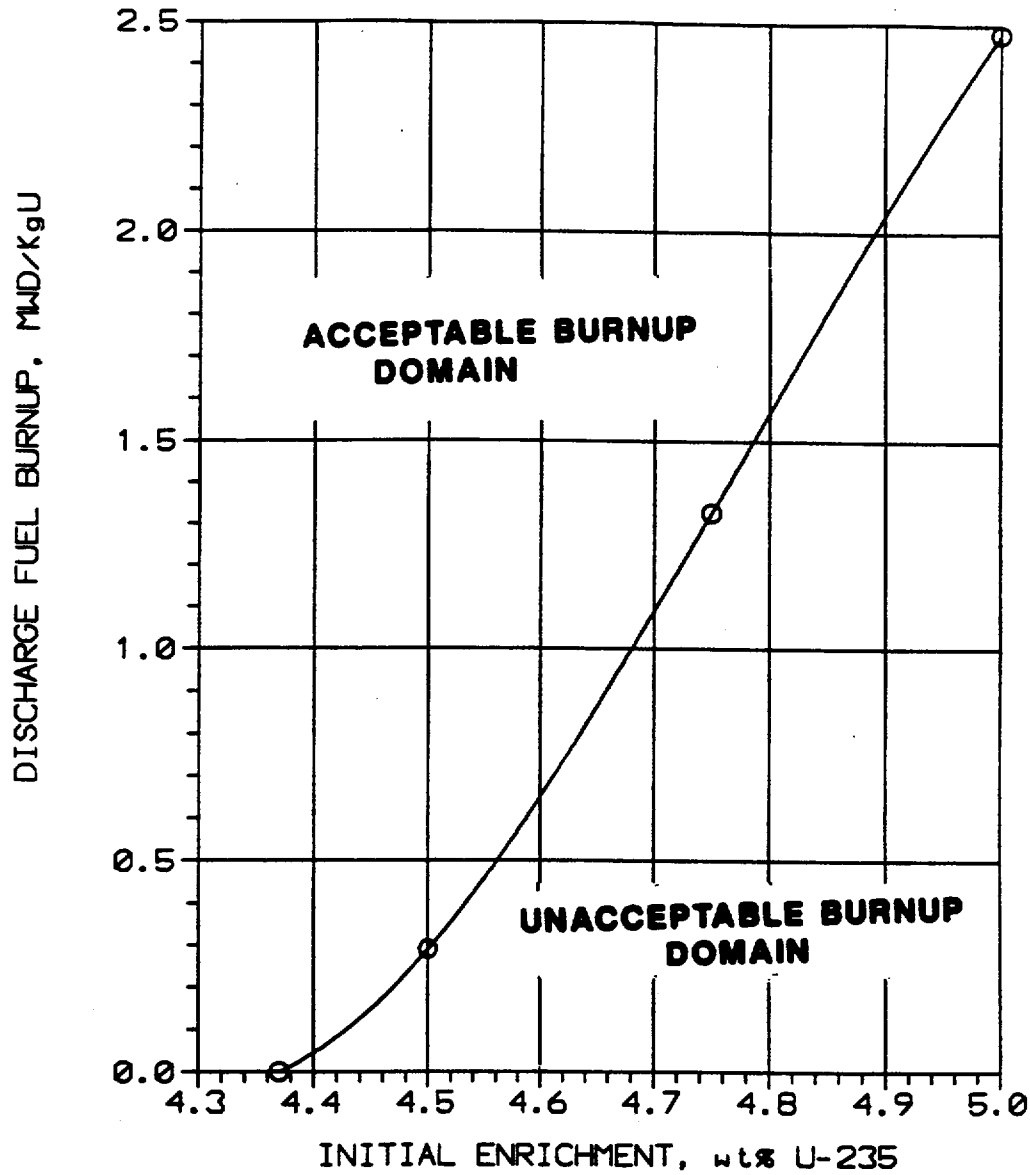

Figure 5-5 **MINIMUM BURNUP REQUIREMENTS FOR FUEL IN THE POOL "B" STORAGE RACKS**

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 170 TO FACILITY OPERATING LICENSE NO. DPR-50

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
PENNSYLVANIA ELECTRIC COMPANY
GPU NUCLEAR CORPORATION

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO.: 50-289

1.0 INTRODUCTION

By letter dated August 25, 1992, GPU Nuclear Corporation (GPUN, the licensee) requested changes to the Three Mile Island, Unit No. 1 (TMI-1) Technical Specifications (TS) to allow an increased limit for fuel enrichment. The proposed changes would allow for the storage of new fuel with an enrichment not to exceed a nominal 5.0 weight percent (w/o) U-235 in the TMI-1 new fuel storage vault and in Region I of spent fuel pool A. The changes would also allow a slight increase in allowable maximum nominal enrichment of fuel to be stored in spent fuel pool B to 4.37 w/o U-235.

2.0 EVALUATION

The analysis of the reactivity effects of fuel storage in the spent fuel storage racks was performed with the two-dimensional multi-group transport theory computer code, CASMO-3. Independent verification calculations were also made with a Monte Carlo technique using the KENO-5a computer package with the 27-group SCALE cross section library. KENO-5a was also used for the new fuel storage vault analysis. These codes are widely used for the analysis of fuel rack reactivity and have been benchmarked against results from numerous critical experiments. These experiments simulate the TMI-1 fuel storage racks as realistically as possible with respect to parameters important to reactivity such as enrichment, assembly spacing, and absorber thickness. The intercomparison between two independent methods of analysis (KENO-5a and CASMO-3) is an acceptable technique for validating calculational methods for nuclear criticality safety. To minimize the statistical uncertainty of the KENO-5a reactivity calculations, a minimum of 250,000 neutron histories in 500 generations of 500 neutrons each were accumulated in each calculation. Experience has shown that this number of histories is quite sufficient to assure convergence of KENO-5a reactivity calculations. The staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the TMI-1 storage racks with a high degree of confidence.

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For the new (unirradiated) fuel storage vault, the fuel assemblies are stored in racks in parallel rows with a nominal center-to-center distance of 21-1/8 inches in both directions. The new fuel storage vault is intended for the receipt and storage of fresh fuel under normally dry conditions where the reactivity is very low due to the absence of neutron moderation. To assure criticality safety under accident conditions and to conform to the requirements of General Design Criterion (GDC) 62, the NRC has two separate criteria for new fuel storage racks which must be satisfied.

- If fully loaded with fuel of the highest anticipated reactivity and flooded with clean unborated water, the maximum reactivity, including uncertainties, shall not exceed a k_{eff} of 0.95.

- If fully loaded with fuel of the highest anticipated reactivity and moderated by the optimum low density moderator (i.e., fog or foam), the maximum reactivity, including uncertainties, shall not exceed a k_{eff} of 0.98.

In order to meet these two criteria for fuel enriched to a maximum of 5.0 w/o U-235, it is necessary to block-off and maintain two empty rows of storage locations. These twelve total storage locations (aligned in two rows of six locations each) transverse rows number four and eight.

The results of the reactivity calculations for the new fuel vault show that the limiting reactivity condition for low-density optimum moderation occurs at a hypothetical moderator density of 9%. This resulted in a k_{eff} of 0.9534 which included all appropriate uncertainties at the 95% probability/95% confidence level (95/95 probability/confidence), thus meeting the NRC criterion of 0.98. For the fully flooded accident condition, the maximum k_{eff}, including 95/95 uncertainties, was 0.9487 which is within the NRC criterion of 0.95 and, therefore, acceptable.

The spent fuel storage racks in Pool A were reevaluated for 5.0 w/o U-235 enriched fuel based on the as-built boron-10 (B-10) loading in the Boral panels (rather than the original design loading). The calculations were made at 20 °C which corresponds to the highest possible reactivity. For the nominal storage cell design in Region I, uncertainties due to boron loading tolerances, boral width tolerances, tolerances in cell lattice spacing, stainless steel thickness tolerances, and fuel enrichment and density tolerances were accounted for as well as eccentric fuel positioning. These uncertainties were appropriately determined at the 95/95 probability/ confidence level. In addition, a calculational bias and uncertainty were determined from benchmark calculations. The final Region I design, when fully loaded with fuel enriched to 5.0 w/o U-235, resulted in a k_{eff} of 0.9470 when combined with all known uncertainties. This meets the staff's criterion of k_{eff} no greater than 0.95 including all uncertainties at the 95/95 probability/confidence level and is, therefore, acceptable.

Since the original design calculations for Region II in Pool A had already extended the analysis to include 5.0 w/o U-235 enriched fuel, little change resulted from the revised calculations at the lower (more reactive) water temperature and the use of the as-built B-10 loading in the Boral poison panels. Therefore, the combination of initial enrichment and cumulative burnup for spent fuel storage in Region II, as given in TS Figure 5-4, remain essentially the same.

The storage racks in Pool B are unpoisoned and use a stainless steel and water flux trap between cells as a means of controlling reactivity. These racks are designed to accommodate fuel of various initial enrichments which have accumulated sufficient minimum burnups. The reactivity analysis for these racks show that the staff's 0.95 k_{eff} limit is met for fresh (unirradiated) fuel of 4.37 w/o enrichment. Calculations to determine the required discharge fuel burnup of 5.0 w/o initially enriched fuel showed that a burnup of only 2.48 MWD/KgU was adequate for unrestricted storage in the Pool B racks. These minimum burnup requirements are given in TS Figure 5-5.

Most abnormal storage conditions will not result in an increase in the k_{eff} of the racks. However, it is possible to postulate events, such as the misloading of an assembly with a burnup and enrichment combination outside of the acceptable area in Figure 5-4 or 5-5 or dropping an assembly between the pool wall and the fuel racks, which could lead to an increase in reactivity. However, for such events credit may be taken for the presence of approximately 600 ppm of boron in the pool water required during fuel handling operations since the staff does not require the assumption of two unlikely, independent, concurrent events to ensure protection against a criticality accident (Double Contingency Principle). The reduction in k_{eff} caused by the boron more than offsets the reactivity addition caused by credible accidents.

The following TS changes have been proposed as a result of the requested enrichment increase.

(1) TS 5.3.1.6 indicates the increased limit for fuel enrichment to a nominal 5.0 w/o U-235 for new reload fuel assemblies and rods.

(2) TS 5.4.1.a indicates that nominal 5.0 w/o U-235 fuel can be stored in the New Fuel Storage Vault or Spent Fuel Pool A, Region I storage locations without exceeding a k_{eff} of 0.95. It also indicates that Region II of Spent Fuel Pool A can accept fresh fuel with low enrichment and Spent Fuel Pool B can accept fresh fuel up to 4.37 w/o U-235 enrichment without exceeding a k_{eff} of 0.95.

(3) TS 5.4.2 identifies the acceptability of storing high enrichment burned fuel in Spent Fuel Pool A, Region II and Spent Fuel Pool B locations as restricted by Figures 5-4 and 5-5, respectively. The number of storage locations in the Dry New Fuel Storage Area is decreased by 12 to reflect the number of locations required to be vacant of fissile or moderating material. Section f specifies a new value for the maximum allowable

grams of U-235 per axial centimeter of fuel assembly to support the increase to 5.0 w/o U-235 new fuel. Figure 5-4 reflects changes resulting from a reduction in the design temperature to 4° C and the use of as-built B-10 loading in the Boral panels. Figure 5-5 depicts the acceptable burnup domain for determining the acceptability for storage of high enriched spent fuel in Pool B based on the revised calculations described previously.

The staff finds these changes acceptable.

3.0 SUMMARY

Based on the review described above, the staff finds the criticality aspects of the proposed enrichment increase to the TMI-1 new and spent fuel pool storage racks are acceptable and meet the requirements of GDC 62 for the prevention of criticality in fuel storage and handling. The staff concludes that fuel from TMI-1 may be safely stored in Region I of Pool A provided that the U-235 enrichment does not exceed 5.0 w/o. Any of these fuel assemblies may also be stored in Region II of Pool A or in Pool B provided it meets the burnup and enrichment limits specified in TS Figure 5-4 or 5-5, respectively.

Although the TMI-1 TS have been modified to specify the above-mentioned fuel as acceptable for storage in the fresh or spent fuel racks, evaluations of reload core designs (using any enrichment) will, of course, be performed on a cycle by cycle basis as part of the reload safety evaluation process. Each reload design is evaluated to confirm that the cycle core design adheres to the limits that exist in the accident analyses and TS to ensure that reactor operation is acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.21, 51.32, and 51.35, an environmental assessment and finding of no significant impact have been prepared and published in the Federal Register on December 2, 1992 (57 FR 57079). Accordingly, based upon the environmental assessment, the Commission has determined that the issuance of the amendment will not have a significant effect on the quality of the human environment.

6.0 CONCLUSION

The Commission 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, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: L. Kopp

Date: February 17, 1993