

September 10, 1993

Docket No. 50-289

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

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Dear Mr. Broughton:

SUBJECT: ISSUANCE OF AMENDMENT (TAC No. M86714)

The Commission has issued the enclosed Amendment No. 178 to Facility Operating License No. DPR-50 for the Three Mile Island Nuclear Station, Unit No. 1, in response to your letter dated June 7, 1993.

The amendment revises the plant Technical Specifications (TS) to reflect the inclusion of gadolinia-urania in the fuel rod design description, to revise the borated water storage tank boron concentration limits, and to clarify the bases section of the TS. The amendment also places a reference in the TS to Babcock & Wilcox Topical Report BAW-10179P, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses."

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: Alexander W. Dromerick

for: 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. 178 to DPR-50
- 2. Safety Evaluation

cc w/enclosures:  
See next page

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| NAME   | SNorris <i>SN</i> | RHernan:cn <i>RW</i> | JStoiz <i>J</i> | <i>W</i>                        |     |
| DATE   | 8/12/93           | 8/13/93              | 8/13/93         | 8/19/93                         | 1/1 |

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

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Sincerely,

A handwritten signature in cursive script, appearing to read "Ronald W. Hernan".

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

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1. Amendment No.178 to DPR-50
2. Safety Evaluation

cc w/enclosures:  
See next page

Mr. T. Gary Broughton  
GPU Nuclear Corporation

Three Mile Island Nuclear Station,  
Unit No. 1

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

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. 178  
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 June 7, 1993, 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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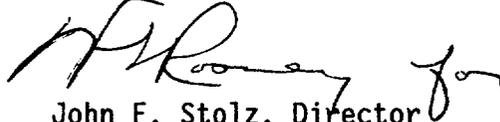
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.c.(2) of Facility Operating License No. DPR-50 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. <sup>178</sup>, 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: September 10, 1993

ATTACHMENT TO LICENSE AMENDMENT NO. 178

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.

| <u>Remove</u> | <u>Insert</u> |
|---------------|---------------|
| 3-21          | 3-21          |
| 3-23          | 3-23          |
| 3-24          | 3-24          |
| 3-45          | 3-45          |
| 5-4           | 5-4           |
| 6-19          | 6-19          |

3.3 EMERGENCY CORE COOLING, REACTOR BUILDING EMERGENCY COOLING  
AND REACTOR BUILDING SPRAY SYSTEMS

Applicability

Applies to the operating status of the emergency core cooling, reactor building emergency cooling, and reactor building spray systems.

Objective

To define the conditions necessary to assure immediate availability of the emergency core cooling, reactor building emergency cooling and reactor building spray systems.

Specification

3.3.1 The reactor shall not be made critical unless the following conditions are met:

3.3.1.1 Injection Systems

- a. The borated water storage tank shall contain a minimum of 350,000 gallons of water having a minimum concentration of 2,500 ppm boron at a temperature not less than 40°F. Specification 3.0.1 applies.
- b. Two makeup pumps are operable in the engineered safeguards mode powered from independent essential buses. Specification 3.0.1 applies.
- c. Two decay heat removal pumps are operable. Specification 3.0.1 applies.
- d. Two decay heat removal coolers and their cooling water supplies are operable. (See Specification 3.3.1.4) Specification 3.0.1 applies.
- e. Two BWST level instrument channels are operable.
- f. The two reactor building sump isolation valves (DHV6A/B) shall be either manually or remote-manually operable. Specification 3.0.1 applies.

3.3.1.2 Core Flooding System

- a. Two core flooding tanks each containing  $1040 \pm 30$  ft<sup>3</sup> of borated water at  $600 \pm 25$  psig shall be available. Specification 3.0.1 applies.
- b. Core flooding tank boron concentration shall not be less than 2,270 ppm boron.
- c. The electrically operated discharge valves from the core flood tank will be assured open by administrative control and position indication lamps on the engineered safeguards status panel. Respective breakers for these valves shall be open and conspicuously marked. Specification 3.0.1 applies.
- d. One core flood tank pressure instrumentation channel and one core flood tank level instrumentation channel per tank shall be operable.

3.3.3 Exceptions to 3.3.2 shall be as follows:

- a. Both core flood tanks shall be operable at all times.
- b. Both the motor operated valves associated with the core flood tanks shall be fully open at all times.
- c. One reactor building cooling fan and associated cooling unit shall be permitted to be out-of-service for seven days.

3.3.4 Prior to initiating maintenance on any of the components, the duplicate (redundant) component shall be verified to be operable.

#### Bases

The requirements of Specification 3.3.1 assure that, before the reactor can be made critical, adequate engineered safety features are operable. Two engineered safeguards makeup pumps, two decay heat removal pumps and two decay heat removal coolers (along with their respective cooling water systems components) are specified. However, only one of each is necessary to supply emergency coolant to the reactor in the event of a loss-of-coolant accident. Both core flooding tanks are required because a single core flooding tank has insufficient inventory to reflood the core for hot and cold line breaks (Reference 1).

The operability of the borated water storage tank (BWST) as part of the ECCS ensures that a sufficient supply of borated water is available for injection by the ECCS in the event of a LOCA (Reference 2). The limits on BWST minimum volume and boron concentration ensure that 1) sufficient water is available within containment to permit recirculation cooling flow to the core, and 2) the reactor will remain at least one percent subcritical following a Loss-of-Coolant Accident (LOCA).

The contained water volume limit of 350,000 gallons includes an allowance for water not usable because of tank discharge location and sump recirculation switchover setpoint. The limits on contained water volume, NaOH concentration and boron concentration ensure a pH value of between 8.0 and 11.0 of the solution sprayed within containment after a design basis accident. The minimum pH of 8.0 assures that iodine will remain in solution while the maximum pH of 11.0 minimizes the potential for caustic damage to mechanical systems and components. Redundant heaters maintain the borated water supply at a temperature greater than 40°F.

The post-accident reactor building emergency cooling may be accomplished by three emergency cooling units, by two spray systems, or by a combination of one emergency cooling unit and one spray system. The specified requirements assure that the required post-accident components are available.

The iodine removal function of the reactor building spray system requires one spray pump and sodium hydroxide tank contents.

The spray system utilities common suction lines with the decay heat removal system. If a single train of equipment is removed from either system, the other train must be assured to be operable in each system.

When the reactor is critical, maintenance is allowed per Specification 3.3.2 and 3.3.3 provided requirements in Specification 3.3.4 are met which assure operability of the duplicate components. The specified maintenance times are a maximum. Operability of the specified components shall be based on the satisfactory completion of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

The allowable maintenance period of up to 72 hours may be utilized if the operability of equipment redundant to that removed from service is verified based on the results of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

In the event that the need for emergency core cooling should occur, operation of one makeup pump, one decay heat removal pump, and both core flood tanks will protect the core. In the event of a reactor coolant system rupture their operation will limit the peak clad temperature to less than 2,200°F and the metal-water reaction to that representing less than 1 percent of the clad.

Two nuclear service river water pumps and two nuclear service closed cycle cooling pumps are required for normal operation. The normal operating requirements are greater than the emergency requirements following a loss-of-coolant.

#### REFERENCES

- (1) UFSAR, Section 6.1 - "Emergency Core Cooling System"
- (2) UFSAR, Section 14.2.2.3 - "Large Break LOCA"

3.8.9 The reactor building purge system, including the radiation monitors which initiate purge isolation, shall be tested and verified to be operable no more than one week prior to refueling operations.

3.8.10 Irradiated fuel shall not be removed from the reactor until the unit has been subcritical for at least 72 hours.

#### Bases

Detailed written procedures will be available for use by refueling personnel. These procedures, the above specifications, and the design of the fuel handling equipment as described in Section 9.7 of the UFSAR incorporating built-in interlocks and safety features, provide assurance that no incident could occur during the refueling operations that would result in a hazard to public health and safety. If no change is being made in core geometry, one flux monitor is sufficient. This permits maintenance on the instrumentation. Continuous monitoring of radiation levels and neutron flux provides immediate indication of an unsafe condition. The decay heat removal pump is used to maintain a uniform boron concentration. The shutdown margin indicated in Specification 3.8.4 will keep the core subcritical, even with all control rods withdrawn from the core (Reference 1). The boron concentration will be sufficient to maintain the core  $k_{eff} \leq 0.99$  if all the control rods were removed from the core, however only a few control rods will be removed at any one time during fuel shuffling and replacement. The  $k_{eff}$  with all rods in the core and with refueling boron concentration is approximately 0.9. Specification 3.8.5 allows the control room operator to inform the reactor building personnel of any impending unsafe condition detected from the main control board indicators during fuel movement.

The specification requiring testing Reactor Building purge termination is to verify that these components will function as required should a fuel handling accident occur which resulted in the release of significant fission products.

Specification 3.8.10 is required as the safety analysis for the fuel handling accident was based on the assumption that the reactor had been shutdown for 72 hours (Reference 2).

#### REFERENCES

- (1) UFSAR, Section 14.2.2.1 - "Fuel Handling Accident"
- (2) UFSAR, Section 14.2.2.1(2) - "FHA Inside Containment"

## 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) and gadolinia-urania integral burnable poison fuel pellets 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.

**6.9.5 CORE OPERATING LIMITS REPORT**

- 6.9.5.1** The core operating limits addressed by the individual Technical Specifications shall be established and documented in the CORE OPERATING LIMITS REPORT prior to each reload cycle or prior to any remaining part of a reload cycle.
- 6.9.5.2** The analytical methods used to determine the core operating limits addressed by the individual Technical Specifications shall be those previously reviewed and approved by the NRC for use at TMI-1, specifically:
- (1) BAW-10179 P-A, "Safety and Methodology for Acceptable Cycle Reload Analyses." The current revision level shall be specified in the COLR.
- 6.9.5.3** The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient/accident analysis limits) of the safety analysis are met.
- 6.9.5.4** The CORE OPERATING LIMITS REPORT, including any mid-cycle revisions or supplements thereto, shall be provided upon issuance for each reload cycle to the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO AMENDMENT NO. 178 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 BACKGROUND

By letter dated June 7, 1993 (Ref. 1), GPU Nuclear Corporation (GPUN/ licensee), submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for changes to the Three Mile Island Nuclear Station, Unit 1 (TMI-1) Technical Specifications (TS). The changes would permit (1) the use of gadolinia-urania integral burnable poison fuel pellets in the TMI-1 reactor, and (2) the replacement of the existing list of NRC-approved analytical methods used to determine core operating limits with methodologies contained in Topical Report BAW-10179P, which was recently approved by the NRC (see Ref. 2).

The licensee also requested changes to TS section 3.3.1.1.a to reflect the increase in the minimum required concentration of boron in the Borated Water Storage Tank (BWST) from 2270 parts per million (ppm) to 2500 ppm. Pertinent bases are revised to clarify the criteria for establishing the BWST boron concentration limit and the acceptable pH range in the reactor building spray and sump. The bases are also revised to correctly reference the peak cladding temperature limit of 2200°F instead of 2300°F, as required by section 50.46 of title 10 of the Code of Federal Regulations (10 CFR).

2.0 EVALUATION

2.1 Use of Gadolinia Burnable Poison

TMI-1 is designed to operate for 646±15 effective full power days (EFPDs). Extended cycles are planned for a nominal length of 650 EFPDs. Typically, extended cycles require more highly enriched fuel which generates higher peaking factors. The use of gadolinia will enhance the control of assembly power peaking, thus ensuring fuel design criteria and requirements are satisfied.

Babcock and Wilcox Fuel Company (BWFC) has performed extensive evaluations of the use of gadolinia as a burnable absorber, and has submitted reports of these evaluations to the NRC for approval. The NRC staff has reviewed these reports and found them acceptable (Refs. 2/3/4). The reports contained benchmarked analytical tools to address neutronics and thermal-hydraulic

characteristics associated with the use of gadolinia in fuel design. They also contained methodology applicable in pressurized water reactor licensing applications, including reload physics analysis, core physics test manuals, safety analyses, and startup predictions.

The NRC staff has found Topical Report BAW-10179P acceptable for referencing in license application (Ref. 2). Specifically, in Reference 2, the NRC stated that the "Core Operating Limits Report (COLR) limits may be established and modified using the approved methodologies identified in Ref. 2. Licensees of B&W-designed plants may reference the approved Topical Report (BAW-10179P) in the reporting requirements section of their technical specifications in place of the references stated above." The "references stated above" are the 18 references listed and include the 12 references contained in TMI-1 Technical Specification Section 6.9.5.2. BAW-10179P also includes references to the computer code NEMO that the licensee intends to use in the Cycle 10 Reload Design and for future cycles designed by B&W. Thus, NRC-approved Topical Report BAW-10179P will be used in calculation of COLR parameters and establishes BWFC methodology for cycle reloads.

## 2.2 Revised Boron Concentration Requirements

### 2.2.1 Revision of TS Section 3.3.1.1.a

Current TMI-1 Cycle 10 (and future cycles) will require higher boron concentrations. This is due mainly to utilization of more highly enriched fuels. The minimum BWST boron concentration specified in TS 3.3.1.1.a is 2270 ppm. Cycle 10 core design calculations by the licensee showed that the minimum concentration must be increased to at least 2462 ppm. The licensee will use a value of 2500 ppm to provide additional conservatism as well as flexibility for future cycles. This value is well below the precipitation limit of 5250 ppm at 40<sup>0</sup>F, and the existing minimum TS temperature limit of 40<sup>0</sup>F is not affected. Analysis by the licensee showed that this change will ensure that during normal operation, the BWST boron concentration will be sufficient to produce a boron concentration in the reactor building sump that will maintain the reactor at least one percent subcritical following a postulated loss-of-coolant accident. The revised BWST boron concentration analysis was subject to assuming the Core Flood Tank boron concentration to be at the minimum value of 2270 ppm currently specified in TS section 3.3.1.2.

Further analysis by the licensee also showed that the existing requirements for the boric acid mix tank (TS section 3.2), the reclaimed boric acid storage tank volume, and the concentration limits continue to ensure adequate boration under all operating conditions, thus ensuring the capability to bring the reactor to a cold shutdown condition.

### 2.2.2 Administrative Revisions to TS 3.3 Bases

The licensee revised the TS 3.3 bases to clarify the criteria for establishing the BWST boron concentration limit and the acceptable pH range for the reactor building spray and sump inventory. The licensee analyzed the effects of increased boron concentration in the BWST. The analyses consisted of determining the potential impact on the pH values for the reactor building

spray and reactor building sump inventory following a design-basis accident. The analyses assumed that the sodium hydroxide tank level and the volume of the BWST were to be at the existing levels required by the TS.

Failures that could result in the maximum and minimum pH conditions were analyzed; results of the analyses were used to calculate the reactor building spray and sump pH. The analyses showed that the reactor building spray and final equilibrium sump pH is within the acceptable range of 8.0-11.0. The licensee analyzed the potential effect of reducing the pH level from 8.5 to 8.0 on material compatibility, equipment qualification, and offsite dose consequences. The analyses showed that maintaining the pH level above 7.0 is adequate to inhibit initiation of stress corrosion cracking of austenitic stainless steel within the reactor coolant pressure boundary. The results of these analyses are consistent with NRC Standard Review Plan section 6.1.1, and the review of the material properties of exposed equipment indicated that the likelihood of component failure will not increase. Consequently, a change in the minimum pH will have no effect on material and fluids compatibility, equipment qualification criteria, or the potential for boron precipitation. The licensee also reviewed the potential impact of the change in pH level on the previously analyzed dose consequences of the postulated design-basis maximum hypothetical accident (MHA). To assess these dose consequences, the licensee used methodology that adhered to ANSI/ANS 56.5-1079 Standard for "PWR and BWR Containment Spray System Design Criteria." The analysis showed that the dose consequences are bounded by the existing MHA analysis and are well below the guidelines of 10 CFR Part 100.

### 3.0 SUMMARY

The staff has reviewed the licensee's proposed TS changes to reflect the inclusion of gadolinia-urania in the fuel rod design description and of revised boron concentration requirements and clarification of bases. The staff concludes that the proposed changes satisfy its positions and requirements in these areas, and, therefore, are acceptable.

### 4.0 REFERENCES

1. Letter from T. G. Broughton, GPU Nuclear Corporation, to the NRC, dated June 7, 1993.
2. Letter from A. C. Thadani, NRC, to J. D. McCarthy, March 16, 1993.
3. Letter from A. C. Thadani, NRC, to J. H. Taylor, January 29, 1993.
4. Letter from A. C. Thadani, NRC, to J. H. Taylor, June 24, 1993.

### 5.0 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.

## 6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC 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 the amendment involves no significant hazards consideration, and there has been no public comment on such finding (58 FR 42352). 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.

## 7.0 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: A. Attard

Date: September 10, 1993